'The bills are a brick wall': narratives of energy vulnerability, poverty and adaptation in South Wales

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Abstract
Recent energy and social science scholarship has proposed the concept of energy vulnerability as a better and more inclusive indicator of energy injustice than dominant definitions of fuel poverty, which can exclude a range of households who nevertheless have difficulties accessing energy services. Energy vulnerability is defined as a propensity under certain circumstances to suffer loss of access to energy services, leading to deficits in key capabilities. Often characterised in the literature as a dynamic condition of instability, energy vulnerability is seen as being best understood using qualitative methods, given how it arises out of interactions between household characteristics and wider socio-material conditions. Analysis of qualitative longitudinal data, produced from three rounds of interviews carried out in a community in south Wales, UK, offers insights into how, as a dynamic condition, energy vulnerability may arise out of complex interactions between socio-material conditions, household characteristics, and capabilities. Further, it is shown how such methods help understand how the outcomes of these interactions can depend on their specific tempo or pace of change, and also upon how household responses to such interactions play out over time. In particular, the different ways in which households adapt to energy vulnerability are explored, which makes it possible to elucidate how the formation of adaptive preferences can play an additional role in undermining capabilities.

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Introduction

One concern linked to prospects for a global transition to a low carbon energy system is that it should not be undertaken in ways which impose instability and lower standards of living upon those who already face significant obstacles to obtaining energy services. That those in fuel or energy poverty already typically pay more for their energy than other consumers, as well as paying a higher proportion of their income for it, is of significant concern within energy policy, in the UK and elsewhere. Research suggests that a significant proportion of households that are unable to secure energy services adequate to their needs nevertheless do not fit within dominant definitions of fuel or energy poverty, which often, as in England and Scotland until recently, only referenced the proportion of household income spent on energy or heating [1]. To take account of the full range of energy challenges experienced by households (such as rising energy prices but also obtaining access to forms of energy appropriate for their needs) and their effects, some researchers have proposed focusing instead on understanding the conditions under which energy vulnerability, the propensity for a household to suffer a lack of adequate energy services, can manifest in the first place [2]. Energy vulnerability is not just about the affordability of energy for a household, but also includes wider socio-material conditions, such as (for example) the availability to a household of energy services adequate for its needs, or poor housing conditions which make households more sensitive to difficulties and less able to adapt to them in ways that sustain their quality of life [2].

Specifying the conditions that give rise to energy vulnerability involves identifying the kinds of harm to which it can lead, which raises complex methodological questions. A combination of longitudinal qualitative research [3] to trace how energy challenges are experienced over time and a capabilities-based approach [4, 5] to understand the impact of energy vulnerability has been proposed in response [6]. Working in this way can explore, for example, how interactions between a variety of conditions – including household income but also housing quality and relationships with other social actors such as landlords – can influence whether households will then suffer from a lack of energy services when facing energy challenges such as rising energy prices [2]. However, if such interactions are important, the 'precise dynamic of these relationships is as yet unclear' [3].

Using data from interviews conducted in the community of Caerau in South Wales, we show in this paper how a longitudinal, narrative-based approach can help to better understand three aspects of the complexities of these dynamics and so highlight further directions for energy vulnerability research. Following Middlemiss et al [6], we explore, first, examples of how impaired access to energy services can be experienced as undermining key capabilities, including bodily health but also the capacity to participate in wider society, and second, how deficiencies in such capabilities (manifested for example in unequal social relationships) can themselves undermine access to energy services. A third and under-researched element of these dynamics is how people's own responses to energy challenges [7] may have

additional impacts on capabilities over time and thus on energy vulnerability. We show that attending to the ways in which interviewees represent their own ability to respond to energy challenges can help identify distinct strategies for dealing with threats to capabilities, either by identifying with divergent social norms, diverting resources to improve energy efficiency, or by forming adaptive preferences and effectively giving up on some valued forms of life. Further, we show how a longitudinal approach can show how the effects of complex interactions between capabilities, conditions and household responses are shaped by the temporal dynamics of these interactions.

While this third strategy may represent an acknowledgement of an erosion of capability and also of a lack of agency, we show how people nevertheless represent it as still being an example of effective agency. This is manifested in how some participants represent negative experiences of adaptive preference formation as evidence of responsible and capable practice. This finding reflects other scholarship showing how those facing difficulties resulting from energy challenges often refuse to identify themselves as vulnerable [8]. In sum we show how using the concept of capabilities helps identify how energy challenges put aspects of valued forms of life at risk, and reading for how people represent their own agency helps illuminate less visible aspects of how responses to energy challenges affect capabilities as time passes.

We conclude by proposing that identifying this third strategy illuminates a need for further research, based on previous work that shows how strategies like humour and disavowal [9] point to the psychosocial dimensions of adaptive preference formation [10] and how such strategies for dealing with capability loss may result in energy vulnerability becoming harder to identify [11]. We close by noting some implications of this perspective for research on the impacts of energy vulnerability and for policy relating to energy vulnerability.

Conceptual Background

If households lack adequate heating, lighting, cooking and other energy services, then various forms of detriment or harm can result. For example, inadequate heating in colder climates can pose risks to household members' health, particularly for those with chronic and severe illnesses, such as respiratory and cardiac conditions, leading to increased premature mortality, especially among the elderly and children [12]. However, specifying a general baseline threshold of energy consumption that can mitigate against such consequences and support well-being [13] is difficult.

The individual circumstances of particular households may mean that some need to consume more resources than others in order to obtain adequate energy services. For example, elderly people or people with disabilities may spend longer in their homes and thus require them to be heated for longer, or may require their homes to be kept at higher temperatures. It cannot therefore be assumed that one threshold of consumption is suitable for all. Similar issues have long troubled debates over welfare and well-being more generally beyond the energy sphere. The concept of capabilities [4, 5] represents an attempt to solve this problem, one which has recently influenced social science scholarship on energy [14]. There are several central elements of this approach which distinguish it from attempts to define such

vulnerability solely in terms of inadequate consumption. In particular, it facilitates a more complex understanding of detriment.

First, a capabilities framework distinguishes between functionings, i.e. desired and valued forms of life (e.g. being an athlete, being a politically-active citizen), and capabilities, i.e. the opportunities to realise such functionings (e.g. bodily health, freedom to participate in politics). The degree of well-being or human flourishing enjoyed depends on someone being able to realise states of being or activities which make up a set of functionings that they value, i.e. some actual valued form of life [4, 5]. Without the opportunities that capabilities represent, achieving valued forms of life is impossible. The absence of such opportunities then represents a cause of harm.

Turning back to the definition of well-being in terms of levels of resources consumed, whether or not resources are available is relevant (for example, income and quality of food are necessary to support bodily health for, say, an athlete or indeed any citizen, and access to information is vital for e.g. political participation). But also relevant are 'conversion factors' [15] such as additional needs (whether or not, for example, someone has a physical or learning disability), and moreover wider social-structural conditions (e.g. whether sports facilities are accessible to people with physical disabilities, or whether members of, say, a particular ethnic group are barred from participating in politics). Capabilities in this sense are opportunities which exist or not thanks to complex conditions. As a result, they are relational in nature rather than being something possessed by individuals [15]. Being vulnerable to a loss of capability is therefore not something that simply afflicts an individual in view of their own characteristics (e.g. being elderly or possessing a disability). Such vulnerability is a product of relationships between individual conversion factors and social circumstances, which may change over time.

Beyond these common elements, the frameworks developed by Sen on the one hand and Nussbaum on the other diverge. Sen did not stipulate exactly what would, in his view, count as core universal capabilities, believing this to be subject to a high degree of variation between different societies and over time. By contrast, Nussbaum used reflections on human well-being from writers such as Aristotle and Marx to define a list of ten core capabilities that represent the opportunities she believes necessary to well-being (or flourishing, in her Artistotelian language). Nussbaum's version of the approach has thus been labelled as paternalistic, given that its universalist thrust appears *prima facie* to ignore that different societies may value divergent capabilities. Some have pointed out, however, that any capability approach (including Sen's) and indeed any concrete account of welfare, including influential theories of human need [16, 17], must necessarily end by stipulating that some forms of capacity are most valuable in human life. Therefore such accounts tend to perfectionism (i.e by providing some definition of what specific forms of being or acting are to be valued, whether or not people choose them) and, as a result, may appear paternalistic [18]. This may not be a problem, so long as empirical research is undertaken to inform reflection on whether accepted definitions of key capabilities might need to change, given (for example) the interaction over time between the scope of legitimate social needs and technological change [19].

Researchers interested in the concept of capabilities as a way of thinking about the impact of inadequate energy services have often focused on the ways in which energy use is necessary to support the provision of capabilities. In doing so, they have frequently discussed the differences between Nussbaum and Sen's approaches, while also tending to take from Nussbaum concrete examples of what 'core' or more universal capabilities might look like [20]. Key examples of such core capabilities include that of possessing bodily health, the capacity for imagination and thought, a capability for developing and exercising affiliation and attachment, and control over one's material and political environment [5]. There remains wide scope for understanding what such capabilities might mean in different contexts through empirical investigation of what specific kinds of activity or way of being might be constitutive of a given capability, as Nussbaum herself argues in relation to determining what will count as adequately providing a capability in different national contexts [21, pp. 293–294]. For example, given the specific circumstances of participants in mental health programmes, control over one's material or political environment might be understood as including self-advocacy or access to advocacy services [22, pp. 33, 39].

Ability to secure adequate energy services can then be understood as one aspect of the wider conditions that are needed to support the availability of core capabilities, as argued by Day et al [21], They identify secondary capabilities which are necessary in order to support core capabilities. Maintaining a certain level of thermal comfort, for example (keeping adequately warm or cool) is necessary in order to maintain health. These secondary capabilities, in turn, require certain energy services, which require resources, tools, devices and/or infrastructures, such as well-maintained heating systems. Other core capabilities also require both secondary capabilities and energy services. Imagination, thought and practical reason require education, which in homes and schools is supported by energy services including heating and lighting, but also increasingly by communication technology [21]. Affiliation includes, Nussbaum [5] suggests, the social bases of self-respect and also the capacity to have high quality and meaningful relationships, each of which is required for someone to be able to participate fully in society. Feeling able to welcome others into one's home and offer hospitality is a secondary capability necessary to support affiliation, which requires adequate heating, lighting and cooking services [6, p. 227 and p. 227 n. 2].

Day et al's suggestion is that any definition of what adequate energy services might look like would then lay out what secondary capabilities are required to support core capabilities, and what energy services, social conditions and resources are needed to ensure these secondary capabilities are available [21, 262-3]. Given that, as noted previously, relationships between individual conversion factors and wider circumstances are important to understanding how and why someone suffers a lack of capability, variations in these relationships have also to be considered, in order to understand what equitable provision of energy services and secondary/core capabilities might look like.

Interactions between individual circumstances, the quality of housing, and regulation of rented housing, for example, can be highly significant here. The Hills report [23], subsequently influential on the redefinition of fuel poverty adopted in England that went beyond income thresholds alone, argued that poor quality housing also affects

the level of heating different households require to achieve the same level of thermal comfort. In addition, as Middlemiss and Gillard [3] point out, possessing a disability and/or living in a poorly-insulated rental property when regulations do not require landlords to provide proper insulation, can also undermine the ability to achieve adequate heating, with consequent knock-on effects for bodily health and/or affiliation. Some households and not others will therefore be more vulnerable to suffering from inadequate energy service provision and shortfalls in secondary and core capabilities.

Recognising this more complex concept of detriment, which identifies it as a relational disadvantage which comes from vulnerability to capability loss, underlines the importance of the concept of energy vulnerability for understanding inequalities related to participation in the energy system. Research on energy vulnerability as a propensity leading to energy poverty stresses the importance of wider conditions, beyond household income. For example, mismatches between household needs and available energy services, or a lack of access among rural households to cheaper energy carriers, may make households more sensitive to specific energy challenges, including energy prices and home energy inefficiency [24]. The result of interactions between such conditions is the erosion of the adaptive capacity of households to respond to energy challenges without an erosion of their members' well-being.

Influential recent research on energy poverty has explored how vulnerability to a shortfall in energy services is unequally distributed, and has investigated how this unequal distribution is a result of complex interactions over time between individual circumstances (conversion factors) and wider conditions. Middlemiss and Gillard [3] suggest that combinations of a wide range of circumstances not captured within dominant 'top down' definitions of energy or fuel poverty can create vulnerabilities, and show how qualitative longitudinal (QLL) methods can shed light on the complexity of these interactions over an extended time period. Use of such methods can highlight two complexities in particular, which demonstrate how the agency of household members can have further effects on capabilities. First, as Middlemiss et al [6] note, a lack of some secondary capabilities might undermine primary capabilities, but on the other hand, deficits in primary capabilities can also affect the ability to secure adequate energy services (e.g. when someone finds it impossible to obtain help from a landlord to improve energy efficiency). Second, how people themselves make sense of their own efforts to deal with difficulties in securing adequate energy services can have additional effects on their capabilities [6]. QLL methods can thus show how conditions, household characteristics and people's own agency and sense-making activities can combine in ways that are significant for their ability to secure secondary and primary capabilities (see Figure 1).
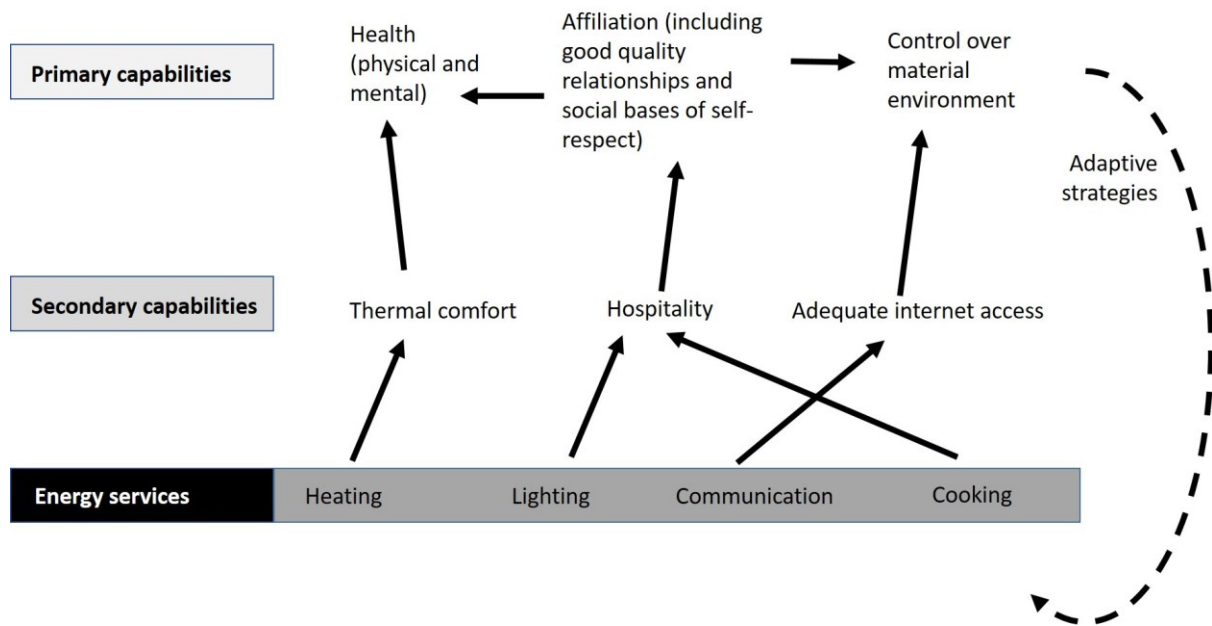
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Figure 1: Relationships between energy services, secondary capabilities and three examples of primary capabilities, with arrows showing directions of influence

In what follows, we examine how complex interactions of this kind can be traced over time within QLL data. The participant narratives we present show how wider conditions can affect secondary and primary capabilities. They also show, however, how deficits in primary capabilities (such as affiliation or the ability to control one's material environment) can affect other primary capabilities (such as health). Finally, it is also possible to use such narratives to track how people may respond to energy challenges, including difficult socio-material conditions, and capability loss by adapting to their situations in different ways. In terms of the capability approach, these forms of adaptation represent actually achieved functionings, forms of life, some of which may risk increasing their energy vulnerability and vulnerability to capability loss. These negative adaptive strategies can be understood as representing examples of harmful adaptive preference formation, as discussed in the capabilities literature [25, 26].

Method and Sample

Participants in our study all lived in Caerau, a peri-urban ex-mining community in the South Wales Valleys that scores highly on a number of measures of deprivation[2]. The case site was chosen as the location of a planned innovative geothermal district heating scheme, due to be constructed in 2021, which will heat local homes using heat from water in disued mine workings. Participants were recruited to our research study through leaflets delivered to all households in the area that will be eligible to connect to the mine water system, contacts were made at information events about the planned mine water scheme, social media advertisements and

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2 Pseudonyms are used throughout this paper

introductions through local gatekeepers. Sampling decisions were not based on demographic criteria. Participants were provided with detailed information about the project and how research practice would operate within ethical guidelines concerning anonymity and confidentiality, which the researcher also provided verbally prior to each interview, at which point participants were asked for their written consent to participate.

To explore people's experiences of energy challenges over time and their sense of how changes in their capacity to respond to these challenges had specific impacts, we conducted three rounds of interviews with community members across a two-year period. During 2017, 18 interviews were conducted involving 24 participants aged between their early 20s and late 70s. Most were individual interviews but some opted to be interviewed with their partner. 22 participants were interviewed a second time one year later (2018) and 19 on a third occasion after another 12-month interval (2019). Participants took part in 1-2 hour qualitative longitudinal interviews concerning energy and everyday life. Interviews covered questions about the proposed mine water scheme, heating routines, energy using practices more generally, and how relationships to energy had changed over time in response to lifecourse changes. Interviews also included exploration of participants' understandings of fuel poverty and energy vulnerability – terms which were used in the interview discussions. Interviews were semi-structured, largely following the same schedule but with flexibility to discuss related topics raised by participants. This flexibility provided space for extended participant narratives about the lived experience of energy vulnerability. At the time of the initial interviews, four participants lived in social housing, six were privately renting and the remainder owned their own homes. Eight participants were retired, ten unemployed[3] and five in employment (a mixture of full-time, part-time and self-employed). Using a demographic definition of household vulnerability taken from Jenkins et al., [27] which covers dwellings where children, elderly or sick/disabled occupants are present, 19 of the 24 participants in our sample could be described as living in vulnerable households at the time of the first interview. Such definitions, as noted in the literature review, should only be regarded as a crude indication of vulnerability. At the same time, they provided an initial discussion point with participants about what constitutes vulnerability and how this may differ from subjective experiences.

The interviews discussed in this paper were conducted as part of the social science element of the interdisciplinary FLEXIS project,[4] a large research initiative exploring energy system developments in Wales. Data from second round interviews were also drawn on as part of the *Better Energy Futures* project,[5] which sought to explore experiences of fuel poverty and energy vulnerability. The methodological perspective draws on previous work undertaken by team members. Specific longitudinal methods were developed from 2007-2012 as part of the *Timescapes* consortium[6] and expanded on within the *Energy Biographies* project (2011-15). A methodological focus on lived experience and biographical narrative allows researchers to account for how energy-using practices evolve over time in relation to wider socio-cultural transitions associated with technological change [28]. Such accounts can also be

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3 All unemployed participants with a partner who did not participate in the interviews also described their partner, where they had one, as being unemployed.

4 http://flexis.wales

5 http://orca.cf.ac.uk/124132/1/better%20energy%20futures%2027%206%202019.pdf

6 http://www.timescapes.leeds.ac.uk/

used to frame wider social relationships *psychosocially*, i.e. in ways that show how mundane everyday experiences and practices nonetheless involve a deeper emotional and implicitly ethical-normative attachment to objects and practices [29]. Attention to how such attachments emerge within interviews allows analysis to explore people's explicit and also implicit commitments to particular forms of life. The qualitative longitudinal approach is inherently temporal and is therefore particularly suitable for exploring dynamic issues [30]. Qualitative longitudinal research enables multiple analytic approaches; an exploration of change over time across waves of interviews; a detailed analysis at one moment in time across a single wave of interviews; and various combinations of the two approaches [31]. In this paper, we present data drawn from the first three waves of interviews.

For the analysis presented in this paper, data were primarily coded using Nvivo qualitative analysis software in relation to reports of energy challenges extensively mapped in the literature (such as financial, housing fabric related, landlord related, and so on), with a view to reading for 'through lines' where consistent narratives of change were present [32]. Below we highlight three main themes; housing, budget and social relationships, as examples of socio-material conditions with significant influence over access to capabilities and people's experiences of energy vulnerability.

Results

Broadly speaking, the energy challenges described by interviewees arose within distinct temporal contexts that affected how unpredictable and intense they reported them to be. A slower or at least more predictable pace of change was, for example, associated with energy costs, which were seen as regularly increasing for people across Wales and indeed the whole UK [33]. Within Caerau itself, seasonal weather conditions and its own socio-economic historical trajectory were also seen as manifested in slower rhythms of change. 150 metres higher above sea level than Bridgend, the nearest large town, perceptions were that Caerau is '*two overcoats colder than Bridgend*' (Terry, 60s, Interview 1 & 2), as well as being isolated: '*when the mist comes down, it's like you could be living on the moon*' (Jenna, 30s, I1). These conditions were seen as creating specific challenges, including sometimes unpredictably harder winters that undermined budgeting for energy bills: '*all you need is for it to, to have a sudden bitter, freezing snap and then all your maths is out*' (Jenna, 30s, I1).

Material deprivation grew within the community in the wake of the end of coal mining in the 1980s and 1990s. Securing adequate heating was made easier by the ready availability of coal in past decades, through the National Concessionary Fuel Scheme coal allowance for colliers' households (which began in the 1950s) and more generally through gathering of loose coal. Even households where no-one was employed in the mines were able to benefit: '*my mother used to have coal from the other neighbours*' (Cheryl, 70s, I1). In terms of social relationships, local colliery-related institutions like working men's clubs created social networks within the community, and as the network of local mines extended down the valley, nearby small towns like Maesteg were linked to Caerau even before the settlements grew together. While recognising negative impacts from mining on workers' health and environmental quality, older residents in particular saw the coal economy as enabling more fairly distributed provision of heating. So while coal mining inflicted unequally

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distributed harm on capabilities like bodily health, it also supported health through adequate heating, as well as supporting affiliation, including social and political networks (through union membership and local associations). The picture began to change in the late 1960s and through the 1970s as coal fires were replaced with gas central heating. Older people remembered moving from a local context in which elements of relative abundance were present to a situation of relative scarcity in an increasingly expensive energy market: '*they took all the fires out then, and it's like, all struggling now, you know what I mean? They miss it like*' (Paul, 40s, I1).

As the mines closed, and the social institutions and networks within and outside the town associated with them disappeared, employment in Caerau decreased, with people increasingly travelling to work outside the community by car or public transport (bringing extra costs). The village was often described as having become, in recent decades, more isolated and neglected, a place where social interventions from local government and others were often tried out (such as energy efficiency improvements for households), with some residents feeling as though they were guinea pigs for schemes that might then subsequently be implemented more successfully elsewhere. Several people expressed views like Amanda (30s, I2):

> *It's more vulnerable people up here because who cares about Valley people? It's more cities and towns and all that. It's just us people, we're just back and beyond and people forget about us.*

The relatively slow, yet clearly defined trajectory of the recent social history of the village marks Caerau out as potentially more exposed and sensitive, collectively speaking, to energy challenges such as gradually rising prices and poor housing quality. Against this backdrop, the centrality of housing quality, financial stability and also social relationships to interviewees' narratives demonstrates how sudden and often unpredictable changes to these three elements over time expose some members of the community more to energy challenges.

Housing

Relatively high deprivation within the community was associated with lower house prices than in many other nearby communities. This had drawn some respondents to move to the area to buy houses. Social and private renting were less common than home ownership. Quality of the housing stock in Caerau is variable. Terraced homes dating from around the early 1900s with solid stone walls built with black mortar are common. They may be prone to damp and hard to insulate, which is particularly significant in Caerau's typical weather conditions. Reducing damp and improving heating efficiency for whole homes were promoted by the local council through the Welsh Government's Warm Homes insulation retrofit scheme (Arbed), open to home-owners and to landlords [34]. Some participants had had this work done, and many were happy with the results, but some had had different experiences: '*I've been let down badly by them, yes, because they never finished or completed the work*' (Angela, 40s, I1). For some participants, a retrofit approach of this kind is not seen as generally viable in Caerau. In the case of internal insulation, such interventions are leading to a loss of space which would '*take away six or seven inches of your space*' (Doug, 60s, I2) in already small rooms in many houses, with a widespread perception that badly installed external insulation is associated with continuing damp problems.

Local weather conditions impose gradual but significant wear and tear on houses. Len (70s, I1) described struggling to carry out repairs to the fabric of his home in response to external weather-related damage:

> *this house, if you go down the valley and look up it's probably one of the highest houses in the valley … so of course we get all the weather smack at the end of this house. You know we've had two outside rendering broken down over the years … but we're forever painting it because that is picking up lichen.*

The second wave of interviews were carried out after an extremely cold winter, which included bouts of snow and subsequent water shortages due to burst water mains. Some participants reported that these weather conditions had suddenly led to new problems with their houses: '*when we had all this heavy rain. We had damp patches on the wall*' (Paul, 40s I2). While homeowners were often limited by cost in repairing their properties, those in rented accommodation generally found themselves unable to undertake repairs themselves or to improve heating systems to help keep damp at bay, becoming reliant on the good will of landlords to undertake such work (a problem we look at in the next section). This illustrates the way that inadequate energy services are often a result of a mismatch between a dwelling's heating or cooling system and the energy system needed by its occupants [2]. Debbie's privately rented house had poor quality glazing, which, exacerbated by an inefficient heating system, made achieving a comfortable living temperature difficult: '*we've got no thermostats or anything, so it is purely on or off. So you either bake or you freeze*' (Debbie, 30s, I1).

Interviewees gave a variety of examples of how housing quality might interact with secondary and core capabilities and produce significant deterioration in living conditions relatively quickly. Amanda described in her first interview how damp in her social housing property, exacerbated by inadequate heating, created a mould problem in her child's bedroom. Consequently, she had had to move her child into her own bedroom, with her and her partner sleeping on the sofa. Persuading her social landlord to take action proved difficult.

> *"Me asking them [social landlord] to do something is always 'no, can't do this, we haven't got enough money for that' … the only time I've been waiting was two years for them to do my wall [issue with damp and mould]. In the end, I said 'I've had enough. You coming out to do my walls, I've had enough, I'm phoning environmental health'" (Amanda, 30s, I1)*

By the second interview Amanda reported that the problem had been remedied, but described suffering back pain after months of sleeping on the sofa, once she and her partner were able to move back into their bedroom:

> *Because I'm so used to sleeping on the couch. When we got back, got the bed and got in, oh I was in so much agony. (Amanda, 30s, I2)*

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Amanda's narrative shows how a deficit in primary capabilities (the quality of social relationships, in particular a willingness to take action in response to need) can undermine secondary capabilities (thermal comfort), with the social relationship in question being that between tenant and landlord [6, p. 227 n. 2], then having further impacts on health. Despite work being undertaken on the property, other issues remained outstanding and in all three interviews Amanda described a sense of being 'bypassed' by her landlord in favour of others. After recent heavy rain, Amanda reported (like Paul) damp coming through from external walls, which then needed re-rendering: '*They need to sort out the roofs and the walls and everything would be fine then. But they don't listen to us, do they?*' (I2). Here, a negative relationship with her landlord prevented full resolution of the housing quality problem. This was exacerbated by lack of legal redress (an issue identified by Middlemiss et al [6] as a social-structural problem), which reduced Amanda's ability to exert any kind of control over her family's environment, and led her in the end to threaten action under environmental health regulations.

Amanda's story provides an example, mirrored in others' narratives, of how the quality of housing and of social relationships (affiliation) associated with it can condition people's efforts at exerting effective control over their material environment. In some interviews, however, housing quality had less significance. Preferences which differ from those of the majority of interviewees – such as for a cooler house – were sometimes expressed, as when Mark and Serena identified with a frugal style of life while discussing increasing energy prices: '*I feel bad, spending money*' (Serena, 20s, I2). Here, a particular moral identity and form of life secured by specific values developed over a long period of time was associated by interviewees with having a greater degree of control over their financial and material environment. A lower level of secondary capability (thermal comfort) here might be preferred for other (such as physiological) reasons too. But achieving coherence over time between practice, levels of secondary capability, and a chosen moral identity can help maintain a sense of effective agency in relation to energy use, often expressed through reference to ideas of sufficiency [35].

Finances

In terms of the resources available to households, some were retired and receiving state pensions, while a number of other households volunteered information about being in receipt of social security payments, or on a low and perhaps unstable income from work in combination with such payments, which can render energy and other necessities harder to afford by ruling them out of additional benefits: '*it's the ones that are earning but who are on low incomes that are caught out*' (Pamela, 50s, I1).

Lower incomes in conjunction with steadily increasing prices created significant challenges for many households in obtaining adequate energy services to support secondary and primary capabilities, leading them to respond in a variety of ways. While utility companies, government and Ofgem (the energy consumer market regulator) typically advise consumers to shop around for lower tariffs from alternative suppliers, interviewees pointed out that, for consumers on low and/or unstable incomes this was often not possible. As with housing, social relationships created

additional difficulties. Switching suppliers typically leads to double billing, creating another challenging financial situation for vulnerable consumers:

> *[…] as soon as you stop with this company, they want anything that you owe up to date then, and then this new company starts you off. So, you end up paying twice as much that month and you can't do it.* (Jenna, 30s, I2)

The dominant response interviewees reported adopting is to budget carefully by determining key priorities for expenditure, which tended to begin with energy, given that most other capabilities within a household depended on energy. Terry (60s I2) stated that the '*bills are like a brick wall*' one has to get over before anything else is possible, reminding him of the degree of power exercised by utility companies: '*it doesn't matter how little income you're on, you've still got to pay your bills*'.

'Budgeting' had several meanings for interviewees, chiefly dependent on the budgeting period, the temporal rhythm with which the practice operates – emphasising once again the importance of temporality in understanding energy challenges. Monthly energy bills and a relatively stable income (with stability derived either from regular wage payments or social security payments) can make longer-term budgeting possible. For example, putting money aside in the summer when costs are lower can help with winter costs. Amanda identified her one-child household, where both adults were unemployed due to ill-health, as suffering serious financial hardship. The household received social security benefits and a winter fuel payment. She was not on a prepayment tariff because of concerns about its higher costs, and reported reducing energy use in general and seeking to balance her energy budget across the seasons: '*like through summer we didn't really, didn't really have to use my gas so I got about, I got £200 or something in [account], a good chunk*'. Others described how being on a less-constrained income made longer-term budgeting possible, enabling preparations to be made for anticipated harder times. Having retired due to ill health and now awaiting reaching state pension age while on reduced income, Doug and Joan reported having been able to make plans for this transition, paying off debts and saving enough money so that '*the whole house has gradually been upgraded*' (60s, I2). Being able to 'put something by' thanks to regularity of income, even if it is low, maintains more control over financial and material aspects of the environment in the face of predictable challenges like rising prices and cold winters as well as reducing exposure and sensitivity to unexpected challenges, should they arise.

Such practices were reported as being impossible where further regular costs are faced, or incomes became suddenly unstable. Once again, the influence of social relationships was felt to be significant. With the UK Government's planned integration of a range of benefits such as Housing Benefit and Jobseeker's Allowance in a single benefit payment, Universal Credit, interviewees on social security benefits perceived themselves as facing additional instability: '*it's a nightmare transferring from one to the other*' (Amanda, I2). Additional costs, on the other hand, can derive from relationships with utility companies. Indebted monthly-billed customers are often required to have prepayment meters installed, which come with higher tariffs. Some found this arrangement helped them to keep to a budget, at least on a week to week basis:

Now I've actually got a routine where I get my money, and I top my meters up, then I do my food shopping, and then whatever's left, is my money. (Kim, 30s, I1)

Others, however, found that higher pre-payment tariffs made expenditure more tangible as well as higher - but no more controllable, despite being more perceptible: '*you see it go quicker and especially with the charges on the meters, that comes off as well and that comes out of the balance*' (Jessica, 20s, I1). Relationships with utility suppliers here, together with a lack of resources, made the challenge of rising energy costs much more serious by increasing energy vulnerability [3].

At the same time, the regular rhythm of even just week-to-week budgeting gave people a reason to feel they were not vulnerable consumers. Jessica (I3) recounted how, when her partner was employed, they had budgeted on a monthly cycle: '*You know I can remember when he was working, we'd have four envelopes in the cupboard [laughter], you know, that's one week, two week*'. Saving and spending on a prepayment tariff was beyond the family, but occasional treats for the children were possible: '*There's weeks where we got a nice bit of bob left over, and we treat the kids*' (I3). These acts of care supported a sense of agency, as did dealing with emergencies: '*this year my car cost about £300 to pass the MOT. But we did it.*' (I3) This particular anecdote, however, closed on an ironic note: '*We did it, and then literally a week after that the alternator went*'. Another £100 was required for this repair, '*But*', Jessica insisted '*we did it, it's doable, you know, it is doable if you take from the right, you know.*' Jessica's anecdote affirms her and her partner's ability to exert some control over their financial and material environment, while also hinting, through ironic humour and her final, somewhat uncertain remarks, that there may be more to be said [9].

In other interviews, a sense of increased – yet still not explicitly affirmed – vulnerability associated with adapting to shorter-term planning horizons [36] was manifest. Terry (60s) reported that, being unemployed, he saw his energy use – and life more generally – as being a matter of '*living from week to week, month to month*' (I1).To try to provide adequate heating for the household, Terry relied on donated wood from a carpenter friend for the stove, noting that he '*couldn't afford' 'gas central heating alone*'. By the time of the second interview, the winter he had been 'dreading' had been and gone. His partner had been recovering from an operation, during which time the central heating had needed to be used much more than usual and Terry was awaiting the bill for this period with some concern. He reiterated that budgeting meant to '*survive from week to week*', and that a central part of the experience of budgeting week to week was awaiting the next bill and the '*sharp intake of breath*' he expected to accompany opening it. In his third interview, he reported that although a new gas boiler provided through the Welsh Government's Nest/Nydd scheme had improved his household's heating, other aspects of his situation had stayed the same or worsened.

I make sure - we sit in the dark sometimes, I'm not kidding you. [Laughter] I got a standard light - lamp on, and that's it for us. […] we're only just about doing it, and we don't live an extravagant lifestyle. No car, no transport, we don't, we just - like I said, our best entertainment is the TV, and without that we'd be throwing rocks at each other, you know. (Terry, I3)

While these remarks about 'just about doing it' were delivered, once again, with humour, Terry also pointed out how sensitive to unexpected challenges he felt the household now was (particularly as he was no longer able to carry out repairs himself due to ill-health).

Well, anything major goes wrong now, I don't know how we're going to manage. We've got it insured, we pay our insurances the best we can, but, I used to do all the maintenance, and I don't now, I can't.

While Mark and Serena reported adopting norms of frugality in a way that enabled them to make sense of their situation as one more or less freely chosen in conformity with values (or functionings, in Sen and Nussbaum's terms) they found meaningful, Terry and others reported that frugality was simply a material necessity. It was manifested particularly in terms of '*prioritising, I suppose you can say*' (Jessica, 30s, I1). Identifying priorities was necessary to ensure others within the household (children, relatives with disabilities and so on) are adequately provided with energy services. Restricted and/or unstable incomes made difficult choices necessary in order to support caring responsibilities and self-respect. Caerau's prevalent weather conditions, high prices, health conditions worsening in the winter and additional challenges to core capabilities, as in the case of Terry's wife, made such choices harder. Being able to cope was seen as an accomplishment, and associated with another kind of valued moral identity or form of functioning, that of a person able to show they can care for dependent others as well as themselves.

Social relationships

The importance of housing and of finance underline, in turn, how important social relationships were in creating or reducing energy vulnerability. Interviewees report how influence over their material environment, whether their home itself or their financial 'environment', had been undermined by unequal power relationships in particular. Older residents, as noted earlier, described growing up in conditions where shared forms of life, anchored by the mining industry, were tangible and constitutive of shared practices that embodied broader purposes related to esteemed collective forms of life [37], such as mutual assistance. Older residents and younger ones alike saw such practices as still continuing to a degree, reflecting older traditions of solidarity, yet they had come to represent a less tangible shared form of life, albeit a still-valued one. We now turn to look at how affiliation relates more directly to people's ability to secure adequate energy services.

Caring responsibilities, and the regular rhythms of ensuring that everyday needs are met, exemplified how relationships with others both within and outside the home may increase sensitivity to energy challenges. Caring for dependents may increase sensitivity to rising costs due to their additional needs for heating, for example.

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Keeping temperatures within the home warm and stable for elderly relatives or young children was generally seen as a priority: '*when you're on your own you just put more layers on. Can't promise your kid's going to keep that blanket on all night, can you? [laughs]*' (Stacey, 30s, I1). A similar example was where members of the household were ill or had certain disabilities: '*in the colder weather, we tend to use a lot more heating because it can set [child's health condition] off, you know, he tends to be very uncomfortable and painful*' (Jessica, 20s, I1). Sensitivity to energy challenges like weather conditions and rising prices could thus increase as a result of the capability needs that come with caring responsibilities and the additional needs of some household members.

Where the wellbeing of others was at stake, services other than basics like heating and cooking were also seen as important, such as laundering and entertainment: '*there's more of everything, there's different reasons to have stuff on*' (Stacey, 30s, I1). Some interviewees noted that, particularly where parents were unable to afford to take children on outings for entertainment, TV, PCs or games consoles were seen as providing important and increasingly 'non-negotiable' entertainment functions (Middlemiss and Gillard, 2015, p. 151), though also potentially increasing energy costs. Similar importance was placed on these devices where people suffered mobility problems, or where mental illness was an issue: '*But when I'm not okay, I literally sit there all day, just watching TV, and there's nothing, there's nothing I can really do about that*'. (Jenna, 30s, I1)

Beyond the home, caring as part of social relationships was looser and no longer mediated by the kinds of social networks once associated with the collieries. But as representative of collectively-valued practices [37] they were still seen as standing for collectively valued functionings, forms of life worth aspiring to that affirmed people's capacity to influence the quality of their and others' environments, especially in the face of unexpected challenges. Given the fundamental value of energy to capabilities, as affirmed in Terry's 'brick wall' comment, help given to others was seen as an important if *ad hoc* way of lessening the effect of energy challenges on those perceived as vulnerable [38]. As the second wave of interviews made clear, looser yet still extant social networks were felt to be manifest through the care interviewees described themselves as exercising or as having seen exercised for residents perceived as vulnerable (elderly, with disabilities or those with young children), particularly in the wake of events like the 2018 snow and subsequent water shortage which threatened the well-being of vulnerable people locally.

Jessica (on an already low income) recounted giving a neighbour '*a little bit towards their gas*' during the cold snap (I2). Others checked up on friends or neighbours more regularly:

> *I always make sure I look after my neighbour. I've always looked after her. If she's sick I'm there, bowl of soup. Or stew or something. (Amanda, 30s, I2)*

Here, nutrition and the need to keep warm were looked after at the same time, without direct financial aid. Although participants, older and younger alike, often reported that their image of the community and their sense of where the roots of its

identity lay had changed, it was still possible to rely on a certain level of assistance in difficult times. A sense of individual and community affiliation, associated with the capability to help others, was reported to still be present.

Discussion

Our data show how energy vulnerability – understood as increased sensitivity to and decreased capacity to adapt to energy challenges in ways that sustain quality of life [24] – is influenced by place, housing, income instability, and social relationships and interactions between them over time which manifest a range of temporal rhythms. Social relationships exert a particularly significant influence here, confirming Middlemiss et al's [6] insights about the bi-directional relationship between capabilities and energy services. Inadequate energy services may undermine secondary or primary capabilities (such as health), but poor-quality social relations can also increase energy vulnerability in conjunction by affecting housing conditions and a lack of financial resources. In particular, social relations (such as those with landlords and utility companies) that undermine effective self-advocacy can greatly exacerbate energy vulnerability. Some of these influences are less prone to sudden shifts (relationships with utility companies, for example), or may intensify slowly over time (energy costs). Others (such as finances and housing) may exhibit unpredictable changes (unstable incomes, unreliable landlords, the sudden onset of damp and other problems).

Woven into the accounts people give of these interactions are also their accounts of how they respond to them, which show how temporality is also a key element of how people experience and deal with energy challenges. There are three main kinds of response that can be read in the data by looking for 'through lines' [32] relating to strategies for coping and adapting. First, a minority of people adapt to energy costs by actively and reflectively identifying with long-held social norms that they see as being at variance with more dominant norms and values, such as Mark and Serena keeping their home cooler, and being actively frugal. This is an example of a tendency in consumption behaviour that has become more widely represented in society recently [39], a way of sustaining a valued quality of life in the face of difficulty. Second, some of those with sufficient resources adapt gradually over time by, for example, improving energy efficiency in their homes using savings, as in the case of Doug and Joan. Finally, others adapt as circumstances change more rapidly and unexpectedly by changing their preferences for particular levels of energy service: '*prioritising, I suppose you can say*' (Jessica, 30s, I1). A common element within narratives is how some interviewees talk about a loss of agency (being unable to influence housing quality, income, or negative social relationships with e.g. landlords) while at the same time talking about how they exert agency, over time, in other ways. Often people who described prioritising represent themselves as not vulnerable because they report being able to 'cope' with a situation in which they feel no other alternative is open to them.

To be genuinely vulnerable (and thus to be suffering real harm) is widely seen as having to make desperate choices, for example, the choice to 'heat or eat', a phrase which has wider rhetorical currency in the current era of austerity and welfare reform [40] marking a point at which too much of a valued way of life has had to be given up. Interviewees sometimes represented themselves as being distant from this threshold by pointing out how they were able to offer help to others despite having to

make choices about their own energy use. Alternatively, some did this by denying that such dilemmas are at all characteristic of the community in general, or at least something interviewees '*can't see*' (Len, 70s, I1), and have never experienced such choices themselves, despite sometimes alluding (and often humorously) to difficult choices.

The strongest evidence for many that they are not in need of extra help is what they see as their capacity to budget, which is seen as a marker of responsible agency. The meaning of 'budgeting' can, however, take on various tones, depending on the implied timeframe [41]. For those with more stable incomes, budgeting implies allocating finances across the year between essentials including savings, perhaps trimming expenditure in some areas to ensure that they '*cut our cloth accordingly*' (Cheryl, 70s, I2). For others on less stable and/or lower incomes, shorter term budgeting is a necessity. For some (like Amanda), monthly billing and regular benefits payments means that it is possible to keep aside a regular amount for energy bills, some of which can be saved in the spring and summer for use in the colder months. For others, and particularly those on prepayment tariffs, budgeting means managing cash week-to-week. This too can represent a plateau of stability, allowing (via prepayment meters) close monitoring of usage. But at the same time, it renders a household more sensitive and less able to adapt to price rises, or to unanticipated changes in personal circumstances (illness, disability), to social relationships (suddenly uncooperative landlords, increased caring responsibilities) or the material environment (extreme weather, house repairs). Adapting to see one's life in terms of short-term budgeting implies acceptance of a restricted set of possible functionings (and thus can be seen as a case of maladaptation).

Nevertheless, respondents often represent even very short-term cash flow management as representing a reassertion of control over the financial and material environment. This mode of self-representation avoids having to acknowledge that one's capacity to live up to what are perceived as collective norms of dignity, hospitality and so on may be undermined by energy vulnerability, as detailed in previous findings from narrative interviews conducted by our team during the *Energy Biographies* project, regarding the ethical significance attributed by respondents to everyday energy consumption practices [42]. The importance of Nussbaum's categories of affiliation (including self-respect and social participation) and control over one's environment is attested to by reports from interviewees of trying to maintain self-respect in the face of the degradation of effective control over aspects of the one's immediate situation and detrimental environmental qualities that are important in energy service provision.

At the same time, though, respondents may affirm that valued functionings are being given up. This is typically registered in terms of possibilities that are closed off. For example, Stacey talks about the challenges of trying to undertake everyday activities when her energy supplies run out:

> *I've been there where I've got no gas and no electric and I can't wash my child and, do you know what I mean … when there's no gas or electric, you're stuck. You've got nothing, and that's your life … Whether it's darkness, or whether it's like at a certain of time, you*

know, when it's pitch black in, in the winter, and what are you gonna
do then? You've got no hot water to do anything, you can't warm
wash your dishes, you can't have food. (Stacey, 30s, I3)

Stacey goes on to emphasise that paying energy bills are her priority (echoing Terry's 'brick wall' comment) in order to provide her child with a home that has warmth, light and hot water, but that food can be treated as an area of compromise.

Stories of struggling with energy challenges can therefore, we suggest, be read as attempts to respond to instability in ways that enable certain kinds of moral identity to be maintained, even in the face of having to recognise that one's responses mean one may fall short of certain values and norms that are perceived to be collectively shared. While adapting preferences and prioritising is felt to be materially necessary, it also represents identity work in establishing a level of well-being which Spiers [43] calls integrity or soundness, representing a consistent level of valued functionings over time that harmonises sufficiently with dominant norms to avoid triggering feelings of shame. Narrating the self as capable, knowledgeable in how to save money through thrift, and willing to help others may bring 'the pleasures of narrating one's 'true' self' by aligning one's self-presentation with long-established community norms of reliance and assistance for the 'truly' vulnerable [11, p. 40], even in the face of 'brick walls' like energy costs which force painful compromises.

Using a longitudinal, narrative-focused approach of the kind we adopted enables the emergence of different adaptational strategies to be traced over time. An analysis of the differences between such strategies can highlight how forms of self-representation that present adaptive preferences as a sign of positive adaptability and resilience may mask wider costs in terms of reduced primary capabilities, such as health but also those capabilities associated with social participation [11, p. 44). They can also point researchers towards instances where things unsaid (such as acknowledgements of vulnerability) impress themselves upon what is in fact said [10, and often through humour [9] as in Jessica's budgeting anecdote about her car or Terry's remarks about lighting.

Such contrasts are particularly visible in instances where interviewees describe how the effects of energy challenges have led to a shrinking of what they feel is possible for them and for their household, a case of what in the capabilities literature has been identified as a negative effect of the formation of adaptive preferences. In some cases, 'cutting one's cloth' (to suit a reduced income, for example) may be experienced as helping someone to maintain an overall quality of life by moderating some socially-valued functionings in favour of according greater priority to others [44]. But elsewhere, adaptive preferences may represent a degradation of capability in the face of circumstances felt to be insuperable, leading perhaps to individuals internalising a diminished sense of possibility that can, over time, itself lead to further erosion of the capability for social participation [26].

Conclusion

By combining a conceptual framework informed by concepts of capabilities with longitudinal, qualitative methodology, our analysis adds to current understandings of energy vulnerability by tracing out some of the 'precise dynamics' [3] of the

interactions between socio-material conditions, household circumstances and primary/secondary capabilities. These interactions can play out with a range of different temporal rhythms, and may operate in distinct directions, with loss of primary capabilities affecting energy services and thus secondary capabilities, or difficulties with energy services affecting secondary and/or primary capabilities. Further, how people themselves interpret and respond to their changing situations can have distinct effects on their ability to secure energy services, or on their capabilities.

Some represent positive adaptive strategies, in which people feel they are still able to achieve valued levels of functioning of quality of life. Other strategies in the face of the 'brick wall' of energy costs exhibit the formation of adaptive preferences alongside the erosion of valued ways of life, given that the capabilities needed to pursue them are no longer available (as in Jessica and Terry's narratives). No matter which strategy emerges, however, interviewees construct their narratives using forms of self-representation intended to maintain moral identities consonant with what they feel to be community norms of mutual assistance and also of self-reliance. Our analysis thus underlines how temporal rhythms of change as well as experiential dynamics are important for understanding under what conditions functionings and capabilities may be undermined. It is also sensitised to the ways in which identity work protects selves against feelings of loss, even, and also to how sometimes stories of coping with energy challenges point beyond themselves (through moments of humour or disavowal) to implied harms that are difficult to talk about.

The implications of this work both for research on energy vulnerability and policy designed to address fuel or energy poverty are various. Research on the impact of energy poverty emphasises that it is not just how adequate energy services are unequally distributed that is of concern. The extent to which end users are able to give voice to their interests (through effective energy markets, getting landlords to install energy efficiency measures, or forming local energy cooperatives for example) and whether or not their specific capability needs are recognised by other actors in the energy system are also important. Longitudinal, qualitative approaches can map how the needs of different kinds of households can affect the level of capabilities they require. However, our research, shows that using narratives to understand people's needs in their own terms has to tread carefully, given interviewees' self-representations may mask the impact of the energy challenges they report. Reading for temporal patterns of change in the conditions which influence energy vulnerability may offset this masking effect.

In relation to policy on energy and fuel poverty, the ways in which people's identifications with shared norms may incline them to disavow their own vulnerability may also incline them to not seek additional assistance from official sources. If this is so, then one response should be to provide first contact points for advice and assistance through trusted local sources. Further, our findings regarding the influence of interactions between a range of conditions on energy vulnerability underlines findings elsewhere [3] that such advice and assistance needs to address issues (such as family situation and health) that fall outside energy demand policy. The extent to which social relationships are a central component of how needs are or are not met means that policy responses to energy vulnerability need to look at how to define and regulate the responsibilities of other actors in the energy system, such as utility companies and social/private landlords [45].

Our research highlights the importance of qualitative research in understanding the lived experience of energy vulnerability by building up detailed participant accounts that powerfully illustrate how the concept of capabilities and people's experiences of threats to and loss of capabilities are relevant to understanding the meaning of energy vulnerability. Additional waves of interviews within Caerau are planned which will enable further exploration of changes in circumstances over time and of the interactional dynamics between socio-material conditions, capabilities, and adaptive strategies.

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