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Abstract

Energy vulnerability is an area of interest to researchers and policy makers alike. In this paper we analyse data from a qualitative longitudinal interview study of a deprived ex-mining community in South Wales to explore lived experiences of energy vulnerability in detail. Whilst demonstrating the relevance of caring responsibilities in experiences of energy use and scarcity, we consider the importance of local relationships in helping people to navigate energy vulnerability. We highlight the value of qualitative longitudinal research for informing interventions that are more responsive to people’s experiences of energy vulnerability and changes in circumstances over time.

1. Introduction

Fuel poverty arguably now represents a more salient research topic and pressing policy challenge than ever before (Ambrose and Marchand, 2017), with rapid rises in the cost of heating fuels appearing to have given rise to increasing incidences of fuel poverty (Anderson et al., 2012). Despite efforts to tackle the problem, OFGEM (2017) have outlined how, unless energy bills fall in real terms, continued slow wage growth could lead to increasing numbers of people being at risk of fuel poverty. Addressing fuel poverty has also been identified as

important in meeting UK government climate change targets (Boardman, 2012). There have been various calls for qualitative research into fuel poverty and the nature of energy use in fuel poor households, as it is important to understand how the fuel poor experience change and how they might be supported in coping (Jenkins et al., 2011; Middlemiss and Gillard, 2015; Grey et al., 2017). In this paper we set out to address some of these issues by exploring detailed accounts of those living in households vulnerable to fuel poverty. In particular, we highlight the significance of connections to other people and local places in understanding experiences. We begin with an overview of literature in relation to concepts of fuel poverty and vulnerability, before outlining the relevance of an approach that is sensitive to local place context.

1.1 Defining Fuel Poverty

Historically, quantitative definitions of fuel poverty refer to the proportion of income households spend on energy to keep their home in a 'satisfactory' condition, encapsulated in Boardman's (1991) book in terms of spending more than 10% of income on energy. Following the Hills Review (2012), a 'low income high costs' definition of fuel poverty has been adopted in England (Annual Fuel Poverty Statistics Report, 2019). This approach has been critiqued for problematising fuel poverty as a technical issue in relation to housing stock, which detracts from alternative problematisations, for example in relation to market, health, inequality, and tenancy (Middlemiss, 2017). Questions have also been raised about the motives behind a change in definition given that it leads to a substantial reduction in levels of measured fuel poverty without requiring any legislative change (Moore, 2012). In Wales (where our case site is located), fuel poverty became a partially devolved issue after 2006 and the 10% threshold was maintained (Grey et al., 2017). The Welsh Government Fuel Poverty Strategy (2010) outlined an ambition to eradicate fuel poverty as far as is practical in all

households by 2018. Yet a 2019 statistical release from the Welsh Government indicates that approximately 12% of Welsh households live in fuel poverty (Welsh Government, 2019). An updated fuel poverty strategy for Wales is due to be released in 2020.

The Welsh Government introduced two major policy-led schemes to target fuel poverty; Nest (or Nyth) and Arbed, which addressed energy efficiency of homes with mixed results. Some studies have shown that people who experienced these interventions reported improved thermal comfort, health and wellbeing (Grey et al., 2017), although they appear to have had little effect on helping households escape fuel poverty as defined by the 10% threshold (Atkinson et al., 2017). Moreover, international evidence shows reductions in fuel consumption from such schemes tend to be inconsistent (Vilches, et al., 2017). However, whilst a focus on efficiency makes sense in efforts to address fuel poverty, seeing it as a technical problem to be solved ignores the lived experience of fuel poverty and the many factors that may contribute to it (Jenkins et al., 2011; Middlemiss and Gillard, 2015; Middlemiss, 2017). This is particularly important as vulnerability to fuel poverty depends not just on the fabric of the home, but also on social relationships (such as those between tenants and landlords), health, and the prices charged for energy within energy markets. Action on fuel poverty can thus become disconnected from action to tackle wider drivers of fuel poverty, including poverty more broadly. Family policy, health policy and housing policy can all have a significant impact on vulnerability to fuel poverty (Middlemiss and Gillard 2015). Yet existing research has highlighted how insufficient attention has been paid to the impact of non-energy policy (e.g. health, welfare, transport) on energy and fuel poverty (Butler et al, 2018; Cox et al., 2019). For example, health advice on keeping infants warm in winter could lead to increased heating demand (Cox et al., 2019), which relates to a wider association between heating and care (Shirani et al., 2017) as we discuss below.

1.2 Energy Vulnerability

Despite widespread usage of the term fuel poverty, criticisms have been levelled that such terminology produces a binary where households are either in fuel poverty or out of it, which does not acknowledge the dynamic nature of lived experience (Bouzarovski et al., 2014; Longhurst and Hargreaves, 2019). Instead, the concept of energy vulnerability – ‘*defined, simply, as the propensity of an individual to become incapable of securing a materially and socially needed level of energy service in the home*’ (Bouzarovski et al., 2014:10) – goes some way to encapsulating this more dynamic experience as it encompasses a broad range of conditions that may contribute to a household experiencing fuel poverty. This indicates a conceptual shift in the mainstream theorization of domestic energy deprivation, away from a narrow focus on poverty, access and energy efficiency, onto more complex and nuanced issues of household needs, built environment flexibility and social resilience (Bouzarovski, 2014:11, see also Middlemiss and Gillard, 2015; Bouzarovski et al., 2014 for further discussion of resilience and Béné et al., 2014 on challenges with the concept of resilience in relation to poverty). An energy vulnerability approach acknowledges that households may move into and out of fuel poverty after changes in housing, social, political or economic circumstances (Bouzarovski et al., 2018). Energy vulnerability may thus be a condition that is dependent on the material fabric of housing, but also on lifecycle events (both planned and unanticipated); on housing tenure and on wider poverty and deprivation.

Definitions of vulnerability are often associated with demographic characteristics; for example, households where consumers are elderly, low income or living with long-term illness/disability (Citizens Advice, 2017; Jenkins et al., 2011). However definitions based on such fixed demographic categories are critiqued by Bouzarovski and Petrova (2015), who

argue that such an approach neglects the role of housing and socio-technical factors, while potentially including households who may not have difficulties with energy costs. Instead, Bouzarovski and Petrova (2015) identify a typology of energy vulnerability factors, which includes; access, affordability, flexibility, energy efficiency, needs and practices, in order to provide a more comprehensive picture of energy vulnerability that moves away from socio-demographic definitions. A more nuanced understanding of energy vulnerability recognises an association with lifecycle stage and related expectations of care needs and energy requirements (Longhurst and Hargreaves, 2019). This shows some alignment with previous work that has highlighted the importance of considering social relations within the home. In particular, the role of energy in expressing care for others (Longhurst and Hargreaves, 2019) and, relatedly, norms that exist around hospitality and being a good host (Hitchings and Day, 2011). Expectations around care also relate to associations between health, wellbeing and warmth (Chard and Walker, 2016). Such associations may give rise to a ‘bottom line’ of energy need, which has often focussed on prioritising the needs of children (Jenkins et al., 2011; Anderson et al., 2012; Snell et al., 2018). In this paper we foreground the relevance of these relationships to others and expectations of what caring for others involves, for understanding energy vulnerability. This follows calls for research concerning energy and environment to recognise the significance of family relationships (Burningham, 2017).

1.3 Local place relationships

In our own efforts to explore the lived experiences of energy vulnerability, we highlight the significance of understanding local place relationships, particularly where these histories have strong associations with energy. These concerns are made visible by Sarah Darby (2017), in analysis of data she collected in 2000-1 in a deprived ex-mining area of Scotland. Darby describes how the transition from belonging to a fuel-producing community to being a

solitary consumer of fuel and electricity from distant sources and in an uneasy relationship with a distant utility was one that many people in the area had experienced. Darby (2017:126) argues that geography matters to energy policy; *'gas and electricity may be the same in any place, but they are not bought, used and understood in the same way in any place; housing, climate, demographics and social networks, all place-specific are important in influencing how energy is captured and used.'* Other work has also called for an approach to understanding fuel poverty that recognises the important contribution of place to creating vulnerabilities (Robinson et al., 2018) and the new care-full relationships that may emerge in austere financial conditions (Hall, 2018). The importance of addressing local context for the experience of energy vulnerability is highlighted by Simcock et al., (2018: 253) in their contention that energy poverty is a geographically constituted phenomenon; *'the fact that the causes of energy poverty are spatially embedded and contingent suggests that policies to alleviate the condition would do well to be attuned and tailored to the particular context in which they are being implemented.'* The strength of an energy vulnerability approach, as Bouzarovski and Petrova (2015) argue, is that it allows for a more explicit focus on the geographic aspects of domestic energy deprivation, as dimensions such as energy access, flexibility, efficiency and needs are unevenly distributed across space. Golubchikov and O'Sullivan (2020) use the concept of 'energy periphery' to describe the place-bound disadvantages of a number of marginalised Welsh communities that articulate with a vulnerable position in the energy system. They highlight concerns that low-carbon energy transition may further articulate inequalities inherited from pre-existing (carbon) systems, with uneven experience of energy innovation. With these issues in mind, it is an attentiveness to local place relationships that we seek to take forward in this analysis.

Following calls for qualitative work in this area outlined at the beginning of this introduction, we argue that a qualitative *longitudinal* approach has a particular contribution to make, given its dynamic methodological focus on change (Thomson, 2007). Such an approach may help to elucidate the conditions under which people move into and out of fuel poverty as well as how vulnerability is shaped by life situation (Middlemiss and Gillard, 2015) and local place relationships. It is also well-placed to integrate temporal dynamics with understandings of energy services (Bouzarovski and Petrova, 2015). In this paper we explore accounts of energy vulnerability amongst participants from a low-income community with a changing historical relationship to energy production and use. In particular, we consider how local relationships and informal provision of support may offer some way of navigating energy vulnerability.

2. Method and sample

Participants live in Caerau, an ex-mining community in the South Wales valleys that ranks fifth overall in the Welsh Index of Multiple Deprivation, and as the most deprived community in Wales on health measures (WIMD, 2019). Caerau has been described as an area of deep-rooted deprivation, with high rates of unemployment and income deprivation (WIMD, 2019). Work is currently being undertaken in Caerau to explore the potential for a geothermal community district heating scheme, which will use heat taken from water that collects in disused mine workings to provide heat to local homes (Brabham et al., 2019). Construction is due to begin in 2021, with the first homes connecting in 2022. Connecting households would move to an all-electric system, replacing their current gas boilers with heat exchangers. The scheme will be managed by the local council and will not involve any

upfront costs for residents to connect. The extent of savings that residents could make on their fuel bills if connected to this scheme is currently unclear.

Participants were recruited to our research study through leaflets delivered to all households in the area eligible to connect to the mine water system, contacts made at information events about the planned mine water scheme, social media advertisements and introductions through local gatekeepers. Those who participated were offered £30 as a thank you in recognition of the time they had taken to contribute to the research. Participants were given written information about the study at initial contact and this information was reiterated verbally prior to interviews, where participants had the opportunity to ask questions about the project prior to signing a consent form indicating willingness to take part. Informed consent was sought at each round of interviews, following the model of process consenting advocated in qualitative longitudinal research (Neale, 2019). Participants were asked about their views on the proposed mine water scheme as part of broader qualitative longitudinal interviews concerning energy and everyday life, including past lifecourse transitions and experiences, to explore how relationships to energy change over time. Interviews were conducted as part of the social science element of the interdisciplinary FLEXIS project; a large research operation exploring energy system developments in Wales. Across the first round of interviews, discussions of the affordability of energy were prominent and as such, more focus was given to issues of affordability in later waves of interviews. A small number of second round interviews were conducted as part of the Better Energy Futures project, which sought to explore experiences of fuel poverty and energy vulnerability (Groves et al., 2019). The project was granted ethical approval in 2016 by the Cardiff University School of Social Sciences ethics committee.

During 2017, 18 interviews were conducted involving 24 participants aged between their early 20s and late 70sⁱ. Twenty two participants were interviewed again in 2018 and 19 in 2019 after 12-month intervals. A fourth wave of interviews in 2020 is in progress. 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, eleven unemployedⁱⁱ and five in employment (a mixture of full-time, part-time and self-employed). Economic inactivity was associated with participants spending a lot of time in their homes, which increased opportunities for energy consumption. Nineteen of the participants in our sample could be described as living in vulnerable households at the time of the first interview, in that there were household members who were elderly, long term sick or disabled, and/or young children. However, above we have outlined problems with such broad criteria, which do not capture the subjective experience of vulnerability (or indeed lack of) described by participants. Although the construct of poverty is useful in describing the interaction between low incomes and cold homes, it is not necessarily meaningful to ordinary householders, whose everyday experience is of the specific problems of lack of money and loss of thermal comfort (Anderson et al., 2012), or decisions about whether to ‘heat or eat’ (Snell et al., 2018). Participants were asked about fuel poverty (explicitly using this term) and energy vulnerability (largely through broader discussion of energy affordability, although participants were also asked about how they related to the term ‘vulnerable consumer’) both in their own lives and in the community more widely. Whilst many people indicated that they had low incomes and fuel bills were a concern, few explicitly defined themselves as being vulnerable or in fuel poverty. This highlights the relevance of arguments for a broader understanding of energy vulnerability that focuses on lived experiences, as we seek to put forward in this paper, rather than reliance on specific criteria that aim to measure vulnerability.

Qualitative longitudinal analysis can be undertaken in multiple ways; synchronically across a single wave of interviews, diachronically following cases over time, or an articulation of the two (Neale, 2019). In this paper, we adopt a combined approach, presenting illustrative extracts from across the sample regarding experiences of vulnerability in the community, and individual case studies illustrating change over time. Data were coded thematically using Nvivo software to identify the breadth of issues across the sample, then information-rich cases were selected for longitudinal case analysis.

3. Data Analysis

3.1 Memories of energy sharing

In seeking to understand the situation in Caerau and the experiences of those living there, it is important to contextualise current circumstances in relation to the area's history of fuel production and related employment. Many of our participants had relatives who had worked in the collieries, and some had worked there themselves, which contributed to an ongoing association of the community with mining, particularly amongst the older generation. In this way, the energy system could be seen as fundamentally constitutive of a sense of place (Rohse et al., 2019). The current community situation of unemployment and struggles to meet high fuel costs was on several occasions compared unfavourably with recollections of reliable employment and fuel abundance in previous generations. Those who worked in the mines had been entitled to a coal allowance, with some participants describing how coal could be sold back to the National Coal Board (NCB) in exchange for other heating sources. This largely meant that despite other financial concerns, households with a collier did not have to worry or think about the costs of keeping warm, as Anne describesⁱⁱⁱ;

They had coal yes, because the first lot of central heating we had I think we had to pay about £20 because the NCB paid for the rest of it, they paid for the radiators and everything and the installation ... But we never ran out of coal but as I said that was the main fuel then was the coal and we had to pay for electric I suppose but the coal was free and you'd just chuck it on and forget about it didn't you? (Anne, 70s, I1)

Whilst some participants felt they had inherited an ethic of frugality from their parents, who lived on low incomes, their parents' concerns generally did not extend to energy, given the described abundance of coal. Several participants indicated that surplus coal had often been available to those who were struggling, meaning that even those households without a direct connection to the mines were able to have fuel.

My parents were poor, my father was invalided out of the colliery and when my brothers left home we didn't have free coal so my mother used to have coal from the other neighbours (Cheryl, 70s, I1)

These memories of coal as an abundant resource that was easily shared contributed to a sense that energy vulnerability was a relatively new experience particular to the current generation of Caerau residents. This contemporary experience was distinguished by the older generation from their own experience of poverty more widely, described in terms of growing up when 'everyone was poor'. The ability to share energy in the way residents had once shared coal was no longer seen as feasible, with the move to imported fuels that were part of supply chains with which end-users had little direct relationship. A rescaling of economic

relationships away from the locality and the mines was therefore related to an attendant loosening of social ties. Despite this, local social networks continued to be important for many (Darby, 2017) with some people in the sample describing how they had helped, or offered to help, others in the community who were struggling with energy costs. Such informal borrowing appeared more commonplace than commercial borrowing, which was not discussed except as something that people wanted to avoid (Anderson et al., 2012).

[s]omebody knocked the door, an acquaintance, and said ‘Len, I haven’t got enough money for the meter’ and then I just said ‘ah here you are’ like that.

(Len, 70s, I1)

[next door neighbour] was saying that she hadn’t been down to buy the meter, since she’s run out of gas. So I said, well, if you want to borrow some money or something? ... I said, well, you can use my gas stove if it’s any good to you.

(Alec, 60s, I1)

People look out for each other, help each other. I mean, we’ve always been the same up here, haven’t we, really? We don’t waste anything; if there’s food left over, neighbours have it. And neighbours do the same for us ... We won’t see anybody go without, if we can help it. You know food or heating, we try and help out each other. (Terry, 60s, I2)

The accounts of these three men who had lived in the community when the collieries were operational illustrate how people still attempted to help one another though offers of money, energy and food, although sharing heating was no longer as straightforward as providing a

neighbour with surplus coal. Some people also spoke of energy sharing within families, such as visiting family members living locally to save on heating:

JOAN: My daughter's house is always freezing cold, so she usually comes down here, her and her two [children].

DOUG: For a warm-up. [Laughs]

JOAN: And says, "Oh, it's lovely in here." (50s, I2)

I mean, they're out all day, they can't afford to run their heating, put their central heating on. I know quite a few people, they're out all day, they go visiting or they go to a friend's house. (Terry, 60s I2)

However, being able to do this relied on a level of physical mobility and subsequently was not a strategy that all could adopt.

By the time of the second-round interviews in early 2018, a recent experience of energy scarcity in terms of water shortages due to burst pipes in freezing weather had given rise to a sense of solidarity across the community. Some of our older participants described how neighbours had brought them bottled water or helped to clear snow from the front of houses, often unprompted, whilst younger participants described checking on older neighbours. Participants thus affirmed a shared sense of a community that looked out for one another, even amongst those who did not feel particularly integrated. Often, people explicitly associated this neighbourliness with what they felt it meant to be a Welsh Valleys community, with looking out for one another seen as necessary in the context of what was perceived as neglect from official sources.

“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.” (Amanda, 30s, I2)

Particular characteristics of the community location were seen to exacerbate energy vulnerability, exemplifying structural disadvantages seen to arise from living in a peripheral place (Golubchikov and O’Sullivan, 2020). For example, Caerau was described by participants as significantly colder than the nearest large town, while the fabric and position of housing in exposed areas was seen as increasing susceptibility to cold. Beyond heating, some described other aspects of energy services, such as poor internet connection and expensive, intermittent public transport as leading to a sense of isolation:

I think the problem with living in a place like this is that you do feel quite disconnected. Um, you know like when the mist comes down, it’s like you could be living on the moon. (Jenna, 30s, I2)

Whilst some may have a sense of the community as isolated, relationships within were significant. Experiences of energy vulnerability within the community were frequently articulated through interactions with others, as Jay described how ‘*people struggle round here*’ (20s, I1). Often it was difficult to disentangle this from wider experiences of poverty, as Cheryl referred to people being ‘*poor in a lot of ways*’ (70s, I2), with widespread use of prepayment meters and the demand for local foodbanks being seen as indicators of poverty. One participant who volunteered at the foodbank described how they sometimes helped attendees put money on their fuel meters, although this was not an official aspect of the

foodbank remit. These efforts to provide support highlight some of the new relationships that may emerge in the face of austerity (see Hall, 2018 for discussion).

3.2 A longitudinal lens on energy vulnerability

By looking at the experiences of two participants, Jessica and Stacey, it is possible to elucidate how lifecourse changes have moved them towards positions of energy vulnerability, which is made visible through our qualitative longitudinal approach. Jessica is in her 20s and her household includes young children – one of whom has a health condition – while both adults are unemployed due to ill-health and caring responsibilities. During her interviews Jessica contrasts her current circumstances with her previous experiences of employment prior to having children, when she would help out other members of her family financially. In her account Jessica refers to the expectation that providing a warm home is an important part of good parenting, indicating that restricting the central heating and layering up as she and her partner had done before becoming parents was no longer possible.

We've got four children, so when it was just me and husband to start with it was like just getting a jumper on when we couldn't afford it, but when you've got children it's my priority. As a parent you keep them warm and safe don't you? (I2)

The challenge of being able to keep the house sufficiently warm within their financial budget was magnified by increased heating needs associated with managing their child's health condition. Despite a cold weather payment from her energy provider, Jessica described it as a 'constant battle' to keep their home sufficiently warm so that their child was comfortable.

This meant that a period of extreme weather, such as the bouts of snow in early 2018, presented additional stresses due to increased bills. As another participant, Jenna (30s, I1) described; *'it's all well and good you working out that on an average week you spend this much money on gas, and this much money on electric. But all you need is for it to, to have a sudden bitter, freezing snap and then all your maths is out'*. This highlights the lack of flexibility (Bouzarovski et al., 2014), or elasticity that vulnerable consumers have for making changes to expenditure (Snell et al., 2018).

Although her situation was challenging, like many others in our sample, Jessica was reluctant to describe herself as vulnerable because she could describe ways of 'managing'; a term she used frequently (see Groves et al., 2020 for an expanded discussion of participant budgeting). Again, she emphasises the way the children are prioritised:

I wouldn't see myself as vulnerable if I'm honest, because we manage. As a parent you obviously do the best for your children, so we are a family with a very low income so I know it does put us in a vulnerable way in that type of aspect because you do get people that bring home a wage from work. Myself, personally I don't see myself as vulnerable, but to others I would be. (I2)

However, by the third interview she more clearly articulated difficult circumstances and the challenges of negotiating these with limited resources. At this point, one of the ways Jessica's household managed was through use of the local food donation scheme, which operates as an informal foodbank:

[I]ike recently we've had to go without, for example, one food shop, 'cause we do a fortnightly shop. And we didn't have enough, we had too much going out, compared to what was coming in. So we had to pay the bills and we came here and had a food voucher. You know so we manage, you know what I mean, don't get me wrong. But there has been one or two times where you have to buckle, you know really buckle up. (I3)

Whilst her circumstances have changed, resulting in greater challenges related to energy affordability, the term vulnerability does not appear meaningful to Jessica as a way of describing her situation. One reason that many of our participants did not see themselves as vulnerable, despite challenging circumstances, may be that they were able to identify someone who was worse off. Despite the 'constant battle' to manage her own household's energy costs, Jessica described how she would help others with theirs when she was able to.

I've had a friend who was in desperate need maybe for a bit of gas, so we've helped them out by funding a little towards her gas, but I suppose that's what friends do, help each other out ... If you know you're going to be okay for the week and you've got that spare £5 that they could benefit from, we're the type of people that would help ... if you've got somebody there to help you, you help others on the way up and they help you on the way down. (20s, I2)

Jessica's use of the terms 'way up' and 'way down' highlights a dynamic sense of energy vulnerability, indicating that it is a situation people may move into and out of as their life circumstances change. Again, the offer of assistance she describes holds with the identity of living in a Welsh Valleys community where people look out for one another. Beyond these

individual relationships, participants spoke of other local support; for example, annual fundraising efforts organised by a community organisation to provide Christmas presents for local families who could not otherwise afford them, or support through the school for parents who were struggling to cope financially. These relationships were crucial in offering some level of support to local people in a position of energy vulnerability. Jessica's responses across the course of our research, as well as broader reflections across her lifecourse, show changes in her relationship to vulnerability. This occurs both in response to significant life events (such as becoming a parent) and more mundane events (such as a bout of bad weather).

The experience of Stacey shows some similarities to Jessica's account. A single parent who had moved between work and unemployment across the course of our research project, Stacey highlighted the importance of meeting her son's needs, which required a higher level of energy use than when she had lived alone.

You've got to have more, got to find that extra bit for that gas because you've got to keep that gas on, 'cause 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? (30s, I1)

In initial interviews, Stacey spoke about fuel poverty in abstract terms, suggesting it was likely to be a problem older people faced. Stacey did not take part in the second wave of interviews as this happened to coincide with a difficult period in her life when she was out of work, struggling financially and experiencing related mental-health difficulties. She re-entered the research for the third interview, by which time she was working and in a more

comfortable financial position. It appeared that having some distance enabled her to talk about her experiences when it may have been too challenging to do so at the time. This illustrates the benefits of taking a qualitative longitudinal approach to explore issues related to energy vulnerability, where participants may re-enter the study over time as their circumstances change.

Like Jessica, local food donation schemes had been an important way in which Stacey managed to cope in restricted financial circumstances. In the third interview she recounts some of her previous experiences when she had been unable to afford energy;

My priority is, there's food banks and stuff like that, so make sure you've got gas and electric, because there's always somewhere to get your food ... food is important, but then you can always buy food cheaply as well ... like you can shop cheaply and try to get more meals out of stuff, where gas and electric, you can't do that ... It's like, well shop wisely with your food and put gas and electric on. 'Cause I've learnt, I've been there where I've got no gas and no electric and I can't wash my child ... 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 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. So you've gotta prioritise stuff. (I3)

Stacey's vivid account of the challenges associated with lack of energy indicates food as an area of possible compromise for people in difficult financial situations, either through

reliance on food donation schemes, or being able to shop economically. In contrast, energy bills were seen as both essential for enabling the activities of everyday life, and inflexible, described by one participant, Terry (60s, I2) as a 'brick wall' that had to be got over before anything else could be done. This shows similarity to findings of Snell et al., (2018) whose participants appeared to view food as a more elastic commodity that could be adjusted more easily than fuel.

Several people in our sample anticipated being affected by the changes to benefit payments with the rollout of Universal Credit.^{iv} These were described as a 'nightmare' as people were left for weeks without money to pay their bills. One local volunteer described having seen an increase in people using the food bank across the time period of our research project, which was attributed partly to Universal Credit and delays between payments. This was a particularly problematic situation for those participants who had such constrained finances that their ability to 'put something by' was minimal or non-existent, which meant they had no financial resilience. For example, moving between different benefits following moves into and out of work, Stacey described how she had received the wrong payments and was then '*having charges*', which were difficult to repay and subsequently '*I've had threats of my housing being taken off me because the between of it*' (Stacey, 30s, I3). Even those who did have some savings could quickly move into a more precarious situation following an unexpected energy expense. For example, when Jenna's vehicle broke down at the same time as her cooker, she could not afford to replace both; '*if we'd bought a cooker we wouldn't be able to afford a car*' (I3). She had opted to replace the vehicle as being essential for life in a place that she described as '*disconnected*'. The car was particularly important in enabling Jenna and her partner to attend medical appointments related to ongoing health conditions and to remain in contact with friends and family living elsewhere. By the time of the third

interview, her household had been living without a fully functioning cooker for six months and ‘*just eating salad basically*’. Rather than seeing this as a particular hardship (although it was largely her partner who undertook meal preparation and who may have described things differently), Jenna described the benefits of this restriction in reducing her gas bill. This illustrates some of the challenges of exploring fuel poverty, as a problem of energy underconsumption, in the context of an overall climate of energy overconsumption, where the two issues are interconnected (Walker and Day, 2012). It is potentially problematic for underconsumption to be justified on environmental or financial grounds if it means people are consuming less than they need. These participant accounts illustrate the way non-energy policy areas (e.g. welfare, health and transport) impact on energy vulnerability (Butler et al, 2018; Cox et al., 2019) as experienced in the context of a peripheral community Golubchikov and O’Sullivan (2020).

3.3 Future relationships to energy

The mine water scheme represents an interesting proposition for local residents, in that the community would return to being associated with energy generation, potentially enabling a more direct connection between energy production and use. Whilst there was some enthusiasm for the scheme amongst local residents, this mode of energy generation did not afford the same kind of opportunities for energy sharing that previous generations had experienced. Ultimately, the most important concern for residents in light of the constrained financial circumstances of many in the area, was the ability of the scheme to provide affordable energy:

Everybody would love it if it was cheap enough. The cost to the environment is good, it’s better for us. We’re not burning fossil fuels. We’re not, to keep your

house warm, we're using something that we have heritage in, it's providing but at what cost? That will be the bottom line for everybody. (Terry, 60s, I2)

Whilst addressing fuel poverty is an aim of the scheme developers, at this stage of the development it remains unclear to what extent, if at all, households would see a reduction in their energy bills. However, addressing energy costs is crucial to many local residents; as Bouzarovski and Petrova (2015) note, the affordability of energy is a key underpinning of energy vulnerability. As Terry indicates, there are numerous apparent benefits of the scheme but some of these – such as the transition away from fossil fuels – may be perceived as more remote, or longer-term issues. In the context of constrained financial circumstances that often resulted in people living 'day to day' or 'week to week', these perceived longer-term issues tended to be seen as less of a priority.

Some elements of the scheme were also cause for concern amongst local residents given perceptions that it could increase rather than reduce energy vulnerability. For example, households would replace gas boilers with electric heat pumps, meaning there was no longer a need for a gas supply to the property. However, several participants raised concerns about the potential precariousness of relying solely on one fuel source if anything were to happen to this supply;

I think that's the other good thing about gas and electricity is if you're without one you've got the other you know so you can always, you know if the gas went off for whatever reason you know for a week because of the mains we've got an electric heater you know. So I think it's that bit of standby as well. (Doug, 50s, I1)

Here Doug implies that his household has some level of protection by having ‘standby’ alternative energy sources in case of interruption to supply. Beyond individual households, having a range of energy sources across the community was seen as beneficial in enabling people to help one another when energy is restricted. Angela describes this in discussion of a power cut, again highlighting the importance of energy use in relation to caring for children;

Yeah, and then everybody tends to rally around, you know, if you’ve got little ones and you need hot water, obviously you’ve got no electric, somebody else has got a gas cooker, you boil a saucepan on the gas cooker then to help out. And I think that’s why a lot of people are going back to coal, log burners as well. So at least you’ve got some sort of heating. (Angela, 50s, I3)

Although the scheme developers are planning to have a back-up system in order to minimise any problems with supply, as this is due to be located at community rather than individual household level, it was not sufficient to assuage some participants’ concerns about potential vulnerability. As the scheme is at a relatively early stage of development, there is scope for these issues to be addressed. By making these concerns visible to scheme developers, our research highlights the importance of developments being mindful to local concerns and strategies for managing energy vulnerability, particularly these interpersonal connections. Beyond the specific example of the mine water scheme, we suggest an attentiveness to place context is an important principle for other energy system developments, particularly addressing the place-bound disadvantages associated with life on the energy periphery Golubchikov and O’Sullivan (2020).

4. Conclusions

In this analysis we have outlined a number of issues of concern in relation to energy vulnerability. Particularities of place (in terms of geographical position and historical patterns of infrastructure deployment) gave rise to certain challenges for Caerau residents. As Darby (2017) argues, geography matters to energy policy. Rising energy costs were exacerbated by lack of work in the area, whilst living in a 'disconnected' place presented additional energy needs in relation to transport and connection to others. Despite these place-related challenges, close relationship and identity connections were apparent, associated with historical identity as a mining community where people look after one another, which continues to be upheld as part of life in the Welsh Valleys. These ties were evident in discussions of offers to share resources, such as money, fuel and food. It appears that these links were important in providing a way to navigate energy vulnerability, offering informal support where people may be unable or unwilling to access more formal mechanisms. Beyond these interpersonal relationships, local organisations and their efforts to provide food and other assistance to people in need were seen as increasingly important and were a fundamental part of how some described managing their circumstances. Such ties seemed to be a crucial aspect of why most participants would be unwilling to consider moving away from the area, and may be an important contributor to a sense of coping in adverse circumstances. However, such informal support mechanisms should not be seen as a substitute for more formal measures to address energy vulnerability.

Despite most participants discussing having a low or restricted income, only a minority were prepared to explicitly identify as vulnerable consumers. Yet interviewees' self-representations may mask the impact of the energy challenges they report (Groves et al.,

2020). Being able to save, pay for essential energy services and offer help to others if it were needed were all seen as reasons not to identify as vulnerable. However, whilst some participants did not identify as vulnerable because they could articulate ways of coping or ‘managing’, the practices they described – such as reliance on food banks or donation schemes – could be regarded as extreme (Snell et al., 2018). Some participants may also be unwilling to identify as vulnerable if they know others in worse situations. However, the dangers of this kind of relative understanding of vulnerability is that it masks some challenging experiences if they are not the worst in evidence. Alternatively, being unwilling to identify as vulnerable may indicate problems with existing definitions of vulnerability, which bear little relationship to people’s subjective understanding of their situations. This illustrates the difficulty of trying to define vulnerability according to fixed criteria, which has implications for policy aimed at addressing fuel poverty. Instead, our analysis has highlighted the benefits of an approach that foregrounds lived experiences where more nuanced accounts of managing issues of energy affordability come to the fore (see also Shirani et al., 2020).

In the interviews presented here we have illustrated the impact on energy use associated with being a parent, with a largely unquestioned expectation that young children require warm environments, meaning parents make sacrifices in terms of their own comfort to provide this. For participants who had struggled with energy costs, emphasising the ways in which they had sought to prioritise their children’s needs was particularly important. Beyond heating, high electricity costs were also often associated with young children, particularly when there was little money for entertainment outside of the home, or there were safety concerns about children playing outside. These increased energy demands were not just restricted to households where children were permanent residents. For example, several participants spoke of increasing their heating when grandchildren came to visit, despite usually restricting their

heating use because of concerns about affordability. Aside from looking after children, higher heating costs were associated with managing health conditions, with hospitality and ensuring visitors were comfortable, although were not universally adopted. Exploring these connections between people is important in eliciting a comprehensive picture of everyday energy use and vulnerabilities. It also gives further weight to arguments for considering how family, health and housing policies may impact on energy vulnerability (Middlemiss and Gillard, 2015).

The proposed geothermal mine water heating scheme has the potential to return this community to an area of energy production, utilising a currently idle resource that is strongly associated with the community's heritage. Despite the element of connection that comes from being a district heating scheme, there is little sense that this development would impact on the informal connections and support that are viewed as important in the community. In contrast to the memories of resource sharing enabled by an energy system reliant on coal, the mine water scheme appeared to offer little opportunity for this kind of cooperation between local residents, which was felt to provide some level of resilience to energy vulnerability. Indeed, discussion of the planned scheme illuminated concerns that the development would increase vulnerability through reliance on a single fuel source. These insights suggest the importance of developments taking account of local experiences and strategies for coping with energy vulnerability. Whilst the scheme has many elements that are viewed as laudable and appeal to local residents, the need to address currently pressing issues around the affordability of energy is paramount and likely to be the primary consideration for many in comparison with what were frequently viewed as longer-term concerns. We have also highlighted how the perceived inflexibility of energy costs are experienced as particularly challenging for some participants, leading to compromises in other areas where spending is deemed more elastic,

such as food. Addressing issues of affordability is therefore pressing, but likely to be a relevant issue for the longer-term as well, as our participants anticipated that future generations living in the community were also likely to have limited incomes.

In this paper we have made efforts to address the identified gap in the literature relating to qualitative data on the lived experience of energy vulnerability, arguing for a broader understanding of how people manage issues of energy affordability within a local place context. By highlighting some of the developments in participants' experiences over time, we argue that our qualitative longitudinal perspective has enabled cumulative insights and changes to emerge, providing a more detailed picture than a one-off research encounter could facilitate. In addition, the temporal focus of qualitative longitudinal research has enabled us to explore the significance of past memories of energy sharing, alongside future expectations and concerns related to energy vulnerability. Whilst the sample is relatively small, the level of detailed insights afforded by a qualitative longitudinal approach has particular value in elucidating dynamic experiences of energy vulnerability. Subsequently we argue for the value of further qualitative longitudinal work in this vein.

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ⁱ The majority of interviews involved a single participant but some opted to participate as a couple, or partners participated for some of the interview

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

ⁱⁱⁱ Pseudonyms are used throughout the paper

^{iv} A consolidated benefit payment, which has been controversial partly due to significant delays in payments