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FLEXIS Work Package 17: Social Acceptability and Responsible Development of Energy Systems

Mine water heating in Caerau: Thoughts from
local residents

2020 Report

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Work Stream 2: System Change and Everyday Life.

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1. Summary

The report covers insights from the first four years of ongoing social science research undertaken in Caerau to explore resident views of a planned geothermal district heating scheme. Caerau is a Welsh Valleys community that ranks fifth overall in the Welsh Index of Multiple Deprivation, and as the most deprived community in Wales on health measures. Our research adopts a qualitative longitudinal design where the same participants are interviewed on multiple occasions, providing an opportunity to explore change over time. A small number of participants are interviewed annually, with interview conversation incorporating their views on the latest developments of the scheme, in the context of a broader discussion around energy use, including pressing concerns such as affordability. The report is not intended to represent the views of all Caerau residents but to give insight into some of the main issues that participants raised in relation to the scheme, which are likely to be of relevance to the wider community. This project is one stream of the social science research that is being undertaken as part of the interdisciplinary FLEXIS programme.

Main findings:

1. Financial concerns are pressing in Caerau, with many of our participants expressing concern about increasing energy bills and recounting experiences of being unable to afford adequate energy. Subsequently, residents felt that a low carbon heating scheme would need to result in a reduction of household energy costs to convince people to switch. What is considered to be a sufficient saving on energy expenditure varied between households and according to how much disruption would be experienced.
2. Bundling repairs and maintenance costs into payment rates was considered appealing by some owner-occupiers as a means of simplifying expenditure. However this will not necessarily benefit those in rented properties, given landlords usually bear these costs, which gives tenants little incentive to sign up.

3. A proposed modular rollout of the scheme on a geographical basis is seen as logical, however most participants would be reluctant to be within the initial phase due to concerns about the likelihood of encountering teething problems. The potential inclusion of a number of social housing tenants (who could be signed up by a single landlord) raised concerns about the ethics of these households being 'guinea pigs' for the scheme. Many of these concerns were based on assumptions that there were likely to be problems with the initial rollout. If these did not materialise and the scheme could clearly demonstrate benefits to householders then these concerns would be alleviated. However, this may then give rise to resentment that some households were able to benefit whilst others could not.
4. Regardless of views towards wind energy, participants often expressed dissatisfaction that they did not directly benefit from their proximity to local wind farms, while bearing the inconvenience of their close location. Subsequently it was seen as important that the heating scheme clearly demonstrate how local residents would benefit. The proposed private wire connection to the wind farm to supply power for the heating scheme could help to improve local perceptions of the wind farm as well as bolster the renewable energy credentials of the heating scheme.
5. Aside from concerns about affordability, participants were largely satisfied with the reliability and convenience of their current gas supply. They felt that renewable heating schemes would need to match this to convince people to switch. Some who remembered the unsuccessful district heating scheme at Wildmill, or who had experience of poorly executed energy efficiency schemes (such as external cladding) were wary of signing up to new heating schemes because of these negative experiences. Residents wanted clear information about how any repairs and maintenance to the system would be dealt with, given they would not know how to remedy any issues with unfamiliar technology.
6. The outdoor environment is important to Caerau residents, more so for some since the Covid-19 pandemic, and participants were concerned about potential disruption during construction and installation of new heating technologies.

However, disruption at community level was generally considered less problematic than at domestic level, particularly for older people, who felt the latter would be too much upheaval when they were unlikely to see longer-term benefits. Residents sought clarity about the extent of domestic disruption likely to be involved.

7. The concept of 'comfort as a service' was generally viewed positively by participants, who felt it would make their heating bills easier to understand. However, some were concerned that buying a set number of warm hours would be too restrictive and would want reassurances about potential flexibility. As many of our participants were unemployed or retired and spent a large proportion of time in the home, they were used to being able to adjust heating regularly and often did not see the appeal of a set routine, or of remote heating operation.
8. Beyond short-term advantages to the individual householder, residents were keen for the scheme to demonstrate benefits to future generations in a number of ways. The school was well-regarded and beyond energy saving through connection to the scheme, participants felt that children would benefit through learning about renewable energy. There was some positivity towards the idea of the school being a demonstrator, to inform both the immediate community and have an influence more widely as a pioneering project.
9. Relatedly, opportunities for education and training that could potentially be provided through the planned Heat Academy were regarded very positively. Participants frequently spoke about the lack of employment opportunities in the area as contributing to poverty and deprivation, therefore efforts to address this were perceived as addressing a particularly pressing need, often more so than changes to heating systems.
10. Residents depicted Caerau as a place that has 'things done to it', with interventions seen as imposed from outside rather than addressing pressing concerns within the community. Listening to resident views and relating any interventions to community needs could therefore help improve perceptions and take up.

Recommendations:

1. Pressing concerns about energy cost and affordability for many in the community means low carbon heating schemes will need to demonstrate financial benefits for residents. Information on how costs will be calculated, including transparency about the cost of transporting energy and plans for longer-term price rises should be provided. Details of procedures for system maintenance and whether residents can switch back to GCH should they find the low carbon heating problematic should also be provided as longer-term lock in could be off-putting.
2. Attention should be paid to the different requirements and experiences of people according to household tenure. For example, the inclusion of repairs and maintenance costs in energy bills may appeal to home owners but is unlikely to benefit renters. Different approaches to billing may be required to reflect varying circumstances and to avoid creating difficulties for landlord/tenant relationships.
3. Regular communications and updates about the scheme could help to reassure local residents that progress is still being made and could seek to address some resident queries. Changes to plans for the scheme and the rationale for phased rollout need to be clearly communicated to avoid causing division and resentment within the community, which could potentially lead to vandalism of new infrastructure. A range of approaches to communication are likely to be required e.g. letters to households, Facebook posts and inserts in community newsletters. Community organisations are well-regarded in Caerau and present opportunities for passing on information to the community more widely.
4. Whilst reducing energy costs is a primary concern, it is also important to show how low carbon heating developments are seeking to address what residents see as pressing concerns in the community. The planned Heat Academy and potential for local training and employment opportunities arising from this was viewed very positively by participants as it attended to identified local needs. In many ways this was seen as more important than making changes to decarbonise heating systems, given most people were satisfied with their current mode of heating and viewed decarbonisation as a longer-term issue, whilst the need for jobs was more urgent in the short-term.

2. Overview of the Planned Scheme

Bridgend County Borough Council (BCBC) is leading a scheme to investigate whether disused mine workings at Caerau colliery could be used as a heat source for local residents. The Llynfi Valley scheme in Caerau is one of two proposed district heating (hereafter DH) schemes being investigated by BCBC, the other focussing on Bridgend town centre. Water in the disused mine workings represents a potential geothermal energy source (Brabham et al., 2020). Heat will be extracted from the mine water and transported to residents' properties. In 2019 it was proposed that the scheme would adopt a semi-centralised model with five energy centres around Caerau, from which heat will be transported to individual properties, with a staggered rollout. Each home will be required to have a heat pump, replacing existing gas boilers. As the heat would be 'low grade', alterations to the existing housing stock in order to improve heat retention are likely to be required. Converting to the scheme would involve residents moving to an all-electric system, which may require changes to cooking appliances and supplementary heating sources (e.g. gas fires).

Test drilling took place in September 2017 lasting around four weeks. The main construction of the scheme is due to take place in 2021 with the first homes connecting to the scheme in 2022. As part of the scheme, smart energy management platforms are likely to be installed in residents' homes, although the features of this are still under development. Nordic Heat have been contracted to provide a detailed project delivery plan. In addition to technical work on the scheme, Nordic Heat are looking at ways to create wider benefits for the local community, for example, through a Heat Academy that will provide training and skills development in relation to sustainable heating technologies. The Energy Systems Catapult (ESC) have been undertaking feasibility work in Caerau in relation to the idea of 'comfort as a service' and are shortly due to commence a community trial. Proponents of the mine water scheme are investigating whether it is possible to utilise electricity from local windfarms to power the central heat pumps rather than a national grid connection, which would improve the renewable energy credentials of the scheme. Work in relation to the private wire connection to a local wind farm is currently being undertaken by Challoch Energy.

By late 2020, financial modelling indicated that a whole community mine water scheme was likely to be unviable. Instead, a number of smaller work packages to develop low carbon heating solutions for Caerau are in progress. These developments occurred after the 2020 interviews with participants and are therefore not covered in this report.

3. Portrait of Caerau

(Figures from Building Communities Trust Caerau Community Profile. Figures based on LSOA Lower Super Output Areas)

- Caerau has a population of around 4000, with a higher than average (amongst Bridgend communities) proportion of young people
- The area has 1850 homes, 67% of which are privately owned
- 40% of people have no access to a car (almost twice the Welsh average)
- 48% of children live in poverty (more than twice the Welsh average)
- The health of younger people is much worse than in Wales as whole with around 30% of people under 65 suffering from a long term illness (twice Welsh average)
- Half of people under 65 have no qualifications – twice the number for Wales as a whole
- Around half of all working age people are not in work or looking for work (the Welsh average is about a third)

Caerau ranks fifth overall in the Welsh Index of Multiple Deprivation, and as the most deprived community in Wales on health measures. Caerau has been described as an area of deep-rooted deprivation, with high rates of unemployment and income deprivation (WIMD, 2019).



Our participant Pamela gives an overview of Caerau:

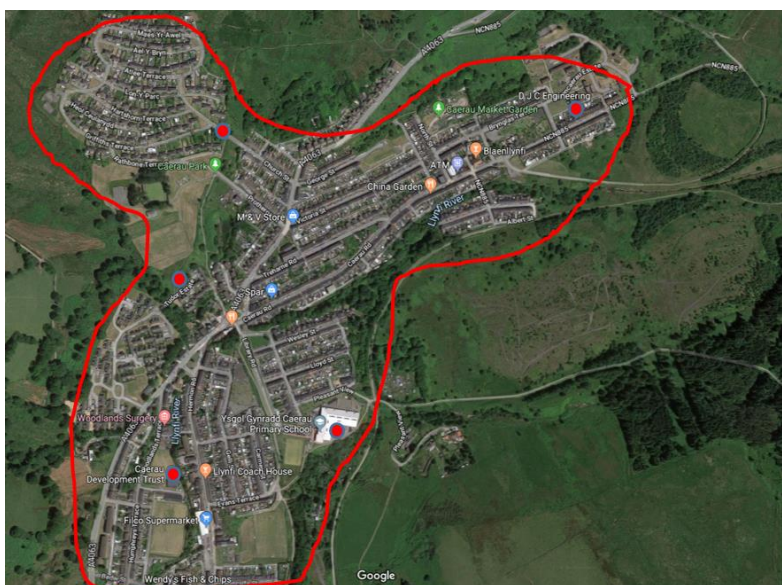
“Caerau itself is in the lowest ten percent of postcodes and in the lower groupings for wards and things for most of the deprivation, it comes sixth I think at the moment. ... But, all of Caerau which is six areas altogether plus Nanty[ffyllon] areas, are all within the worst 20% in Wales. That said, they don't score badly in terms of housing, they don't score badly in terms of environment ok because of the mountains around and because of a lot of work has been done on the housing stock, in particular the local authority or housing association owned housing, has been done up. But they do score very low on things like income, education in adults, things like car ownership is low, you know so people rely on public transport a lot as well. It scores quite poorly on things like health, in particular, numbers of adults with what might be called life affecting illnesses, not necessarily life-limiting but things like chest infections, asthma and that kind of thing they score fairly highly for, unfortunately, so they're having projects in that area in a couple of recent years to try to improve people's health. School wise, Caerau Primary is one of the biggest primary schools in Wales, it's almost 480 pupils I think this year, this term, over 50% on free school meals and it was over 50% I think on various other registers including needing special support in the classrooms and so on so it has got a high percentage of support staff in school as well. It attracts pupils in from outside the catchment area because its facilities are good and but that also means some problem families that you know have been taken in because of that but you know but that's a good thing really. There isn't an awful lot of industry, there are some small estates, particularly the one they call Spelter which is down in Nanty which is building supplies and rubber and various things like that. People travel out of here to work, they travel to Bridgend, a lot down to the industrial estates in Brackla and Bridgend, some to Cardiff and people tend to go away to university and not come back, they don't feel there is enough for them to come back to I think so we tend to be sort of top-heavy age wise, bottom-heavy age wise, but not a lot in the middle.”

Some local residents draw a distinction between Caerau itself and other areas of Caerau ward (such as Nantyffyllon). Only a section of the area will be eligible to connect to the mine water scheme in the initial phase of development. In first wave interviews, this was a fairly limited area of Caerau, as illustrated in figure 1. By interview 3, development of a semi-centralised model to be rolled out via a modular design widened the potential recruitment area, as shown in figure 2, with the school being earmarked as the likely first site for connection.

Figure 1 – map of proposed area for mine water project at interview 1



Figure 2 – map showing expanded area for mine water project at interview 3 – red dots indicate approximate proposed locations of energy centres



Caerau colliery (site of proposed mine water development) was in operation from 1889 to 1977. Workers were transferred to Coegnant (closed 1981) and St Johns/Cwm du (closed 1985). There were several local industrial estates employing residents but many of these also closed down, meaning that there are limited local employment opportunities. During the course of our research, the Bridgend Ford factory closed

(September 2020), which participants felt would have an impact on Caerau. There were plans for an Afan Valley adventure park nearby, which could provide job prospects. After some tentative local enthusiasm for the scheme, media stories emerged in 2019 concerning the financial dealings of the scheme's developer, which gave rise to scepticism amongst our participants about this coming to fruitionⁱ. This contributed to the sense that a lot of things were promised in the area that never materialised.

4. Methodological Note

The research described in this report was undertaken in Caerau as part of social science work on the FLEXIS projectⁱⁱ, in particular, our work stream 'System Change and Everyday Life'. This report outlines the issues that the Caerau residents we spoke to raised in relation to the proposed mine water heating development. Some of the first wave interviews were conducted prior to the test drilling, with the remainder during or just after the drilling process, and residents had varied understanding of the proposed scheme before the interview. Most participants lived within the test area, but some were outside (although for some this changed over the course of our research as a result of expanded recruitment areas discussed above, as well as some moving house). It was explained at the start of each interview that the researcher was not a technical expert and would only provide a basic explanation of the proposed scheme. Participants were offered the contact details of colleagues at Bridgend Council and the Cardiff University School of Engineering if they had any more technical queries. Participants were provided with written information about the project and what participating would involve, which was reiterated verbally, before they were asked for their consent to take part. This information is provided and consent is sought for each wave of interviews. The study was given ethical approval by the Cardiff University School of Social Sciences ethics committee in 2016 and is subject to annual monitoring.

A small number of second round interviews (10) were conducted as part of the Welsh Government funded 'Better Energy Futures' project, which was delivered in partnership with the Energy Systems Catapult. Following this project, we have

published two reports and the work has been featured in the Welsh Government smart living initiative annual review of progress and learnings^{iii iv}. Our work in Caerau is also referenced in the Energy Systems Catapult's report to BEIS on the Smart Systems and Heat phase 2 smart energy plan for Bridgend^v. The report highlights the importance of insights from our work being considered when taking forward heat decarbonisation activities in Bridgend.

Various efforts were made to recruit participants to our study, including;

- Exhibition/information sessions in three community venues
- Emails/letters sent to those who had attended the mine water exhibitions
- Leaflets through doors of all properties in the test area (in figure 1)
- Visits to local community organisations
- Facebook adverts shared by local organisations

In 2017, 18 interviews were conducted involving 24 participants aged between their early 20s and mid-70s^{vi}. Fourteen had lived in Caerau for their entire lives. The first ten interviews were conducted prior to the test drilling, whilst the following eight were conducted during or soon after. Several participants had a connection to the mines, either through having worked there themselves or having a family member who did so.

Demographic details of sample at interview 1:

20-29	30-39	40-49	50-59	60-69	70+
5	5	2	3	5	4

Male	Female	Employed/ self-employed	Retired	Unemployed
8	16	5	8	11

Live Alone	With partner	With children	With partner and children	With parents
4	13	2	4	1

Home owner	Private tenant	Social housing tenant	Other
14	5	4	2

Second interviews were conducted with 22 of the original participants approximately one year later. A third wave of interviews with 19 participants was undertaken in 2019 and 13 participated in a fourth wave of interviews in 2020^{vii}. We hope to return to participants again in 2021 and 2022. The aim of undertaking longitudinal interviews is to consider continuities and changes in participants' lived experiences in and through time. These in-depth interviews allow for exploration of deeper issues relating to identity and technical changes. Alongside exploring changes in views over time, the longitudinal design enabled us to consider how wider events had an impact on the community, for example; the Bridgend Ford factory closure, the February 2018 extreme cold weather that resulted in local disruption to water supplies, and the coronavirus pandemic and related lockdowns. In addition, many people experienced changes in their individual life circumstances, which had an impact on household energy use.

Over the course of our research...

- 7 participants experienced household composition change (e.g. moving in with partner, children leaving home)
- 5 participants moved house
- 10 participants lived in households where new boilers were installed
- 14 participants lived in households where a household member experienced chronic illness or accident (which had an impact on heating needs)

Given the small sample size, this report is not intended to be representative of all Caerau residents, but details a number of issues that were raised by our participants that are likely to be pertinent to other members of the wider community. The primary aim of this report is to elucidate residents' initial views of the mine water scheme, as one element of our work which seeks to consider the local implications and social acceptability of various aspects of energy system change. The report will be provided to stakeholders who are involved in developing the technical and public engagement aspects of the mine water scheme. Further analytical work will be undertaken for future academic publications. We currently have a number of papers under development and

three published journal articles based on data from this sample (Shirani et al., 2020, Groves et al., 2020, Shirani et al., 2021).

Initial interviews were broadly organised into three main sections:

1. Discussion of Caerau and residents' homes within it
2. Discussion of the planned mine water developments
3. Discussion of current everyday energy use, including how this may be different to previous generations/may change in the future

Second interviews also incorporated discussion of the mine water scheme, including a brief update as to what progress had been made in the intervening period. Similarly, third interviews involved an update on the scheme development and discussion of aspects of the scheme that were under consideration (such as the semi-centralised model of energy centres and location of thermal storage). Fourth interviews included further updates as well as discussion of the comfort as a service proposition and potential scheme co-benefits, such as the heat academy. In all interviews, discussion of the scheme was part of a broader conversation about energy use and life in the community.

In this report we set out seven themes that encompass the main topics of discussion in relation to the mine water scheme; money, community, security, landscape, practicalities, the longer-term and co-benefits. We also include a section to make explicit some of the continuities and changes in people's perceptions of the scheme across time. We use quotes from participants throughout to illustrate points, all names are pseudonyms with the exception of Fiona (the interviewer).^{viii}

An overarching aim of FLEXIS social science work is to make flexible integrated energy system proposals more responsive to societal concerns by embedding their development within a Responsible Research and Innovation (RRI) framework. We suggest that it is crucial to understand the views of local residents living in the vicinity of energy system developments in order to consider how such developments are regarded and what concerns may exist. This is a key issue for the mine water scheme, which relies on local households signing up for the scheme to be viable. Over the course of our research, participants have commented that Caerau is a place that has 'things done to it' that do not necessarily reflect the needs or views of local residents.

One couple used an example of discussions about a potential relocation of the children's park to illustrate the way they saw local authorities as making decisions without listening to the practical experience and local knowledge of residents. Despite local efforts to organise a protest in relation to the park relocation, Dawn was resigned that 'they've already made their minds up'.

DAWN	<i>"[w]e had a big meeting in Blaencaerau, because we're trying to fight for our park. We want to keep our park. But they think it's a waste of time and they want to take it over on that field over there ... But obviously there was a park down there years and years ago. And there was nothing but trouble down there, you know?"</i>
PAUL:	<i>They'd light the swings on fire. It was terrible.</i>
DAWN	<i>Whenever the kids came, it's out of the way so the kids could go and take their drugs or whatever they wanted over there you know? It's a bit stupid to me, but there we are. That's the common sense in them.</i>
FIONA:	<i>It doesn't really make sense as a good place to put it?</i>
DAWN	<i>Not at all. Because with this park here all the kids use it in any case. You know we wouldn't have kids drinking or kids vandalising the park because we live right opposite it. And all the babies use that park around here. You know, and their mothers be safe that they can go in there because it's right outside their doorsteps. So it is a bit bad.</i>
FIONA:	<i>So are you still waiting to hear what's going to happen about that?</i>
DAWN	<i>They're still fighting it, they are. They've put a committee on it now but they're still fighting that. I think they've already made their minds up, to be honest, but there we are." (40s, 14)</i>

In contrast, by listening to the opinions of local residents and feeding these insights back to stakeholders, participants saw our research as having an important role in ensuring that resident voices were being heard and concerns were recognised.

"Yeah. It's nice to have our input. And it's nice to hear that obviously you always feel as being listened to, because some things you can have an input in and it doesn't mean nothing. But it's nice to know that the scheme is listening and wanting people's opinions, and wanting to know how we feel, what we think. Because it's not all the time you get to have a say, is it? ... You know, it's nice to know that, you know, thoughts are being taken into consideration."
(Jessica, 30s, 14)

In the following section we briefly highlight some of the issues that participants identified as particularly pressing in Caerau, before moving on to detailed discussion of various aspects of the mine water scheme.

5. Important issues for local residents

Nineteen of the participants in our sample could be described as living in vulnerable households at the time of the first interview, based on demographic measures of vulnerability, in that there were household members who were elderly, long term sick or disabled, and/or young children. Whilst such demographic definitions are potentially problematic as they encompass households that may not experience any specific difficulties with energy and do not capture the experience of dealing with energy-related difficulties, they provided a useful starting point for discussing vulnerability in our interviews. In our initial interviews, issues of energy affordability were prominent and therefore more emphasis was given to this in later waves of interviews. 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. However, several participants described instances of being unable to pay for energy, or having to rely on local foodbanks and donation schemes, suggesting affordability is a pressing concern. For example, Stacey describes her own experience of being unable to afford her energy bills:

“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.”
(Stacey, 30s, I3)

Even those who were relatively secure financially thought that fuel poverty was likely to be an issue locally and therefore felt it was important that the scheme made efforts to address this by reducing energy costs.

Financial concerns were related to a lack of local employment opportunities. Older participants contrasted past memories of a thriving community with current experiences of job scarcity and lack of local resources:

"You used to be able to finish work on Friday and go and get a new job on Saturday but that doesn't work anymore, does it? I feel really sorry for these kids that are coming up because they've got no jobs, they've got no future and they've got no way to buy a house. I feel really sorry for them, I do. But as I said, it's no wonder they get into trouble. I don't condone what they're doing but I can understand it, feel frustrated, they've got no money, they've got no jobs, they've got nothing for them, have they ... But when I was young we had two cinemas in Caerau and we had the library at the top of the hill and up by Newtown and we had dancing there twice a week, on a Saturday and on a Wednesday, and then you could go to Nanty to dance, you could go to Maesteg town hall and dance, you know there was plenty going on. And there were three cinemas in Maesteg, so you could go anywhere you liked... now there's nothing, nothing at all for them."
(Anne, 80s, 14)

With lack of local employment opportunities, participants often described car ownership as necessary for enabling Caerau residents to commute to work further afield. This was compounded by what was perceived as expensive and unreliable public transport (which became more restricted following the Covid-19 pandemic and lockdown). However, car ownership was beyond the means of some of our participants. The creation of local employment opportunities was therefore seen as important for improving life in the community by all our participants.

"Wealth spreads. Once they've got work, it, it would have revitalised this part of the valley, which needs it badly ... it needs work. Manufacturing work. There's a lot of empty factories in the valley, you know, there's, they've knocked down three, four factories in Ewenny Road, which would have, was about 2000 jobs were there one time, and they've gone, and they haven't been replaced with nothing. And that's what it needs, it needs, it needs jobs, especially for the youngsters. They got it tough now ... And if you haven't got transport, you can't get anywhere to work. It's like a vicious circle, isn't it? ... No, it, it's the circle of life, I suppose. You know, take the jobs away, take the wealth away, and then you bring poverty in."
(Terry, 60s, 13)

Across our research, participants pointed to issues with the local housing stock. 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 (see Groves et al., 2020 for further discussion). There appeared to be wide variation in housing condition, with some concerns expressed about the impact of poor quality housing on health:

"I walked in and I kind of did two steps back a bit because the damp, couldn't see it but you could smell the damp all the way down the hallway, all the way into the living room that they were in and it was literally you could have almost pulled it out of the air around you. You felt if you went to put your hand on the chimney breast it would come off damp. It felt that bad and there was the wife sitting there, oxygen cylinders, massive great pump thing the size of a suitcase, wires, oxygen constantly and she said ... "I don't know why we're always so bad breathing." I'm thinking because the damp in here is phenomenal ... None of them have the resources to get them fixed themselves, no ... there were others where they are literally living in houses that have not been touched since the fifties, literally. They might have moved into them 50 odd or 60 odd years ago and they really haven't done much since and there are still houses in Caerau that have still got their original coal fire grates, maybe a couple of radiators running off it from the boiler or maybe not. Maybe it's just coal fires." (Pamela, 50s, 14)

Despite the association with multiple challenges and disadvantages, many participants felt that there was a good sense of community in the area, particularly amongst the older generation, and the vast majority of our participants indicated a desire to live in Caerau long-term. Residents were largely positive about local relationships and there were a number of active community groups. Alongside concerns about drug use being problematic locally, participants raised problems with littering and vandalism as pressing concerns, which was seen by some as indicative of a lack of care for the local environment. However, the natural environment, scenic views and proximity to walking routes were valued by our participants and described as positives of living in the area, which had become more important to some since the Covid-19 pandemic.

6. Money

6.1 Energy costs

Perhaps unsurprisingly given the issues outlined above, financial concerns were at the forefront of most people's minds when discussing the scheme. Whilst other matters may be relevant, cost was seen as the overriding factor, as Terry describes:

"I think that would be the bottom line to it all. 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)

As miners had been entitled to a coal allowance throughout their lifetime, several participants spoke about previous generations not having to worry about fuel costs because they had a free, local source of energy. Even those households without a direct connection to the mine spoke about benefitting through coal being shared between neighbours. This means that fuel poverty was seen as a more pressing issue for current Caerau residents than it had been in the past.

PAUL: *"Yeah, that's, that's what it is in a valley like this because from Croeserw, Caerau down to Maesteg, they used to go and get their own coal, you'd have women up there with carrier bags, all women, like we was talking the other day with our neighbour, his mother lives across the road from us, and they'd always be up there, and the house was always boiling, do you know what I mean? And they took all the fires out then, and it's like, all struggling now, you know what I mean? They miss it like."*

DAWN: *"And it's not a rich place. It's not, Caerau's not a rich place. It's not going to have loads of rich people here, we're just getting through. We're just getting by, you know. So, you know, that's just, so I don't think, I think everybody would jump to it if it was, a lot less like."* (40s, I1)

Several participants queried whether any initial outlay would be required from residents to connect to the mine water heating (e.g. drawing comparisons with having to purchase solar panels) and thought that nobody in the area would be able to sign up to the scheme if this was the case because of pressing financial concerns. Even

those who did not describe any money worries in regards to their own circumstances recognised that Caerau was a poor area, and therefore reducing bills would be the primary concern across the community, particularly given assertions that energy bills had risen substantially in recent years.

"I think the biggest [issue for the future] will be heating which is really why my interest is in this project because of the future needs of ours, wouldn't it be nice if we could get free on-tap, well not free but you know cheap on-tap heating is what my thinking is. So but yeah if they do their feasibility and it doesn't turn out to be cheaper then I don't know, I still think it should be done but my selfish need for it probably wouldn't be you know as much because I'd be looking to save money really."

(Doug, 50s I1)

"Yeah. I think it would depend on, on how much, if any, initial outlay was. And obviously if it's going to cost us more than the gas we're already using, then, it wouldn't make sense for us, you know? I mean, mm, it, it sounds like a good, green solution, to the problem, but I think with neither of us working at the moment, um, I think it would have to be really economically sound as well. Um, because we can't afford to be green without being economical."

(Jenna, 30s, I1)

"I don't think it will go down very well if there's no money saving with it, I think it's going to be all to do with the money and whether you can save people a bit of money and I think that would be the only way you will get people to swap."

(Jay, 20s, I1)

These quotes suggest that participants saw the scheme as beneficial for longer-term futures (see section 11) but it would need to make a short-term financial impact for them to be convinced to sign up. Some people in the community thought that the mine water scheme could provide them with free energy, which led to concerns that, because money was such an issue, residents would sign up to a scheme providing them with reduced cost energy without properly considering the potential risks of the project.

One issue raised by participants in terms of financial viability of the scheme was needing to avoid periods of 'double billing'. Some participants spoke about being unable to switch energy provider because there would be a period of overlap in bills from the old and the new suppliers, which was unaffordable for people on limited

incomes with little or no savings who were living 'hand to mouth'. Assurances about being able to avoid this situation would be important in convincing people to switch.

"What might be a concern is the overlap, if there was an overlap. If they had to pay the extra electric and they were still paying a deficit on the bill because when you're on benefits, it's hand to mouth. So, it's like, if you swap an energy supplier, doing that on benefits is really silly because you can't do it because 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 ... I don't think we'd be able to cope with an overlap."

(Jenna, 30s, I2)

Many people made connections between the mine water scheme and the local wind turbines as both being renewable energy sources. There were mixed views about the turbines. Some felt resentment that an energy source so close to the community didn't seem to produce any tangible benefits directly for the community. Subsequently, it was seen as important that the mine water project would make this direct link. By the third interviews, the scheme developers were investigating the possibility of a connection to local wind farms. This was overwhelmingly regarded as positive by participants, who saw this as improving the renewable energy credentials of the scheme and utilising the wind turbines for the benefit of the local community. However, as people observed periods when the wind turbines were not operating, there were concerns about the implications this would have in relation to reliability of energy supply, with further reassurances in this vein required.

As another local source of energy, participants felt it was difficult to justify why the mine water scheme could potentially cost people the same or more than energy imported from outside the UK.

"I think people would look at it and think it should be cheaper because it's coming out of the ground and isn't involving oil or anything like that. I think the financial, I would think the people that I have spoken at the minute see this as a way of making savings, because energy bills are so high. I don't think they are seeing that their fuel bills are reducing drastically now the wind turbines are working ... they're not seeing their bills reducing and I think that's the main driver to people at the minute."

(Pamela, 50s, I1)

In addition, some participants queried why the mine water scheme connecting to the wind turbines would not make their bills cheaper, given wind was a free source of energy. This suggests further information about the various costs that constituted energy bills would be required by households to convince them to sign up. Participants also expressed the desire for information about longer-term price rises, anticipating that they should have more static energy costs if connecting to the scheme, given the renewable energy source, than the regular price rises they associated with gas and electricity companies.

In fourth interviews, we discussed a potential figure of 10% saving on energy bills as the base case for the scheme development. Some participants were enthusiastic about any potential saving that they could make on energy costs and would be satisfied with a 10% saving:

“Honestly, I think anything where you can make a change then it’s worth it. Because, you know, if, some people are like oh, only 10%? Really? And it’s like, for me, it can be, you know, a saving is better than nothing, you know? It’s nice to be able to have a saving on your energy supply, do you know what I mean? It’s, because, you know, like I said, every little helps, you know? And especially with the pandemic. Every little helps for low income families, I find. For myself, anyway ... your bills mount up at the end of the year for me. So yeah, it would be really good to have it and save with it. It’s nice isn’t it, to obviously have that saving?”
(Jessica, 30s, 14)

Others felt that 10% would not be sufficient to persuade them to switch, particularly if it would involve any significant disruption. A small number of older participants felt that disruption to their properties would put them off connecting to the scheme because it would be too much hassle, without the likelihood of seeing a longer-term benefit. Younger participants were largely more accepting of potential disruption if they felt that it would result in a beneficial system. It is possible that a higher rate of savings could be made with more substantial changes to properties (such as changing radiators and installing insulation). Most participants indicated that they would tolerate a few days’ worth of disruption to their properties if this level of work was required. Some even suggested that they would prefer to have more disruptive work undertaken as they felt this would make a more substantial difference to improving their property:

"I'd be more for that than just getting like smaller things. You know, I'd rather them say, 'Yeah, we're going to do all of this, and it'll be, you know, a 21st century house by the end of it.' That would be good."

(Doug, 60s, I4)

In contrast to those who would not sign up to the scheme unless it would offer financial savings, others said that they would still consider it if their bills would be the same price because they saw other benefits to the scheme. A small number said that they would even be prepared to pay a bit more for energy from a local, renewable source.

"I would probably, if I could, through our energy suppliers if they could guarantee all of our energy was coming through more renewable sources I would happily pay more than we're paying because... I would pay more if I knew it was coming from renewable sources all the time. I'm not sure how many other people would."

(Mark, 20s, I1)

"I'd be prepared to pay a little bit more, as long as it's renewable energy. So if I save £100 [figure quoted in BBC news story] on top, it's a win-win situation isn't it?"

(Alec, 60s, I2)^{ix}

However, even those who were prepared to pay more felt that the majority of others in the area would be unlikely to feel the same, as concern about current fuel bills was at the forefront of people's minds.

"But not if it's the same price, it don't matter if it's from the local area sort of thing, it's just the hassle of changing over and doing everything, you're better off staying the way you are."

(Amanda, 30s, I1)

"So, yes, if I was going to sign up to it, I'd want it to come in less. If it was going to be more, I'd have to think about it ... That's when your personal experience takes over from your 'I want to save the world' type ... You know, it's all very well me saying, 'Yes, they should do more like this.' But if it's going to cost loads more, then I'm sorry but I can't afford it."

(Doug, 50s, I1)

"I know people will say, 'What's the point? If it's going to be same [cost], why bother having it at all?' It's got to be better, if it's gonna be better, it's got to be cheaper, that's the way people's minds are. Like I said, you're looking at a poor area."

(Terry, 60s, I2)

Reducing energy costs was a significant concern for many participants, who felt that this would be the main motivation for signing up to the scheme.

6.2 Bundling costs

During third interviews, participants were asked how they felt about a combined billing system where maintenance and repairs were covered within their energy bill costs. For owner-occupiers who often had insurance policies or monthly service payments, this idea was appealing as they could identify savings.

FIONA:	<i>“If ... you would get all your maintenance and repairs within that price, would that make it sufficiently appealing?”</i>
DOUG:	<i>It would indeed, yeah. I think that’s one of the big bugbears of the modern age now, that everything you’ve got, you’ve got to have a maintenance plan on it or insurance plan ... it’s about 18 quid a month for the gas boiler and that’s just the boiler and not the rest of the heating system, so it’s quite an expense ... but it’s one of those things that I feel you can’t be without. As I say, heating’s important and it’s worth that to me to make sure we get somebody out quick if it does go ... Yeah, that would be a big plus for me.”</i> (50s, 13)

Conversely, participants in rented properties would not benefit from these savings, as their landlords were responsible for system maintenance, so this bundling of costs would provide little incentive for them to sign up to the scheme. This highlights the relevance of power dynamics in the landlord/tenant relationship, raising the question of how things would be resolved if the tenant wanted to sign up to the scheme but the landlord did not, or vice versa.

<i>“If [landlord] wanted to do it, we’re powerless, aren’t we? I think as far as how we feel, as long as it doesn’t cost us any money, I wouldn’t have an opinion either, like, you know. If, if we’d had, if we had to contribute money to it, or it was gonna cost money, additional bill money, then I think that would be quite, that’d make me grumpy ... it’s tough really, because if the landlord wanted to do it and we didn’t, it still, we, we’ve got no choice. So we’d have to endure it, I think really.”</i> (Jenna, 30s, 13)
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Subsequently, an important issue for consideration in taking the scheme forward is the potential challenges it could create for landlord/tenant relationships. Some were concerned that the need for the homeowner to sign up would mean the most vulnerable (perceived as those in rented accommodation) would not end up benefitting.

CAROLE: *"I think it probably will pay better for those people who aren't probably going to go for it. It would be better for maybe those that are renting or what-not. And also, I think some elderly people they tend to heat the one room and not the whole house and I think it might be better to have the whole house heated, but it's whether those people will actually go for the change."*

FIONA: ***So what makes you think they wouldn't go for it?***

CAROLE: *Because sometimes elderly people [laughs] they don't like change, they don't you know they're a bit afraid of something new and trying things. And also I think the tenants who it would definitely benefit more probably have to ask the permission of their landlord but they're the ones that don't seem to be bothered."* (60s, I1)

Those in social housing were more positive about landlords being interested in connecting than private renters were. Reassurances about how contracts would work for the property if occupancy changed would be required for people to sign up in these contexts.

An additional issue for those in rented housing in particular was the current use of prepayment meters. Although often seen as problematic because of being a more costly way to pay for energy, several of our participants spoke about valuing the meters for helping them to budget. For example, being able to buy £10 of gas and knowing this would last the week. Some expressed concerns about moving to a quarterly billing system as they felt they would be more likely to get into debt by becoming further removed from energy spending. For people on very low incomes this could be a significant concern.

DAWN: *"I think you get used to a routine now, so you know what you've got to put in to last you now, so I think, once now that I'm settled with it, I don't think I'd ever change back... because I know how much I've got to put in a week and I'm right then for the week. So I think it's getting into that routine with it then once we do that it's fine, like..."*

PAUL: *Because like with ours now, if it runs out, it knocks off, we'd have no more gas or whatever, but with that it keeps on going, and it keeps adding the money up... So you get into difficulty then. So you'd have to change back then to prepayment.*

DAWN: *You can get back into debt can't you with that, like, I think."* (40s, I1)

Being able to retain prepayment meters in moving to a new system was important for some. Further explanation and reassurances about the ability to do this under the mine water scheme are required. Possible changes to payment methods encompassed in a 'comfort as a service' proposition were discussed with participants and are considered in section 10.3 below.

By interview 3, the anticipated area eligible to connect to the scheme had expanded substantially with the new semi-centralised modular design. This was widely approved of by participants in making access to energy more equitable, but it did raise questions about payment equity, given it was anticipated that it would be more cost-effective to supply houses closer to the colliery site or energy centres than those further away. This led to concerns that people living close to the colliery site would end up subsidising those further away. Transparency about how payment rates would be calculated across the community (as well as between different households with varying levels of demand) is therefore also required.

Section summary:

- **Financial concerns are pressing for many in the community, which means some residents would be unlikely to sign up to the scheme unless they could see a reduction in their bills**
- **Bundling repairs and maintenance costs into current payment rates may be considered sufficiently appealing by owner-occupiers but will not necessarily benefit those in rented properties, which gives them little incentive to sign up**
- **What is considered to be a sufficient saving on energy expenditure varies between households and according to how much disruption would be experienced.**

7. Community

7.1 Heritage

The mines still played an important role in community identity, particularly amongst the older generation. There was some nostalgia about what the community was like in the mining heyday as a thriving local town but many people described the difficult working conditions, and resultant health problems experienced by family members. Several of the men spoke about how their fathers had been adamant that their children would not work in the mines and they had been encouraged to look for work elsewhere. The collieries were also described as ‘deep black scars’ spoiling the appearance of the area, creating pollution and causing health problems. Therefore, several people saw the mine closures as positive (at least retrospectively, if not at the time) in terms of improving the environment.

Using the mines as an energy source again drew some parallels with the situation when the mines were providing coal for the community, however, this could lead to misconceptions that the mines were being re-opened for coal (this was clarified during the interviews). Because Caerau had experienced the negatives that come with being a mining community (pollution, health problems) and subsequent mining closure (unemployment), everyone felt that the scheme would be constructive in bringing the community some benefit from the mines.

“Because if my father was here, he’d say, I’ve worked all my life down the coalmines, I’ve put a lot of, lot of energy and effort into it, so why can’t the community receive some benefits, other than from getting the coal out. It’s lying idle there at the moment. Is it not? There’s nothing been done there, so why not use something that’s not going to cost that much to provide heat for the area.”
(Alec, 60s, I1)

“So I think that’s the reason that people know because this is still an area that would think of having been a mining area... So I would think they would look at that and think the families over two centuries have given their all to working in the pits and their lives sometimes to working in the pits, get something back. I mean that’s the feeling I have got from people was if it’s there, use it.”
(Pamela, 50s, I1)

"It's something, because it's in our, in our genes, isn't it, like our grandparents went down there, I think it should be used in respect for them as well, so that's using it for something, isn't it? Obviously they're not going to put people back down the mines, because it's not, it's not, no health and safety or nothing down there, so obviously it's not going to work, but this, I think it's brilliant."
(Dawn, 40s, I1)

"I think it's good, a lot of the men up here worked down the mines for years and now they're just all blocked off so using them again it's like bringing old things back to Caerau, it's like years ago that was people's livelihood the mines so although they're not going down there to get coal again the fact of it being open is like bringing something old back, that's my opinion anyway ... the mines are just sitting there doing nothing or they could be useful and possibly helping people out. So I don't know I just think it's a good thing."
(Leanne, 20s, I1)

Everyone saw one of the main benefits of the scheme as using a resource that was otherwise lying idle and which had a strong association with the community's heritage. This was seen as positive by being efficient/avoiding waste. In some cases this led to participants drawing parallels with fracking (which itself gave rise to a range of opinions) as using an untapped local energy source.

Because the mine workings were already there, it was not seen as controversial to use the site for energy in the same way as establishing a completely new site might be. An exception to this was for those who lived in close proximity to the colliery site, whose homes now had views onto a quiet green landscape, and who were concerned about disruption to this. Some residents close to the site were also worried about potential impact to their properties, for example caused by subsidence, and queried who would be responsible for rectifying this. Despite several participants knowing of accidents and fatalities in the collieries, there had been no large scale accidents that meant it had associations as a site of tragedy (such as Aberfan or Black Vein). It was felt that it would not be possible to establish a mine water heating scheme in such communities because the mines had such negative associations.

7.2 Community benefits

Beyond potential benefits for the individual householder, we were keen to explore whether participants saw positive outcomes for the community. One potentially important benefit was by being the first community to have this technology they would

be seen as a pioneering community, helping to 'put Caerau on the map'. This was particularly pronounced in the initial round of interviews:

"I want mine water, the only one in the country, warming my house. I mean you've got the bragging rights haven't you? ... Oh it would be, well its headlines innit? For a small mining community in Llynfi Valley in South Wales have just tapped into something we didn't that was there, and it's working."
(Len, 70s, I1)

"Yeah, yeah, there's always a sort of um, what's the, what's the local, what's the local slang, cred. We got, yeah, we're the first. It's good."
(Alec, 60s, I1)

Some participants queried why Caerau had been chosen as the site of the development, suggesting the area was vulnerable to exploitation. The converse of being seen as pioneering was that by being the first ones to have the scheme, Caerau residents would effectively be guinea pigs for an experimental technology:

"Because, by the time, if you build one here and you test it, then it'll probably be less efficient than if you build one, then the next five come along, because they'll learn from their mistakes, so whether or not then it means they then have to dig everything back up and redo what the new ones are doing, it's like with anything isn't it with technology. You get the first ones always a bug. You always find out all the bugs ... So there's pros and cons to being the first. I think."
(Debbie, 30s, I1)

Although this was not always seen negatively:

"When they do stuff like that, I'm always first to be a guinea pig; I love being a guinea pig, especially for new technology. This is why we got so interested in it in the first place. Yes, I like that sort of thing. Yes, I'm quite happy to be a guinea pig."
(Doug, 50s, I2)

The semi-centralised design that was foregrounded at the time of interview 3 would enable the scheme to reach a wider proportion of the community, which was overwhelmingly regarded as positive. However, this would be done via a modular rollout, meaning that some areas of the community would have access to the scheme before others. During the interviews a number of participants indicated that they would not be keen to be amongst the first to sign up in case things went wrong, with several participants suggesting bad experiences in the early phases would be quickly communicated and likely to put people off connecting later down the line.

“If it was working fine, yes, they’d moan, ‘where’s mine then?’ If any problems with it, ‘Oh, I’m glad I didn’t have it.’ You know what I mean? That’s, that’s - will be it. It’s - providing the initial ones work properly and people are saving by it, I can’t see no problem. If, if it don’t work properly and there’s a lot of mess and disruption to their home, ‘Oh, we don’t want it, we don’t want it.’ That’s, that’s the reaction you’ll have straightaway.”
(Terry, 60s, I3)

The sites earmarked to connect first are those with the most straightforward base load (such as a housing estate with a large number of properties owned by a social housing landlord that is on board with the scheme). Participants understood this as a rationale for rollout, but again this raised questions about the landlord/tenant relationship and those living in the property being potentially powerless to avoid connecting to the scheme if the landlord wanted to do so. One participant described tenants as ‘sitting ducks’ in this context. Some also suggested that those in the initial area eligible to connect should have a higher rate of saving from the scheme as compensation for being the ‘guinea pigs’.

Some residents felt that as a deprived area, Caerau often had ‘things done to it’ and there were not the same sanctions or restrictions that would be applied in other areas of the UK. There was also emphasis on the importance of understanding what people in the community need, rather than having things imposed on them from outside (as discussed in section 5). This led back to the notion that the community should have direct benefit from the scheme and not be exploited as a test bed for others to benefit instead. This was emphasised on a number of occasions (again parallels were drawn with the wind turbines and their lack of direct local benefit).

“So, there’s a lot of pride, there’s a lot of feeling in the valley, especially amongst the older people for this valley. I mean, it’s been done, I remember attending a meeting saying they wanted an open cast in the area, we fought hammer and nail against that; we would not have it. We had councillors telling us what they were going to do. No, no, they represent us, we tell them what to do. I think councillors and government have got the wrong idea; instead of telling us what to do, listen to us, we’ll tell them what we need. That’s another common-sense thing I don’t understand.... Decide what’s best for you. I think we should have a say in that. We’ve lived here, worked here, built everything, we need to decide.”
(Terry, 60s, I2)

"I think it's great. I think it's great that somebody thought to use it here, right? But then the suspicions come in, you know, they're using it here because we let them. Like I say, if you asked down in Cowbridge or in Cardiff if you could start drilling holes all over your city or all over your village or all over your town, they'd say, "No." We're saying, "Yes," because people are placating us by saying, "But you'll have cheaper energy in the future. Your children will benefit." But we're getting suspicious now." (Len, 70s, I2)

The scheme was seen as being a way to potentially improve the reputation of the area, which some residents felt could lead to increased investment in the community more generally. The main benefit that this additional potential investment was seen to offer would be increased employment opportunities, which the mine water scheme itself was initially seen as unlikely to provide (although the proposed Heat Academy did have an impact on this perception, discussed in section 12.1). Most residents felt that the installation and maintenance of the mine water heating technologies would need to be done by specialists and would be unlikely to bring any direct employment opportunities to Caerau. Because the area is currently seen to have a poor reputation, some residents raised concerns about technical equipment being stolen or vandalised^x.

"The first thing I just thought of was because Caerau is generally known for crime, that's the only concern that I would have is that it would [laughs] things would be nicked." (Serena, 20s, I1)

"Yeah, I think, yeah, I think it could be really good. Um, and it could, it could start to dispel this, this rumour about um, Caerau being really rough, as long as, you know, the, um, because I think Noddfa chapel, I think they created a BMX track somewhere, and I think that got broken into, and destroyed, so, I think if they build, you know a giant water pump, and somebody scribbles twat on the side of it or something, I don't think it's going to help Caerau much at all (laughter)." (Jenna, 30s, I1)

Another potential concern at community level was that not all Caerau residents would be eligible to connect to the scheme. Whilst spatial boundaries may have a logistical basis, participants were more concerned that if there was any sign-up fee/initial outlay then this would create a wealth divide, which would be much more likely to lead to resentment.

Several participants saw a generational divide in the community, with younger people depicted as those most likely to benefit from the scheme, but also those who may be least aware or interested. Conversely, older people were described as being more likely to take pride in the area and see the scheme as an extension of that, but less likely to benefit due to being concerned about disruption or long-term commitment.

Section summary:

- **It is important to residents that the scheme provides direct benefit to the community and helps to improve the reputation of the area**
- **The scheme needs to avoid causing division within the community, which could potentially lead to resentment and vandalism**
- **The modular rollout is seen as logical but most would be reluctant to be within the initial phase due to concerns about being most likely to encounter teething problems with a new system**

8. Security and safety

8.1 Energy security

As we have highlighted, participants were overwhelmingly positive about having a local energy source. Some explicitly articulated concerns about the current vulnerability of a UK energy system reliant on imported oil and gas, or on European owned nuclear power stations.

“I think you’re going to have to go that way anyway because eventually for whatever reason gas, coal all that sort of stuff won’t be available so the sooner the changes are made I think the sooner everybody will get used to it. ... I think it will have to eventually yes so the sooner we start looking at the ways of doing it I think you know the more we’ll be prepared for when it does you know if Russia turns off the gas pipe like they keep saying they’re going to, you know we’ll have to do something else.”

(Doug, 50s, I1)

"I think there's a lot of instability at the moment – political instability – it would be interesting to have something that is local, reliable and locally owned – not necessarily locally as in Caerau but locally as in the UK."
(Jenna, 30s, I2)

"We've still got big, big power stations working throughout the country, haven't we? And these atomic ones. I don't like those. Er, too dangerous. Too dangerous to have in the country I think. And they're all owned by France. By different countries. We don't even own, not one kilowatt of it, and we're being charged for it. I get quite upset,"
(Terry, 60s, I1)

The appeal of a local supply was also more pronounced in some participant accounts following the Covid-19 pandemic and related lockdown. Although energy supplies had not been impacted, local area lockdowns and restricted travel had led to increased reliance on local resources for many participants. In addition, by fourth interviews the impending Brexit date was seen as further reason for making efforts to utilise local resources rather than relying on energy imports

DAWN:	<i>"I think we should use our own. I think it's a good thing, I really do. I think it's a really good thing because we should be regenerating all our own energies and things. We're coming out of Brexit now as well, you know? He's coming out with no deal so we need to start thinking about ourselves and our own countries and our own..."</i>
PAUL:	<i>Especially like this pandemic has gone around the world. They're saying we should grow more of our own food. So most of our stuff is from abroad.</i>
DAWN:	<i>Yeah. And I guess when we can't get it here, we're going to be stuck, aren't we? So we do need to start thinking of using our own resources, I think. They're there for a reason as well.</i>
PAUL:	<i>If Caerau can do it then every village could do it, because in every village...</i>
DAWN:	<i>There's a mine.</i>
PAUL:	<i>There's a mine. So a lot of people can benefit from it"</i> <i>(40s, I4)</i>

Having a local energy supply was also seen as a more sustainable and 'environmentally friendly' option, as well as potentially making people more aware of where their energy comes from, which was seen as beneficial.

“Well that just, I don’t know it just seems so much nicer the fact that it’s just down there. It’s like you feel a bit more connected don’t you rather than it just coming from somewhere that you’re not really sure about or you don’t really know, you just don’t know ... You don’t know where it’s come from, you just take it for granted don’t you? You’re like oh well we just have power, our lights are on. Like you don’t really think I wonder where that has come from.”
(Serena, 20s, I1)

Subsequently, having local resources was seen as increasingly important, with the mine water scheme an extension of this.

8.2 Relationships to gas

As the scheme would be replacing gas central heating, this led to conversations about gas and how participants currently feel about their existing energy supply. Most were relatively content with the reliability and convenience of their current gas systems, although some described problems with inefficient boilers. Whilst some participants struggled to understand how to operate their current heating controls, they were often able to achieve the heating routine they wanted by turning the boiler on and off directly.

Some participants discussed the possibility of having a heat pump instead of a gas boiler but felt that this would be unappealing as a relatively ‘unknown’ technology. By the second interviews, several people had heard that the scheme would involve having a heat pump ‘the size of a fridge’, which led to questions and concerns about the size, location (in or outside the property), safety and noise emissions of the pumps. Whilst some felt the answers to these queries may put them off wanting to be involved, others felt that they could overcome these concerns if they would benefit from the scheme:

“Yeah, I suppose you would find a space. You’ll always find space for something like that, especially if it’s going to make everything easier.”
(Kim, 40s, I2)

By interview 3, the interviewer was able to discuss with participants the possibility of replacing their boiler with a heat exchanger, which allayed some concerns and which most participants felt would be acceptable from a space point of view. Participants did express concerns about noise, assuming that a pump would inevitably make more noise than a boiler, and requested further information about noise levels. Gas boilers were seen as an investment, with people who had recently upgraded theirs seen as

unlikely to want to change their heating system for a new and uncertain technology. Six participating households had had new boilers installed between rounds of interviews, which made them less inclined to want to replace their boiler with different heating technology.

“Especially people who own their own houses, well there’s a lot of people around here who have new boilers going from the old ones where you’ve got to warm your water for half hour to the new upgrades, well I couldn’t imagine them wanting to get rid of that ... my father have just had a new boiler and I just couldn’t imagine him getting rid of that, and he spent a lot of money on it.”
(Jay, 20s, I1)

“I mean until we know the hard facts on everything then you know, myself personally I wouldn’t want to dip my foot in the water until I knew. It’s a step, because you’re stepping out of your comfort zone, you’re using gas, you know...like there’s people saying, ‘I know where I am with my gas’ but then you’ve got to look at it from another point of view and say, well, sometimes you’ve to make that jump to know that you’re going to benefit from it. Sticking to what you know isn’t always one hundred percent, you’ve got to jump sometimes. Yeah, if you jump and it goes wrong, you can go back but yeah, it’s something new isn’t it.”
(Jessica, 20s, I1)

“Do you think we’re too old in years, because we’ve got the best, a brand new boiler for the gas, so I don’t think it will be good for us.”
(Bob, 70s, I2)

Whilst some praised the convenience of gas and expressed that the mine water scheme would need to match this, several people raised concerns about gas being unsafe and were primarily interested in the mine water scheme because it was seen to offer a safer alternative.

“I always sort of think when you’ve got any sort of gas there’s a slight risk ... I’m not expecting it to be free, I don’t think they’re going to come and, you know there is always going to be a cost. But if it was in any way comparable I’d go the all-electric route rather than having a gas boiler sitting there because there is, doesn’t matter what you say, there is always a risk with gas and then as I said I always put it on my thing every year, service the boiler, but it takes me several weeks to get around to arranging it and to be in at the right time and things like that so.”
(Carole, 60s, I1)

"It's not gas. I, you can't gas yourself, you can't gas your family, you can't gas your pets, you can't accidentally gas somebody that you love, you can't accidentally inhale gas, you can't accidentally blow anything up, when you light it, if the thing has broken you don't get a boof of all the gas, it doesn't smell of gas. And I just hate gas, I hate it to my core, you know."
(Jenna, 30s, I3)

However some raised concerns about safety in establishing the scheme in relation to gas, suggesting that methane could be released during the test drilling process, in light of concerns about existing methane release from Coegnant colliery.

8.3 Reliability

An important issue for participants was the reliability of their energy supply. Existing gas and electricity provision was generally seen as very reliable and participants contrasted this with power cuts that had regularly been experienced in previous decades. Having two fuel sources was also seen as contributing to reliability, as if one supply was interrupted the other should be available:

"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 so there was always a way to generate heat. 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;

"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)

It was therefore seen as vital that the mine water scheme provided a reliable energy supply as this is what people had come to expect. Relying solely on electricity could

be seen as risky without a backup solution in place. Questions of reliability were also raised in relation to the level of water in the mine and whether this would be consistent to guarantee a supply of heat over the longer-term.

“As long as there is an alternative if it doesn’t work one night when it all clicks into gas or electric or whatever. As long as the house’s got a thermostat on it whereas an old dear or somebody my age needs to be 18 degrees and all of a sudden they’re down to 10 because the only source is the water coming from the mine. You know just saying that it will happen and this is the future and then you can build a row of houses which are heated by the water coming from Caerau colliery, it’s got to be tried, tested, absolutely guaranteed waterproof that it will not break down, ever. I mean ok we have power cuts, you can have electric power cuts and you can have gas cuts you know but it’s rare. But if your entire heating system is reliant on an untried scientific experiment I’d be worried about that.”
(Len, 70s, I1)

“I don’t know an awful lot about it but I would be concerned if something went wrong with the pump if it was only coming from there, would the whole valley go out? You know not just one house whereas with the gas now one house will go out, ok with electric it could be the street, but with the gas it’s usually only one house will go out but if you’re talking about a whole street being without any heating, cooking, anything, that’s like [laughs], or the whole valley!”
(Joan, 60s, I1)

The semi-centralised model foregrounded by interview 3 included a back-up gas boiler at each of the five energy centres in order to ensure that heating and hot water could continue to be supplied in the event of a problem with the mine water system. Most participants viewed this favourably in ensuring a reliable energy supply, although one participant felt it indicated insufficient faith in the mine water system, which undermined credibility. However, there were still some concerns about relying solely on one energy source at household level. Several participants were aware of the unsuccessful Wildmill district heating scheme in Bridgend and used this as an example to illustrate the importance of a reliable heating supply and concerns about district heating more generally.

“Because they had a project in Bridgend, a long long time ago, it’s a bit of a legend now, called Wildmill and it’s a pretty big estate just outside Bridgend and they had a central not generator what we’ll call it, anyway there was, I don’t know what the heating means was. But they were going to heat all these houses so these people would have literally free heating, but it never worked. It was always conking out, it was always

breaking down and people were cold, people's houses were warmer than other people's houses etcetera etcetera." (Len, 70s, I1)

Related to this were concerns about maintenance of the system and who would be responsible for fixing (and paying) for it if anything went wrong. Because people would not know how to fix a problem with the mine water system in the same way they would with their gas central heating (i.e. calling a plumber) then they wanted reassurance about how this would be dealt with. This was particularly important for people like Angela who had had negative experiences with poorly executed energy efficiency schemes in the past:

"I would be concerned about having it for the simple fact that I have been let down so many times. Unless there was some sort of backup system that you keep your general heating source as a backup, even, because I haven't got a coal fire, so if that central heating broke down, you know, it's like a gas boiler really isn't it, you know. What would happen then? You'd have to rely on somebody else then to come and fix it where if, because I've got my own property, if the gas boiler breaks down, it's my responsibility and I know that it's going to get fixed because it's my responsibility but if somebody else had that responsibility of coming to pump hot water into my house and they've been left, you know, I've been let down in the past through this thermal, it's the reassurance really of it being fixed and there is no guarantee on anything these days, on jobs, on maintenance, or anything like that, it's solely on the individual, I think personally." (Angela, 50s, I1)

The aforementioned discussions in interview 3 about maintenance and replacement being covered within participants heating costs was therefore regarded favourably. However, further information about how this would work in practice (in particular how quickly problems would be addressed) was desired. Some residents also raised concerns about maintenance of the system being solely down to one company.

"Would there be one group who had a sort of monopoly on fixing them, which would be a concern? ... 'Cause that I wouldn't be too keen on, anything where the one group has a monopoly on anything, I'm always a bit sceptical of... if you can only go to one place, nothing to stop them saying oh we're going to up our service charges here." (Mark, 20s, I2)

Similarly, if there was any damage to properties due to the scheme – several people raised concerns about potential subsidence, or damage to home interiors if new

radiators and insulation were required – residents wanted to know how this would be rectified and paid for. As Angela’s quote shows, previous energy efficiency schemes in the area that had been poorly executed left some residents very sceptical about further interventions. There were also concerns about how any remedial work to properties would be undertaken and the timeframe in which this would be done, with some participants worried that they could end up waiting months for work to be completed.

“So going, you know, for schemes, it’s really hard for me to open my mind to think, “Oh, well, is this one going to go pear-shaped as well?” ... if I didn’t have such a bad experience and they could guarantee that I wouldn’t be at a loss, you know, that it would benefit, but it would have to be a good salesperson to do that.”
(Angela, 50s, I2)

PAUL: *“[u]p in Croeserw they had a big scheme of, they were like pre-fab houses and they started bricking them on the outside, just bricking them up and doing them all up, putting PVC windows in and there was a big uproar and the people was like their carpets got ruined 'cause all the muck, the cement and there was rows up there and they, I think they spent, the lawyer has, they had to give a lot of money out then; people were having new carpets and...*

DAWN: *So would they be prepared for that compensation thing off the carpets and things if they ruined anybody’s carpets as well? It could go into thousands that could, couldn’t it?”*
(40s, I3)

People in the community appeared to have many questions about the scheme, with a lack of certainty around many of the answers putting people off making a commitment. Despite it being relatively early in the development, there was frustration about a lack of information concerning the ways that it would affect people in the area.

“There are the questions about the technology involved, like, “I don’t really want dirty mine water going around my house. It will clog up the radiators.” Yes, heard that one quite often. “How is this heat exchanger going to work for the house? Where are you going to put it and what happens to my boiler? And what happens if it breaks down?” You know, “If it breaks down, who fixes it? Because at the moment I’ve got a contract with British Gas and they come out and fix my boiler. Who’s going to do it? Have they got the expertise to do it? Is it going to cost to do it?” There are all those kinds of questions coming up in every conversation,”
(Pamela, 50s, I2)

Over the course of our interviews, participants felt they had received little information about how the scheme was progressing, with increasing uncertainty about whether it would come to fruition. Everyone felt that they would like to receive more regular communications about the planned scheme and progress, although it was difficult to ascertain the best way to communicate with local residents as some thought that postal communications would 'go straight in the bin'. Facebook was often described as an important means of local communication.

The uncertainty amongst local residents about the scheme is perhaps unsurprising given the innovative nature of the technology, but could lead to lack of trust in the system.

"I think people would be happier if this was what you might call, I suppose, an 'off the peg solution'. "Here is this system. It works. We've put it in place." But this really, really gives the impression of people thinking on their feet. You know, "Think this might work. We'll have a go at doing it this way around." It's a little bit too difficult sometimes for people to grasp properly." (Pamela, 50s, I2)

Having a demonstrator site in the community to 'prove' how the technology would work was seen as valuable by most participants, who felt that this would help move the scheme from idea to reality. Some felt that the modular rollout design would effectively lead to the first areas becoming a demonstrator for the rest of the community.

"You want to build enthusiasm for it. A lot of people say, "Not another bloody scheme, it won't come off", or "It's going to be too expensive". You've got to work with people. You've got to show them why they should have it in their house, convince them." (Terry, 60s, I2)

Others who were interested saw a demonstrator as of little relevance, feeling that they did not have to understand how the technology would work to be convinced to sign up but were happy to trust that the scheme was being undertaken for their benefit.

Section summary:

- The mine water scheme needs to provide a reliable and convenient energy supply, with clarity on how it will be maintained. With these things in place it may be appealing to people as a safer and more secure alternative to gas
- Regular communications and updates about the scheme could help to reassure local residents that progress is still being made and could seek to address some resident queries
- Residents would be seeking assurances about how any problems with the scheme would be dealt with and the timeframe in which issues would be addressed

9. Landscape

9.1 Natural environment

Residents described the local landscape as beautiful and scenic. Indeed, the outdoor environment was one of the main attractions for those who had moved to the area and had become increasingly important to several participants following the coronavirus pandemic and restrictions on travel. There appears to have been a lot of effort in recent years to improve the local environment e.g. by planting trees and establishing a walking route on the old Coegnant colliery site. It was therefore seen as important that the mine water scheme should not impact on the appearance of the area^{xi} beyond the initial construction/set-up phase. Concerns were raised about disruption and safety:

“Will there constantly be an hole there now? Or are they going to I don’t know, find a way to close it up and still, I don’t know because if something is down there, I don’t know. But like there’s dogs running around by there, my dog is running around there, like if I go out on the field because the field where they’re drilling is directly my house so if I go out on the field they’ll run around and they’ll run in the bushes and obviously if there’s a hole there that’s a bit panicky like.” (Leanne, 20s, I1)

However, some felt that using an existing resource would mean less disruption than the introduction of an entirely new energy source.

“Yeah, ‘cause obviously, anything that’s going to be beneficial to the environment, but also you know, I think is good. And to use things that are already here, just makes sense, rather than you know, like the wind turbines are great and everything, but you’re using, with the mine water, you’re using a resource that’s already here. You’re not having to create anything more. So yeah, I think it’s a really good idea. And I mean the potential for it as well, with all the other mines are around in all the other valleys, is, yeah. It’s really good.” (Serena, 20s, I2)

Residents regularly walked their dogs in the Caerau colliery area (with reference to the washery in particular) and were concerned about being able to continue doing this as it was a key way of enjoying the local environment, which had become more important to some following the Covid-19 pandemic. It was also regarded as an important area for local wildlife, which was seen as crucial to protect.

“And how about the impact on wildlife and things, would that be you know, and are they going to like cordon off bits out there, because at the moment I take the dogs up the mountain, walk round the mountain and back down without any you know, I’m not trespassing ... Because there’s loads of wild birds out there as well, I’ve seen a red kite out the back, which you don’t see very often ... I’m quite interested and I know that you, you don’t want them destroying furry things do you?” (Debbie, 30s, I1)

Whilst it was a frequently used area for walking, some participants also raised concerns about it not being particularly safe. Therefore they thought that potential improvements to the area as part of the mine water scheme would be beneficial.

“And the thing is as well I think there is a lot of, because obviously there has been because of all the mining work like you walk up onto the mountain and it’s got loads of signs like ‘be aware like the ground can open up’ and there are holes everywhere and you’ve got to be careful and I think putting it to use is, because it feels a bit like everything has just been shut down and kind of forgotten about and I think yeah, and if you can do stuff like this then definitely all for it.” (Serena, 20s, I1)

“It would probably help the mines stay a bit safer, if the water is sitting down there and it’s not monitored it can move around and that’s when you get things like mine collapses and that but if they’re actually using

the energy from it they're more likely to be monitoring what's going on down there, I'm sure that's got to be a positive really." (Mark, 20s, I1)

Most people were willing to put up with some disruption at a community level, provided that it was short-term and that they would see the benefit of it at a later stage. Whilst digging up roads to install new pipework was seen as inconvenient, it was something that residents felt happened relatively frequently anyway and so would not be enough in itself to put people off the scheme, although it might lead to some complaints. By third interviews there had been work undertaken on Caerau and Blaencaerau roads to update gas pipework, so concerns about potential inconvenience of further work in this vein were more apparent. If it could be combined with the upgrading of other services (such as internet or utilities), and improving the conditions of the roads then this was considered preferable. Disruption at a household level was seen as more problematic.

PAMELA: *"I think they would have to be convinced that there was a benefit to signing up but also I would think they would have to see that there wouldn't be too much disruption involved in being included in the project. You know if you were to come along and say they've all got to have their boilers changed and they've all got to have this changed, I think people will start backing off but what I gather is that that's not the case.*

FIONA: ***What about if it was more disruption at a community level rather than a household level you know someone else mentioned digging up roads to puts pipes in...***

PAMELA: *We are constantly digging up the roads here ... The roads here are in such poor condition, if you're going to improve the road after you've dug it up, put it back down and done it it's probably an improvement." (50s, I1)*

As discussed above (section 6.1, section 7.2) several of the older residents felt that they were 'getting too old' to cope with domestic disruption, and therefore would be put off the scheme if it meant a lot of upheaval making changes to their property. This relates back to concerns about the size and location of heat pumps.

"If it is that big and it's got to be inside the house, then I think it would make a difference to people. And if it's outside of the house, where are they going to put it? They can't put it outside the front because the majority of streets are just terraced houses with no garden in the front." (Joan, 50s, I2)

During initial interviews the interviewer raised the need for houses linked to the scheme to be as efficient as possible, which could mean potential retrofitting work. Residents would be happy for changes to be made to their properties to improve efficiency (with the exception of internal cladding, which would make the room smaller) but felt that they had already made improvements in this vein and were not sure how much more could be done. The issue was different for those in rented properties who were unable to make improvements to their homes, but would like them to be more efficient.

9.2 Energy centres and thermal storage

Discussion of the semi-centralised model in interview 3 encompassed talk about the appearance and location of the five proposed energy centres. Each building would be approximately 5x3 metres in area, with most participants feeling that it would be relatively unproblematic to site these in the community. However, views on this did differ somewhat according to the proximity of participants' homes to the proposed energy centre sites; again concerns about noise emissions were also raised. It was suggested that efforts should be made to make these energy centres blend in with the surrounding environment as much as possible by painting them green, or cladding with natural materials. Alongside the energy centres, provision needs to be made for thermal storage. At the time of third interviews, proposals suggested this could be done in one of two ways; storage in individual properties (such as a hot water tank in an airing cupboard) or at a community level (a storage tank approximately 5.6 metres high located alongside each energy centre). Most participants had a combi boiler so no longer had a hot water tank in their property. A small number had an older system with a tank still in situ and therefore saw little problem in utilising this space in their property for thermal storage. Several participants still had an airing cupboard and did not envisage a problem with reinstating a hot water tank. Some participants expressed a preference for the community level storage as they felt housing space was too restricted to find room for a thermal storage tank (although the possibility of it being situated in the loft was raised, with this being more palatable, however this was explained as being unlikely to be feasible due to cost). More participants expressed a preference for individual level storage to avoid large – and what they anticipated would be unsightly – structures around the community:

"I mean I don't know about everyone else, but I think I'd prefer it in the airing cupboard ... Because you're saying about putting the energy centres outside and that we might be able to see them from the house, I think that's one thing, but I think a 5 metre high tank is another ... I don't think there's much they can do to that to make that look okay ... I think that's just a no. I think that would make me quite grumpy, you know. I mean it's bad enough that we've got, out there we've got an electric pylon that buzzes all day, it just buzzes and it's, it's just like, I, I just think if it can be avoided, I think it should be avoided, 'cause I think that will really make people grumpy ... we like living with our back gate going onto a mountain, it's, you know. And a couple of energy centres around and I think, especially when it's not necessary, if, if they can put them into houses, it's not necessary then ... I just think something like that is worth everyone shouldering a part of the burden really, because then nobody is looking at something that, you know." (Jenna, 30s, I3)

Several suggestions were made for efforts to make the tank less unsightly – such as burying it underground (which is unlikely to be economically feasible), or making the structure longer and lower so it could be more easily hidden (e.g. by planting trees). However, the large size meant it was likely to be difficult to disguise. Again, participants' willingness to have thermal storage tanks depended on the proximity of their homes to the sites and the likelihood that it would impact them directly. Having large storage tanks was also seen as more feasible in some areas of the community than others:

PAUL:	<i>"there's plenty of space up there in Blaencaerau. So you could put it anywhere up there, couldn't they? They could be out of sight out the back</i>
FIONA:	<i>Do you think it would be more of a problem in other areas of Caerau then?</i>
PAUL:	<i>Yeah. In some places it will be. It's like some estates, the Tudor estate, they've only got a green there.</i>
DAWN:	<i>They'd have to put it right in the middle of the green and it would...</i>
PAUL:	<i>Yeah, so it's gonna be in the middle and that would be</i>
DAWN:	<i>... if any noise comes from it, then they're gonna moan about that, yeah. Because obviously there's gonna be some kind of noise coming from dragging water around somewhere, you know, it's obvious, innit? So yeah, I dunno. I think it could be in some places, but others, then they'd be fine."</i> (40s, I3)

Some participants felt that either option would be feasible; that people would find room in their properties or get used to structures around the community if they were benefiting from the scheme.

*“Saves them money in the long run, they probably wouldn’t care.”
(Amanda, 30s, I3)*

*“I think so long as it blends in with the background, it’s not too, not too invasive, it’ll be alright, you know what I mean? After all, they’ve had collieries and mines and tips around here ... if they can make it blend in, you know, it wouldn’t be so bad. I can remember the big electricity boxes they had, and they were dotted around here and there. Again, they were more or less - once you got used to ‘em, you didn’t take any notice of ‘em. So it’s suck it and see, sorta thing, isn’t it?”
(Terry, 60s, I3)*

The mixed views raised by our participants regarding these storage options are likely to be reflected more widely across the community depending on available space in individual properties and proximity to the proposed tank location sites. Some participants queried whether different areas could adopt different designs depending on preferences in each locality (e.g. one energy centre use individual storage and another centralised) and that residents would have to be consulted on their preferences as the scheme develops.

Section summary:

- **The outdoor environment is important to residents, who want to continue to access the space around the colliery for dog walking**
- **Disruption at a community level is less problematic than at a domestic level, particularly for older people**
- **Community location of energy centres is seen as relatively unproblematic but the siting of thermal storage raises more concerns**

10. Understanding the scheme

10.1 Technical feasibility

The previous sections have touched on a number of practical issues that residents wanted reassurance about before deciding whether they would connect to the scheme (reliability, disruption etc). Fundamental to many of these reactions was scepticism that the scheme was technically possible, or that it would be realised in the near future.

"I think it sounds really complicated and I genuinely believe it might be more work than what it's actually worth, seems like it is, and are people going to save that much? So I don't know, I don't know if there is any point in it to be honest with you."
(Jay, 20s, I1)

"It doesn't seem very realistic to me, to be honest with you. If it's warm underneath the ground, as soon as you take it out of the ground and into the pipeline, if those pipelines are not insulated really good obviously then the heat is getting lost."
(Angela, 50s, I1)

CHERYL: *"It's a new idea and I reckon there's a lot of dubious feelings about it."*

BOB: *Maybe we'll be in our graves before it comes out.*

FIONA: ***What kind of sort of dubious thinking would there be about it?***

CHERYL: *How can it work you know and all that business you know how are they going to manage to get water up here and heat homes? ...*

BOB: *Yeah but it's ok saying it comes up very well, but when it comes up it's cold so they'll have to have a machine on top to warm it up again won't they?*

CHERYL: *No, you'll have a pump see and they'll use a pump.*

BOB: *Yeah, I know a pump but it's hot water coming up, by the time it comes to the surface it will be cold, that's what I am saying.*

FIONA: ***That's what you kind of imagine; they'd have another issue?***

BOB: *Yeah then the hot water lovely coming out of a pit yeah but by the time you get to our house or their house.*

CHERYL: *No but they will have a pump see heating it.*

BOB: *I know, they'll have heating I know what you mean yeah but by the time it comes from the pump to us it will be cold again. I don't know, I'm just being negative."* (70s, I1)

"And the, so I don't really understand it, and I think it's quite a hard thing to grasp, because, if the, if the mine water is 13 degrees, I don't want my house being 13 degrees, I want it to be sort of 25 ... I found it quite tricky to understand."
(Jenna, 30s, I1)

These sorts of discussions, where residents expressed scepticism and confusion to the researcher or one another, highlighted that it was a difficult concept to understand, with residents stressing the importance of scheme developers communicating what is going on. This view that the technological feasibility of the scheme was difficult to understand led some participants to express concerns that vulnerable people would sign up to the scheme in order to reduce their bills, without fully appreciating how it would work.

However, some suggested that people would not need a comprehensive understanding of how the scheme worked; just to know that their bills would be reduced would be sufficient to generate interest.

"I don't understand how my TV gives me little pictures on the box, but I just accept the fact that that's what it does. So do you think people would just accept that, this is going to heat, you're going to have hot water, and your heating will be at this temperature?"
(Debbie, 30s, I1)

This reflects the varying perceptions of the utility of a demonstrator site (see section 8.3).

10.2 Smart controls

People's ability to understand the scheme also related to discussion about the smart control systems planned for the homes of residents who sign up to the mine water heating scheme. There were mixed views on this, with some residents enthusiastic about the greater control that they imagined such a system would give them (such as being able to operate heating remotely), whilst others could not see the benefits, saying such a control system would make things more complicated and use more energy.

"I mean, if it's going to tell me you owe me that much, or it's going to say, you should knock it off now or leave it, I won't enjoy that. I'd rather, I want to be in charge. If I've got an on and off switch on it, that's, I'm happy with that."
(Terry, 60s, I1)

Discussion of proposed smart controls was part of a broader interview conversation about residents' views and experiences of smart technology. Most commonly

encountered were smart meters, although some residents had purchased or been gifted smart devices such as the Amazon Alexa. Participants had mixed views of smart meters, with some feeling that they were helpful tools that enabled better household budgeting, whilst others felt that they didn't tell them anything that they did not already know. The latter perspective was often articulated by low income participants, who felt that they had a good grasp of their energy use and ways to reduce it out of necessity.

"They do go on about this smart meter, but anybody with an ounce of common sense won't use anything they don't want to use. You know, and 'we can put it on your phone so it comes on when you come in from shopping'. Why? You can switch it on yourself. I don't understand this modern technology. They're brainwashing people ... I can turn it off when it's warm enough to turn it off, turn it on when it's cold, I'm the smart meter. I don't need something on the wall to tell me that. It's not going to save me money. Plus the fact you're being charged for the installation of it. That goes on your bill as well. They think, they think people are stupid ... Thick, dumb, I don't know, or, is it, they're spraying something in the air today? Because I'm a grown, I know how to do all that. You know, I won't let things run over time. I won't leave things on overnight. I roughly know the cost of it, and the ones I've seen, the needle's going up like that. All the time. So I don't want to be reminded how much I'm using. I'm quite good at cutting back." (Terry, 60s, I1)

Several participants had been offered smart meters by their energy suppliers but had refused because of concerns that it would end up costing them more. Therefore moves to a system based on smart control operation would be potentially off-putting for some participants, with concerns in particular about older residents' ability to understand the technology. Whilst age is not the only marker of difference in how people were perceived to engage with smart technologies, it was the most commonly commented on. Jenna expressed specific concerns about the use of smart technology in relation to the planned district heating scheme in Caerau because of perceptions of connectivity.

"I think you'd really have to put some effort into combating the potential fear, for old people, older people, or people that aren't tech savvy ... Yeah, if we're all connected to the same thing, they might feel that, if they mess up their heating across the road, we're all going to freeze, or something. You know, I think there's potential there for people to get really scared of it." (Jenna, 30s, I1)

Our data indicate that whilst learning how to use smart technology might be intimidating for some people, the added complexity of being linked to a district heating scheme in which people might have the *perception* that their energy use could impact on others (although in reality smart heating controls would operate at the individual household level) could mean people are ‘really scared’ of the technology, potentially self-disconnecting or limiting their energy use. Others expressed concern that the internet connection in the area was not of a sufficient standard to facilitate the use of smart technology, or that there were many households in the area who did not have an internet connection or the technical skills required to use a smart control system and therefore reliance on a smart control system was seen as potentially problematic for many in the community. Two participants also raised concerns about security of smart devices. (For more detailed discussion of participants views and experience of smart technology see Shirani et al., 2020).

10.3 Comfort as a service

In the fourth interviews, participants were asked about their views on the concept of ‘comfort as a service’, a proposal being developed by the Energy Systems Catapult (ESC) whereby customers pay for their heating in terms of warm hours rather than kilowatt hours. The rationale behind this approach is that customers care more about heating outcomes (such as being warm and comfortable) than how the heat is delivered. Existing work by the ESC indicates that triallists of a comfort as a service approach were more open to transferring to a low carbon heating system than the general population^{xii}. Therefore transferring people to a comfort as a service scheme with their current gas central heating system could help to mitigate the risk of getting people to sign up to the mine water scheme. Most participants were positive about the comfort as a service concept, suggesting it was likely to be easier to understand than current billing systems based on kilowatt hours:

“Yeah, no I, sign me up. [laughter] I really like, yeah, no. I like the sound of that. That sounds, for someone like me who, yeah, I just can’t be bothered with kilowatt hours and you know they send me charts every year to say you used last year and this, I’m not interested, you know? As long as I can, yeah, as long as I can have it comfortable yeah, I would, I would sign up to that.”
(Doug, 60s, I4)

However, whilst participants may not understand the mechanism through which their current bills were calculated, most felt that they had a good idea of how much their energy use cost. In particular, some who had prepayment meters were reluctant to move to a different mode of energy billing, which they were concerned could lead to debt.

"I use it and I pay for what I use, you know? So that's my business if I want to use £10 a week or if I want to use £20 a week. That's my business. It's nothing to do with them [energy provider]. That's where I like my key [prepayment meter], because I use what I want to use and what I need to use, you know? I know exactly what I've got to put in, how much I'm using. Because that's what we've always done, you know?"
(Dawn, 40s, 14)

Some participants expressed concerns about the potential inflexibility of a system where they paid for warm hours, feeling that this would require a pre-determined routine, which would not necessarily correspond to the way they currently lived and operated their heating. Several participants spoke about regularly adjusting their heating depending on their circumstances (including health) as well as who else was in the house, and this flexibility was highly valued. A heating system based on set times and which could be operated remotely was seen as potentially appealing to people who spent most of their time out at work and had regular schedules, but this was not the situation of the majority of our participants, who were retired or unemployed. In these circumstances, having a set schedule led to concerns that participants would end up paying for energy that they didn't use (for example if they were unexpectedly absent from home), or unable to increase their heating if they had already used their scheduled hours. Some participants indicated that they would be open to suggestions from their energy provider about how to use their heating more efficiently, as long as the householder retained overall control:

"I'd be happy with suggestions. And to be honest, you know, I would trust their expertise most of the time, but if they don't know exactly what's going on in my house then I don't think they should be you know, I think that I'd need the absolute control."
(Jenna, 40s, 14)

In addition, the digital literacy required for such a system was a potential concern given the challenges participants had encountered with existing smart technology (section

10.2). The prospect of bundling energy costs with repairs and maintenance was also less appealing for tenants than homeowners, as discussed in section 6.2.

Under the comfort as a service proposition, and the mine water scheme more generally, energy bills would be paid to an Energy Services Company (ESCO) managed by Bridgend Council. Aside from one participant who felt that paying energy bills to a council subsidiary would be off-putting (seemingly based on a view that recycling and waste services were poorly managed by the council, which led to concerns about reliability) most participants were unconcerned about changing who they paid their energy bills to, it was price that was considered most important.

“I think that some of the deals that people have had with their energy suppliers in recent years, they have no idea who they’re actually buying their energy from anymore. I mean, what do you know about Octopus Energy? You know, what do you know about this one, that one? If it ever turns out that ten percent savings on their heating, it happens to be coming to Bridgend County Borough Council, why should that be an issue because you know where Bridgend County Borough Council is? They’re not going to do a runner and disappear overnight.”

(Pamela, 60s, 14)

Initial interviews covered the prospect of having a long-term contract for the mine water scheme, so households would effectively be tied in to a heating supplier. Some people saw this as unproblematic, as they would rarely switch energy supplier anyway (partly due to the double billing problem, section 6.1). For others, a long-term contract raised concerns. In particular, renters felt that they would not be able to take on a contract themselves as they would not be able to move it to another house (i.e. in the same way that a Sky TV contract could be moved) and would therefore be reliant on their landlord taking it on, which they might not see the benefit in doing. There were also concerns that older people could pass away during the time of the contract and they were unsure of what a connection to the scheme would mean for relatives trying to sell their home.

10.4 An all-electric system

In moving to an electric heating system as part of the mine water scheme, residents would not see any savings if they continued to keep a gas supply for cooking, as they

would still be paying a standing charge for gas. Subsequently, in interview 3, the need to switch to electric cooking was discussed. This change was seen as potentially quite controversial, with one participant suggesting ‘that’s going to be a bugbear’. All but one of our participants had a gas supply for cooking (either gas hob or hob and oven) and most expressed reluctance to switch to electric. The exception was those participants who had voiced concerns about gas from a safety perspective (see section 8.2) who would prefer electric cooking for the same reasons and saw this as a further plus of the scheme. However, participants raised the question of who would be paying to replace gas cookers with electric ones. If this was down to individual householders then even those who were most enthusiastic about the scheme may be reluctant to switch, given it would require financial outlay rather than savings.

Reluctance to switch to electricity for cooking stemmed from familiarity with and confidence in using gas – the fuel most had cooked on their entire lives. Participants recounted negative experiences with using electric cookers, although these were generally not recent and there was little acknowledgment that technology may have improved. In the third interview, Doug said that he hadn’t used an electric cooker for years but ‘just didn’t like it’ and would be reluctant to move away from gas. However, by the fourth interview he had bought an electric induction hob in an effort to be more efficient when cooking small amounts, which had changed his view of electric cooking:

“That was one thing that I think we’d said before, was that we don’t want to stray from gas. Because it’s so easy, controllable. But having just bought my little induction hob, standalone thing, it’s brilliant. I never knew it boils a saucepan full of water in about 35 seconds. Yeah, it’s quicker than the kettle. You know, I put a saucepan on the gas and it’s on for 20 minutes before it boils. So yeah, I am now of a different opinion having used this but yeah, I would definitely consider getting rid of gas altogether.”
(Doug, 60s, I4)

Some felt that being able to try an electric cooker beforehand – as with Doug’s practical experience of using an electric hob – may help convince them to switch. One participant described cooking classes that were being offered at a local community venue (Caerau Development Trust). Therefore the potential for offering local residents experience of electric cooking through a course at a community venue could be

explored as a way of mitigating concerns about switching. This echoes some participant views of the value of a demonstrator of the scheme more generally.

Section summary:

- **The technicalities of the scheme are difficult to understand and this can lead to scepticism about it coming to fruition**
- **Residents need more information about whether a connection to the scheme would be seen as an asset (i.e. like solar panels) when selling the house, in order to sign up for a long-term contract**
- **Comfort as a service is potentially appealing but concerns about inflexibility need to be addressed**
- **Convincing residents to switch from gas to electric cooking is likely to be problematic, particularly if it will involve financial outlay from householders to replace appliances**

11. Longer-term

In this section, we briefly highlight some of the opportunities that residents saw the scheme potentially being able to provide beyond the current community residents and for future generations. Some felt that having a local heating scheme may help to change perceptions of renewable energy, which currently seemed to give rise to mixed views in the community.

“It could help change people’s perceptions and say oh because of this renewable energy thing I’m getting cheaper heating they’ll think of well perhaps renewable energy is not the devil, but they seem to think it is at the moment.”
(Mark, 20s, I1)

Whilst some participants were concerned about changing from their reliable and convenient gas supply to an unknown technology, others felt that a move away from fossil fuels and towards renewable energy sources would inevitably happen sooner or

later and therefore it made sense to take up opportunities for renewable energy when they arose:

DAWN: "Yeah, but you've gotta change with the times as well, haven't you?"
PAUL: "Well it's better because you'd be getting rid of gas, there'd be more electric then you know what I mean?"
DAWN: "It knocks onto like the ozone layer problem."
PAUL: "Yeah."
DAWN: "Because it's taking, it's all self-efficient and know what I mean? It's gonna come in any case, so you may as well go with it, rather than fight against it, innit? And when our grandchildren are that age, they should have healthier air and a cleaner living and stuff, so." (40s, I3)

Several people thought that it was important for school children to benefit, beyond current plans to heat the local primary school via the mine water scheme. The importance of educating children about the scheme and renewable energy more generally was stressed by several participants. In addition to benefitting the primary school within the test area, there were suggestions for an educational facility that other schools could visit to learn about the scheme.

"What would be quite good as well, if they did build it, is to have some kind of educational facility there, um, so that they can get the local school children involved in ecology and, you know, outdoor, you know energy sort of saving, renewable energy and things like that ... I think if it, if it could have something like that alongside it, then they would be sort of killing two birds with one stone, really. They'd be, you know, the community will benefit, the children will benefit from learning." (Debbie, 30s, I1)

Whilst children were the main focus in learning about the scheme, some saw opportunities for local organisations to capitalise on the pioneering aspect of the project and help to train people to undertake similar projects elsewhere:

"it would be really good if, if places like Caerau Development Trust and that were involved, to help train people to learn more about um, renewable energy, and so that, not only could Caerau be the first place in the UK, sort of, or one of the first places in the UK to have it, but we could start producing um, you know, um...the engineers of the future and stuff, and I think that it could be really uplifting, yeah." (Jenna, 30s, I1)

This was another way that the scheme was seen as potentially being able to improve the reputation of the area. This possibility was significantly enhanced by the planned Heat Academy (section 12.1).

Some residents spoke about not necessarily expecting to directly benefit from the scheme themselves, but would consider connecting because they saw it as a positive step for future generations, who will have to make more use of renewable energy.

"[i]t's a great idea, because I believe in renewable energy, simply because it affects the planet, the old um, coalmines and oil and the gas. I know it's going to run out eventually. Perhaps, not always, you know, in my life, my life will be gone by the time all this is about, but coming to my grandson, and you know, and his sons, perhaps, or what have you. It's going to run out so we have to find something to replace, or renewables, yes. That's how I, it, it's a good idea, alright, when I talk about the cost ... I think, I, I could, um, pay more, for the short term, and as I say, it won't benefit me. But it'll benefit my grandson, and his children beyond that. So initially I, I would expect to pay a little more. But not, like too great deal, you know." (Alec, 60s, I1)

"I just think of my kids and my grandkids, and my grandkids' kids, because I think if something's got to change for them to keep on going, so this all what you're doing is some kind of change." (Dawn, 40s, I1)

"I was positive. I'm positive because I'm pro doing anything that will make future generations better off." (Len, 70s, I2)

"I think that's important too, that's really important. But again, future generations that live here, are they gonna be rich or poor?" (Terry, 60s, I2)

Benefitting future generations was seen as important by many participants, but this was often overshadowed by more pressing financial concerns in the present. Most people are unlikely to be convinced by a scheme that offers long-term benefits if they cannot also see advantages in the present. Relatedly, as Terry notes, a low-cost energy supply is likely to be a priority for future generations as well.

Section summary:

- **Beyond short-term advantages for the individual householder, residents were keen for the scheme to demonstrate benefits to future generations in a number of ways**
- **In addition to providing a renewable energy supply, opportunities for education and training were identified as particularly important**

12. Co-Benefits

12.1 Heat Academy

As part of their work on developing the mine water heating programme, Nordic Heat are keen to consider the wider issues that the scheme can address, such as regeneration and job creation. In conjunction with Bridgend College they are working to develop a Heat Academy, which would provide both professional and vocational training (with emphasis on the latter) in relation to new heating technologies. The aim is to be part of a regional training hub for net zero solutions by 2020, which will also involve re-training and upskilling current practitioners. This is part of a broader vision for Bridgend to be a decarbonised, digitally connected, smart County borough (net zero carbon by 2050).

Participants were overwhelmingly enthusiastic about the prospect of the Heat Academy, seeing it as addressing a crucial absence in terms of local education and employment provision.

“Absolutely great. Because there’s no jobs up here. The only jobs that were up here were in the coal, coal mining industry and the coal mines have closed a long, long time ago. You know, people are living here but they travel, got to travel into work. So whatever job opportunities can be created in this area, fantastic. Absolutely. If there’s anything I could do to support it, I would.”
(Alec, 60s, I4)

“If they, if they’re providing jobs for this part of the valley it would be brilliant ... I think they’d jump at the chance to become heating engineers in this part of the valley, yeah”
(Terry, 60s, 14)

“That’s brilliant that is. That’s what needs to be done, isn’t it? Absolutely brilliant because that’s providing jobs. That’s what we need in places like this definitely. Brilliant. That’s what it’s all about. I think bringing a new in now innit and like you said, training them to know what to do with it. Yeah, really good.”
(Dawn, 40s, 14)

Some participants suggested additional benefits of local training and employment, such as that local people would better understand the ethos of the area and people than outsiders would, so this additional level of connection would be helpful. It was also suggested that having trained people on hand locally would mean a greater likelihood of getting any problems with the system remedied quickly. The need to ensure that the training provision corresponded with the skill level of available jobs was also remarked upon.

As discussed in section 5, lack of local employment opportunities was one of the main challenges participants identified for life in the area. In many ways this was seen as more important than making changes to decarbonise heating systems, given most people were satisfied with their current mode of heating and viewed decarbonisation as a longer-term issue (see section 11), whilst the need for jobs was more urgent in the short-term. This shows similarities to accounts given in interviews with experts working in relation to the scheme, as part of another of our FLEXIS social science work packages^{xiii}.

“Any economic benefits that we can bring in are going to be pretty important in that one as well because it’s a high unemployment area, it’s the fifth most deprived ward in Wales so there is kind of reasons why we would want to generate something that generates jobs in the area, even if it’s purely transition jobs like construction jobs, it’s still jobs coming into that area and those skills that can come off that.”
(Expert 3)

Consequently, the Heat Academy and local jobs in relation to the scheme that were expected to follow from this were well-regarded by our participants as they were seen as addressing pressing concerns in the community.

12.2 Agriculture projects

In addition to the Heat Academy, further regeneration and job creation opportunities are being explored in terms of potential agriculture projects, such as a commercial greenhouse. This would provide consistent heat demands and increase the efficiency of the mine water scheme. There would also be benefits in terms of local food provision and potentially bringing jobs into Caerau. As Bridgend College specialises in agriculture there would be potential links for further training opportunities. Again, participants were overwhelmingly enthusiastic about this prospect:

“That would be nice, wouldn’t it? [Laughter]. No, because I do know there is allotments locally and, you know, to obviously be able to grow and to sell, if they were looking obviously for that side of it all, it’s nice, isn’t it? Obviously to think like using your own energy to grow your own, you know, fruit and veg. Because nothing beats having fruit and veg not, you know, naturally. Do you know what I mean? If I’m honest with you, like come Christmas time, there’s only a few occasions I do buy fresh veg. Normally it frozen veg, you know? [Laughter]. But yeah, to be able to have it grown in your local community and to sell, it’s lovely, isn’t it? For my personal opinion anyway, I think it’d be lovely.”

(Jessica, 30s, 14)

Participants queried how a new greenhouse would relate to the existing Caerau Market Garden. They saw the presence of the existing market garden as indicative that people in the area were interested in growing their own food already, with enthusiasm for this perceived to have increased following the Covid-19 pandemic and lockdown. Again, this contribution to improving local resources, which would also benefit future generations, was seen as particularly important. Some participants wanted to know where a greenhouse would be located, presuming it would be quite large, although did not necessarily feel that this would be problematic within the community.

“It would appeal to me, I think so, yeah definitely. A lot of people are like minded in the area. When you ask around, they think, yeah, that’s a good idea ... It would appeal to a lot of people ... Yeah, we’ve got plenty of room for it, that’s one thing ... Plenty of land to do it and it involves the children as well. Children are growing their own up there as well so if the children would be involved, that would be something else. That would encourage them to do it.”

(Cheryl, 70s, 14)

One participant suggested that if food was to be sold locally, types of food grown would need to be chosen carefully to make it viable:

“Yes, as long as it wasn’t too ambitious, because what I’ve found is they’ll bring, sort of, like, a box of runner beans into foodbank and they’ll come in and go, “Well, what do you do with those then?” So you’d have to be selective in what you grow, is what I’m saying.” (Carole, 60s, I4)

Participants were enthusiastic at the prospect of both the Heat Academy and greenhouse. However, as with the mine water scheme more generally, there were concerns and scepticism about the likelihood of it ever coming to fruition, given past experiences in the area:

“Yes, I would, yes, because there have been a lot of schemes around here. They were going to put a ski well, resort on the mountain, and then they were going to put a ski run down there and this and that and then they had big plans and they come round and ask you do you like this idea and you say yes, and you fill a form in and then you don’t hear any more.” (Anne, 80s, I4)

Our interviewees felt that more frequent communication and updates about the progress of the mine water scheme would help to reassure people locally that work was still underway, as some assumed the lack of information meant that the scheme was no longer going ahead. When prompted, some participants recalled being sent (and completing) a questionnaire from BCBC in late 2018 but none had heard anything about the scheme subsequently. None had attended organised events, either because they were unaware or unavailable. Upon returning for subsequent interviews, most participants commented that they had heard nothing, or very little, about the scheme in the intervening period. For many, their views on the scheme remained unchanged, although the fact that there was little visible evidence of progress meant that there was increasing scepticism about whether the scheme would come to fruition.

Section summary:

- **Planned co-benefits of the scheme such as the heat academy and agriculture projects were well-regarded by participants because they were seen to be addressing pressing needs in the community**

13. Changes over time

The longitudinal design of our research project, which involves speaking to the same people on a number of occasions, is well-suited to highlighting change over time. Amongst our sample there were several house moves (some within the local area), which had an impact on likely connection to the scheme; partly due to location and partly not wanting further upheaval. Six households had new boilers installed during the course of our research, which had implications for the likelihood of them being prepared to make changes to their heating systems. There were also changes to the composition of some households, which had an impact on patterns of energy use. In particular, periods of ill-health were associated with greater demand for heating.

Most participants felt that their views on the scheme had not changed significantly over time, however, some had experienced more radical shifts in thinking during the intervening period. For example, Angela described moving from a stance of ‘no way’ to possibly thinking about it in the future. This was dependent on finding out more about the scheme and seeing the technology working (i.e. as part of a ‘pilot’ or demonstrator) before being willing to reconsider. Conversely, Len had initially been quite enthusiastic about the scheme, but since having a new boiler installed – which was saving money on energy bills – and talking to other people about their concerns, he had become more cautious:

“They’d made news; that was ground-breaking. Caerau was one of the first in Britain to try it out. And it was happy days. But then, picking up on what people I know are saying, they’re saying, “It’s going to cost blah blah blah. I’m going to have a lump in my kitchen the size of a fridge, which I don’t really want. They’re telling me the water won’t actually be in my radiators; that it’s got to go through this machine and exchange them back out. Why do I need it? Why don’t you just give me a new boiler?” ... You’ve obviously seen a bit of a seismic shift, if that’s the right word. I’ve had time to think about it now, haven’t I, and I’m thinking, yes, okay, great. I don’t want to stand in the way of progress, but I also want to see results and I also want to see fair play. And that people who can’t afford what I can afford, they should have an efficient, warm boiler to keep their houses, we’ve had enough disruption with the coal up there.”
(Len, 70s, I2)

For a small number, the widened recruitment area for the scheme meant that their household was now in the area potentially eligible to connect, whereas initially they had been too far out. Interestingly, for one couple who had initially been very enthusiastic, the greater likelihood of being able to connect appeared to make them more tentative about the scheme. This was partly due to the installation of a new boiler between interviews 1 and 2, which meant they wanted several years to reap the benefits from this investment before thinking about changing to a different energy supply. These insights suggest that it will be important for the scheme to be attentive to changes in people's circumstances over time. Participants want to be confident that switching to a renewable heating system will be suitable for their household in the longer-term as their situations change.

Beyond changes in personal lives and individual circumstances, our research has been able to consider the impact of significant external events. For example, prior to the second interviews, a period of extreme cold weather that resulted in disruption to the water supply highlighted for many participants their dependence on energy and the reliability of their current supply. By fourth interviews, participants had experienced six months of restrictions due to the Covid-19 pandemic, which for some had meant a significant alteration to everyday life. In particular, those who had children and teenagers at home during the period of school closures spoke about substantial increases in their energy use – as Jessica described '*it was like having the weekend 24/7*' – which led to concerns about increased expenditure on energy. Both these external events appeared to give rise to a greater sense of solidarity within the community, with descriptions of neighbours looking out for one another, sharing resources, and community organisations making efforts to support vulnerable residents. Participants described this as an important part of what it meant to be a Welsh Valleys community and these relationships appeared to play a crucial role in providing a way to navigate energy vulnerability. We suggest that attentiveness to such aspects of place context is important for the successful rollout of energy system developments.

14. Summary

This report has outlined some of the main concerns and anticipated benefits that participants talked about in relation to the proposed mine water district heating scheme. We reiterate that this report is not intended to be representative of all local residents' views, but to give an insight into the diverse concerns and benefits that our participants have spoken about to date. At this stage of the development, many uncertainties about the scheme still remain and residents will need further information before they make decisions about signing up. In initial interviews most participants were generally positive about the scheme and felt that there was positive feeling towards it in the community more widely, although it may be that those who were uncertain or against the scheme were less likely to want to participate in an interview to discuss it. Interviews that took place after the test drilling had commenced uncovered more negative opinions about the scheme, although several people commented that the drilling itself had not been as disruptive as anticipated. In later interviews participants more frequently reflected that they had not heard anything about the scheme, that it was something that people were not talking about and were assuming that it may not come to fruition. Many were not surprised by the anticipated timescale of development but would prefer more frequent communication to update them on progress. The importance of communicating with local residents about the scheme was stressed by participants on a number of occasions, with a range of views on how this had been undertaken to-date and might best be undertaken in future. In general, designated meetings were seen as only reaching a small section of the community and information posted through the letterbox was thought likely to go unread. Communication via social media (particularly Facebook), local events and knocking on doors was thought likely to be more effective, although the latter runs the risk of being perceived as intrusive.

Residents saw one of the most important benefits of the scheme as potential saving on heating bills, which seemed the primary way to generate interest in the scheme. Some residents felt that a potential 10% reduction in energy bills was significant, whilst others thought it would not be substantial enough to warrant making extensive changes to their heating system. Repairs and maintenance being included in heating costs seems to be appealing to home owners but is unlikely to offer any benefits to

those in rented accommodation, raising important issues about how the dynamic between landlord and tenant could potentially give rise to disagreement and dissatisfaction in this context. Other major benefits included using a local energy source, which would otherwise go to waste, meaning that the mining site would give something back to the community. The main concerns about the scheme centred on reliability of the energy supply (including repairs and maintenance) and residents' ability to understand and control their heating in the same way that they currently do with gas. Disruption at household level was seen as more problematic than at community level.

Issues around ensuring equitable access to the scheme were raised across the interviews, with the expanded geographical eligibility area overwhelmingly regarded as positive. The proposed modular rollout was largely seen as unproblematic, but most participants indicated that they would prefer not to be amongst the first to connect because of concerns about 'teething problems', and would rather connect later once they had the opportunity to see and hear about how it worked in practice. There were some suggestions that the first households to connect should get additional benefits as compensation for being guinea pigs, whilst others highlighted the need for fairness; for example, addressing questions about whether those living closer to the colliery site would end up subsidising costs of households further away, as it was perceived as being more expensive to transport the heat greater distances.

Returning for interviews at 12 month intervals has enabled us to explore changes in participants' views as the technical developments progress and participants receive more information about the scheme. We hope to return to speak to participants again in 2021 and 2022 as construction and initial connection take place. This is one element of our wider work exploring continuity and change in participants' lives through time, considering deeper issues relating to identity and technical changes undertaken in response to the energy trilemma. In outlining some of the main issues raised by our participants at this early stage of scheme development this report is intended to provide initial insights for those involved in technical work and public engagement roles in relation to the mine water project. More extensive analytic work on broader aspects of the data will be undertaken by the team in due course to inform further publications.

15. Summary points

1. Financial concerns are pressing for many in the community, which means some residents would be unlikely to sign up to the scheme unless they could see a reduction in their bills
2. Bundling repairs and maintenance costs into current payment rates may be considered sufficiently appealing by owner-occupiers but will not necessarily benefit those in rented properties, which gives them little incentive to sign up
3. What is considered to be a sufficient saving on energy expenditure varies between households and according to how much disruption would be experienced.
4. It is important to residents that the scheme provides direct benefit to the community and helps to improve the reputation of the area
5. The scheme needs to avoid causing division within the community, which could potentially lead to resentment and vandalism
6. The modular rollout is seen as logical but most would be reluctant to be within the initial phase due to concerns about being most likely to encounter teething problems with a new system
7. The mine water scheme needs to provide a reliable and convenient energy supply, with clarity on how it will be maintained. With these things in place it may be appealing to people as a safer and more secure alternative to gas
8. Regular communications and updates about the scheme could help to reassure local residents that progress is still being made and could seek to address some resident queries
9. Residents would be seeking assurances about how any problems with the scheme would be dealt with and the timeframe in which issues would be addressed

- 10. The outdoor environment is important to residents, who want to continue to access the space around the colliery for dog walking**
- 11. Disruption at a community level is less problematic than at a domestic level, particularly for older people**
- 12. Community location of energy centres is seen as relatively unproblematic but the siting of thermal storage raises more concerns**
- 13. The technicalities of the scheme are difficult to understand and this can lead to scepticism about it coming to fruition**
- 14. Residents need more information about whether a connection to the scheme would be seen as an asset (i.e. like solar panels) when selling the house, in order to sign up for a long-term contract**
- 15. Comfort as a service is potentially appealing but concerns about inflexibility need to be addressed**
- 16. Convincing residents to switch from gas to electric cooking is likely to be problematic, particularly if it will involve financial outlay from householders to replace appliances**
- 17. Beyond short-term advantages for the individual householder, residents were keen for the scheme to demonstrate benefits to future generations in a number of ways**
- 18. In addition to providing a renewable energy supply, opportunities for education and training were identified as particularly important**

16. Recommendations

- Pressing concerns about energy cost and affordability for many in the community means low carbon heating schemes will need to demonstrate financial benefits for residents. Information on how costs will be calculated, including transparency about the cost of transporting energy and plans for longer-term price rises should be provided. Details of procedures for system maintenance and whether residents can switch back to GCH should they find the low carbon heating problematic should also be provided as longer-term lock in could be off-putting.
- Attention should be paid to the different requirements and experiences of people according to household tenure. For example, the inclusion of repairs and maintenance costs in energy bills may appeal to home owners but is unlikely to benefit renters. Different approaches to billing may be required to reflect varying circumstances and to avoid creating difficulties for landlord/tenant relationships.
- Regular communications and updates about the scheme could help to reassure local residents that progress is still being made and could seek to address some resident queries. Changes to plans for the scheme and the rationale for phased rollout need to be clearly communicated to avoid causing division and resentment within the community, which could potentially lead to vandalism of new infrastructure. A range of approaches to communication are likely to be required e.g. letters to households, Facebook posts and inserts in community newsletters. Community organisations are well-regarded in Caerau and present opportunities for passing on information to the community more widely.
- Whilst reducing energy costs is a primary concern, it is also important to show how low carbon heating developments are seeking to address what residents see as pressing concerns in the community. The planned Heat Academy and potential for local training and employment opportunities arising from this was viewed very positively by participants as it attended to identified local needs. In many ways this was seen as more important than making changes to decarbonise heating systems, given most people were satisfied with their current

mode of heating and viewed decarbonisation as a longer-term issue, whilst the need for jobs was more urgent in the short-term.

- Previous negative experiences of poorly executed energy efficiency programmes within the community means that some people are cautious about signing up to new schemes. Additionally, some people feel that energy technology developments (such as smart devices or heating controls) are not necessarily designed with them in mind. New energy infrastructure schemes should be mindful of these concerns in providing information about potential benefits of proposed changes.

17. References

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ⁱ <https://www.theguardian.com/business/2019/jun/26/uncovered-the-200m-theme-park-the-businessman-and-the-missing-millions>

ⁱⁱ See <http://www.flexis.wales/>

ⁱⁱⁱ <http://orca.cf.ac.uk/125642/> and <http://orca.cf.ac.uk/124132/>

^{iv} <https://gov.wales/sites/default/files/publications/2019-07/smart-living-initiative-annual-report-july-2019.pdf>

^v https://es.catapult.org.uk/wp-content/uploads/2019/02/ESC_SSH2_D37-D38-Smart-Energy-Plan-Bridgend.pdf

^{vi} Some interviews were undertaken individually and others as couples

^{vii} The sample size reduced as some opted not to participate in later interviews, generally because their circumstances had changed in relation to work. In addition, some participants moved out of the area, or where

interviews had been conducted with couples, only one partner was present for later interviews. This was particularly the case for fourth wave interviews, which had to be conducted remotely due to social distancing restrictions in light of the coronavirus pandemic. Sadly one participant died prior to the fourth wave of interviews.

^{viii} All interviews in wave 1, 3 and 4 were conducted by Fiona Shirani. A small number of wave 2 interviews were conducted by Gareth Thomas and Catherine Cherry to cover Fiona's maternity leave

^{ix} <https://www.bbc.co.uk/news/uk-wales-south-east-wales-42702581>

^x Around the time of the initial interviews there had been several incidents of vandalism at the BMX track and Caerau Market garden, which were publicised on social media

^{xi} Some felt that the wind turbines had had a detrimental impact on the area's appearance, which is why they saw them as controversial

^{xii} <https://es.catapult.org.uk/wp-content/uploads/2019/06/SSH2-Introduction-to-Heat-as-a-Service-1.pdf>

^{xiii} Work package 1 'Flexible systems and expert visions' involved interviews with some of those leading the technical work across FLEXIS; engineers, project managers, local council employees, and industry representatives, to discuss their visions of energy futures and the technical changes that this will involve.