Dadansoddi ar gyfer Polisi

YMCHWIL GYMDEITHASOL Y LLYWODRAETH

GSR

GOVERNMENT SOCIAL RESEARCH

Analysis for Policy

Llywodraeth Cymru
Welsh Government

SOCIAL RESEARCH NUMBER:
66/2020
PUBLICATION DATE:
15/09/2020

Research to identify early lessons emerging from the Innovative Housing Programme

Mae'r ddogfen yma hefyd ar gael yn Gymraeg.

This document is also available in Welsh.

 Digital ISBN 978-1-80082-006-7

Title: Research to identify early lessons emerging from the Innovative Housing Programme

Author(s): Dr Aimee Ambrose, Dr Tom Archer and Dr Emma Bimpson

Full Research Report: Ambrose, A., Archer, T., and Bimpson, E. (2020). *Research to identify eary lessons emerging from the Innovative Housing Programme*. Cardiff: Welsh Government, GSR report number 66/2020. Available at: https://gov.wales/research-identify-early-lessons-emerging-innovative-housing-programme

For further information please contact:
Rhian Davies
Knowledge and Analytical Services
Welsh Government
Cathays Park
Cardiff
CF10 3NQ
Tel: 0300 025 6791
Email: Rhian.davies45@gov.wales

Table of contents

List of tables

1. Introduction

About the Innovative Housing Programme

1.1 Initiated in 2017, the Welsh Government's Innovative Housing Programme (IHP) is supporting innovation in housing delivery in Wales. It is targeting innovations in three key elements of the housing supply process: construction techniques; delivery pathways and housing models. The programme aims to:

- increase the supply of affordable housing in Wales.
- support the seven goals enshrined in the Well-being of Future Generations (Wales) Act 2015 (WFGA).
- address the cost and value in new homes, and develop housing that meets current and future housing needs.
- support innovators through the use of alternative approaches and demonstrate the benefits of such approaches to encourage uptake.
- harness opportunities to deliver jobs, skills training, and develop local industry.
- publicly disseminate key findings and maximise learning.

About the research

1.2 In March 2020, the Welsh Government commissioned the Centre for Regional Economic and Social Research (CRESR) to undertake research into the lessons emerging from the first year of the IHP. The aim of this research was to understand the early construction messages emerging from the IHP, including those relating to the planning process, construction challenges and benefits, costs, materials and timescales. The research focussed on housing schemes funded in year one of the IHP (2017-18) only.

1.3 The research involved qualitative interviews with housing developers (mostly Registered Social Landlords) leading the 18 schemes funded during year one of the IHP and, where possible, their construction partners[1]. The research took place

[1] It proved more difficult to engage construction partners in the research than other stakeholders for several reasons including their short term stake in the development; the fact that a small number had gone out of business since year one of the IHP; changes in key personnel; the nature of their work and the fact that many were now absorbed in other projects.

between March and June 2020 and was guided by four key research questions, as follows:

1. What are the early messages emerging from the scheme, including in relation to:

- planning barriers?
- construction (challenges and benefits)?
- workforce skills (challenges and benefits)?

2. How does the IHP compare to more typical build programmes, in terms of:

- build costs?
- availability of materials/supply chains?
- waste materials during construction?
- sustainability of production?
- timescales/pace of build?
- energy performance (according to Standard Assessment Procedure2 or SAP calculations) and affordability?

3. Have any specific challenges been encountered relating to:

- the different methods of construction exemplified?
- different types of site?

4. Are the projects delivering the outcomes and outputs they intended to at the following stages:

- the planning and construction phase?
- up to practical completion?

The impact of Covid-19 on the research

1.4 It was originally intended that the research would be conducted as a series of workshops held in four different locations around Wales where funded organisations and their construction partners would share key learning and participate in a series of focus groups intended to provide detailed insights into experiences of the

[2] The SAP is the UK government's recommended method for calculating the energy rating of residential dwellings.

scheme. However, the circumstances around Covid-19 and the associated lockdown necessitated a remote approach to data collection.

1.5 It was decided, in close consultation with Welsh Government, to redirect resources towards a programme of in-depth telephone or video interviews with representatives of as many of the organisations funded in year one as possible. This format proved successful, allowing respondents to be interviewed wherever they were whilst achieving sufficient depth of insight to be able to identify the key lessons emerging from the first year of the scheme. Under this model, funded organisations and their contractors miss out on the opportunity to share learning in a direct manner but it is hoped this report will provide a means of sharing key learning between organisations. More detail on the methodology is provided in Section 2.

Purpose and structure of the report

1.6 This report provides a summary of the key learning to emerge from the first schemes delivered under the IHP which will be used by Welsh Government in their onward development of the Programme which is now in its fourth year. The report can also be used to enable the sharing of key lessons between participating organisations and those considering seeking funding through the scheme in future.

1.7 The report comprises of six sections in addition to this one. Section 2 provides more detail on the methods adopted and details of the final sample of respondents. Section 3 provides a brief description of the policy context in which the IHP sits and the circumstances that gave rise to the development of the programme. The following four sections present empirical evidence and analysis relevant to each of the research questions outlined above. Please note that insights in relation to research question four have been integrated into the analysis relating to research questions one and three due to the substantial overlap in the themes that emerged in relation to these questions. The report concludes with a summary of the key findings and lessons identified through the research.

A note on anonymity

1.8 The authors have endeavoured to report all findings from the research in an anonymised format. However, the study involves a relatively small number of organisations and individuals and details of their participation in the IHP are in the public domain. It therefore cannot be guaranteed that all information which may identify participants has been removed, although every effort has been made to avoid this.

2. Methods

Approach and sample size

2.1 As outlined above, the unprecedented circumstances in which the research was conducted necessitated an alternative approach to that planned. In the event, data was gathered via in-depth interviews conducted remotely by video conferencing platforms or telephone. A detailed semi-structured topic guide was used, which was based around and elaborates the four key research questions. The topic guide is included in Appendix A.

2.2 The research team were supplied with contact details for the funded organisations and their construction partners (where available). Given the circumstances around Covid-19, multiple attempts were made to contact representatives of each scheme and the utmost flexibility was afforded to participants in terms of when and how the interviews were conducted. This approach was effective in enabling the research team to gather data from 16 of the 18 schemes funded during the first year of the IHP.

2.3 A minimum of two individuals were contacted in relation to each scheme, but in some instances, it was only possible to speak to an individual representing the developer or the construction partner rather than both parties and on other occasions additional or alternative respondents were nominated by the individuals contacted initially. There were also occasions where the developer felt able to speak from both their own and the construction partner's perspective (i.e. where an 'in-house' construction team was used or where the two parties had worked very closely together). This meant that in relation to some schemes, only one individual was interviewed whereas for others, up to five individuals participated. The uneven nature of participation did not pose particular problems in relation to the analysis, as the purpose of the report is to identify lessons from across the schemes and illustrate them with reference to specific examples, rather than to provide in-depth accounts of each individual scheme.

2.4 The research team were able to speak to both the developers and their construction partner in relation to ten schemes; the developer only in relation to five schemes and the construction partner only in relation to two schemes. The research team

found that where we were only able to speak to one individual associated with the funded scheme, they were usually well positioned to identify key learning. In total, 31 individuals were interviewed. Overall, these numbers represent a robust sample whereby empirical data was gathered from 90 per cent of funded schemes. Each interview lasted one hour or more, allowing for a detailed discussion of each scheme from a variety of perspectives.

2.5 Table 2.1 below provides more detail on the sample of respondents.

Table 2.1: Description of the sample

Scheme number	Lead organisation (developer)	Construction partner (S/M/L)	Main innovation	Who interviewed
1	Local authority	Private construction (SME) and a Registered Social Landlord (RSL).	Innovation in relation to construction and environmental performance.	Developer only
2	RSL	Large private developer.	Modern Methods of Construction (MMC)/ housing for young people.	Developer only
3	RSL	Small private company.	Container homes.	Developer and construction partner
4	Local authority	Private company, SMEs	Container homes	Developer only
5	RSL	Two private local companies (SMEs)	Low carbon development	Developer and construction partner
6	Local authority	In house team and external contractors.	Passivhaus scheme	Developer only
7	RSL	Local company (SME)	Modular extra care scheme	Developer only
8	RSL	Larger company (Wales and SW England)	Passivhaus	Developer and construction partner
9	RSL	Local company (SME)	Passivhaus	Developer and construction partner
10	RSL	In-house team	Accommodation for downsising housing and those taking on first home.	Developer and construction partner
11	RSL	Local company (SME)	Off grid homes, solar powered	Construction partner only
12	RSL	Local company (SME)	Off grid homes, solar powered	Construction partner only

13	RSL	Local company (SME)	Low Carbon development	Developer only
14	Local authority	In-house team	Passivhaus	Developer and construction partner
15	RSL	Local company (SME)	Modular construction	Developer only
16	RSL	Local company (SME)	Barnhaus construction	Developer and construction partner

2.6 Some of these interviews were conducted on a one to one basis whilst others involved multiple participants and took the form of mini focus groups. Developers and their construction partners were generally interviewed separately but on occasion developers and construction partners asked to be interviewed together. In the main, it was useful to interview each party separately as this allowed for a more detailed discussion in relation to specific aspects of the scheme (for example: construction partners could usually comment in more detail on research questions two and three) and also allowed each respondent to speak more frankly about their experiences of the programme.

Approach to analysis

2.7 The majority of interviews were professionally transcribed to enable rigorous analysis and to allow for the extraction of verbatim quotes for inclusion in this report. Shorter, less detailed interviews were written up as detailed notes which included verbatim quotes. Given the relatively small scale of the data set generated, a manual approach to analysis was adopted. In practice, this involved each member of the research team completing an analysis template structured around the four key research questions and based on the interviews they had been responsible for conducting. Schemes were never split between researchers to avoid fragmenting this process. Each researcher then synthesised data from across the schemes they were responsible for researching under each heading and identified the key learning points. To increase the robustness of this process, the research team also discussed their analysis of the data verbally. The report authors were then responsible for drawing together insights from across all of the 16 schemes included in the study with the purpose of addressing the key research questions.

3. The Innovative Housing Programme: understanding the policy context

3.1 Initiated in 2017, the IHP is supporting innovation in housing delivery in Wales. It is targeting innovations in three key elements of the housing supply process: construction techniques; delivery pathways and housing models.

3.2 These wide-ranging aims reflect the broader policy context within which the programme has developed. The WFGA has a set an ambitious vision for the future of Wales as a prosperous, responsible, resilient, healthy, equal, cohesive, vibrant and thriving country. This is embedded in the IHP programme, as applicants are required to demonstrate how they align with the seven goals of the WFGA.

3.3 Alongside this broad agenda, there are specific housing policy objectives to which the IHP is making an important contribution. Recent analysis of housing need, broken down by tenure, suggests that 8,300 dwellings per annum are required across Wales up to 2022/23, 47 per cent of which should be in an affordable tenure[3],[4]. CRESR's own research in 2019, for the Joseph Rowntree and Bevan Foundation, highlighted pressing issues of affordability in specific areas of Wales[5]. This was reflective of various external factors influencing both supply and demand-side factors, such as the introduction of Universal Credit.

3.4 Welsh Government has committed to investing £2 billion over the Assembly term to provide 'good quality housing [and] to support thriving communities'. Central to this is an objective to develop 20,000 additional affordable units (Welsh Government, 2020[6]). As of 2018/19, 13,143 units had been delivered, with an additional 6,857 to be supplied by 2021 (Welsh Government, 2019[7]).

3.5 The Independent Review of Affordable Housing Supply, which concluded in April 2019, made a number of recommendations, for instance, on housing quality standards, Modern Methods of Construction[8] (MMC), rent-setting, the role of local

[3] Welsh Government (2019) Estimates of housing need (by tenure): 2018-based.
[4] Lichfields (2019) Welsh Government Housing Need Estimates by Tenure.
[5] Archer, T. Green, S. and Wilson (2018). Effective housing for people on low incomes in the Welsh Valleys.
[6] Welsh Government (2020), Draft Budget 2020-21.
[7] Welsh Government (2019), Affordable Housing Provision, 2018-19.
[8] 'Modern Methods of Construction' (MMC) encompasses a range of offsite manufacturing and onsite techniques providing alternatives to traditional house building.

authorities and housing associations, releasing public sector land and the financing of affordable housing. Welsh Government responded to the review in July 2019, accepting all but one of the recommendations.

3.6 Of specific note is the desire to maximise the opportunities related to Off-site Manufacture (OSM) and Modern Methods of Construction (MMC). In February 2020 Welsh Government published a strategy for use of MMC in the development of social housing[9]. This strategy sets out a path to widespread adoption of MMC, to increase the volume of homes built with MMC. With several of the IHP projects using modular and panelised build systems, as well as other innovative construction techniques, this research provides insights for those seeking to pursue these approaches at scale.

3.7 This issue is also tied to wider government objectives relating to climate change, and the desire to create a more resource efficient construction sector in Wales. Welsh Government is committed to sustainable development, reinforced through legislation and funding commitments including the Environment (Wales) Act 2016, which targets a reduction in carbon emissions of 80% by 2050. The Wales Infrastructure Investment Plan has invested £10m in modular factories to contribute to this commitment to sustainable housing development.

3.8 The efforts of Welsh Government to maximise reductions in carbon emissions through the improved energy performance of new housing links to the acute issue of fuel poverty. In the Welsh Housing Conditions Survey 2017-18, 28% of dwellings in Wales had an EPC rating of band C or worse, which is lower than other UK nations and perhaps due to the older age of Welsh housing stock (Welsh Government, 2019). The relatively poor energy performance of the housing stock contributes to a situation where 12% of households in Wales are believed to be living in fuel poverty (14% living in rural and 12% living in urban areas) (Welsh Government, 2018). These statistics are concerning given what is known about the relationship between poor energy efficiency in homes and physical (Gilbertson et al., 2012), as well as mental health (Liddel and Guiney, 2017). The Welsh Government Warm Homes

[9] Welsh Government (2020). Re-imagining social house building in Wales: A Modern Methods of Construction Strategy for Social Housing.

programme is yielding vital improvements to energy efficiency in the homes of low income and otherwise disadvantaged people (Welsh government, 2019). The IHP is another programme with the potential to directly address these issues, and test solutions which can be mainstreamed into future housing developments.

3.9 This policy and funding context makes the current research important and timely. It can help stakeholders understand the factors enabling and constraining the development of housing fit for the future. This report provides insights into issues concerning the planning, construction and replication of innovative housing schemes, as grantees have sought to improve the energy performance of housing, pioneer new construction techniques, and create new pathways to housing delivery.

4. Early stage challenges and benefits: planning, construction and workforce

4.1 This section focuses on the experiences of developers and their construction partners in relation to the early stages of mobilising the funded schemes, including obtaining planning permission; assembling an appropriately skilled workforce and getting construction underway. In particular, it focuses on the benefits and challenges associated with delivering innovative housing schemes under the IHP.

Navigating the planning process

4.2 Once funding for the schemes had been obtained via the IHP, a key next step was to secure detailed planning permission. The planning process did not appear to represent a major challenge in relation to most of the schemes, although respondents did reveal a diversity of experiences and there was a strong sense that different planning authorities operate in very different ways. Respondents highlighted a range of lessons for future rounds of the IHP as well as more general lessons regarding taking innovative housing schemes through the planning process.

4.3 These lessons broadly relate to:

- The responsiveness of the planning process to innovative approaches.
- Resident objections and the importance of early dialogue with residents, key local authority officers and local councillors.
- The unusual appearance of innovative housing schemes.
- The planning process and statutory connections to water and sewerage and highways issues.

4.4 Some of the lessons identified are specific to the innovative nature of the schemes in question whereas others relate to general challenges that would be encountered in relation to most developments as they made their way through the planning process. The primary focus of this report is on understanding the learning of greatest relevance to the IHP. The key lessons are explored in turn with reference to specific examples.

Responsiveness of the planning process to innovative approaches

4.5 Planners had reportedly been generally supportive of the innovative approaches proposed under the programme including uncommon approaches such as Barnhaus construction and Passivhaus, which most local authority planners would have limited experience of approving, especially at scale. Indeed, many developers felt that the planners they were dealing with were very welcoming of the IHP's aims around improving housing quality and reportedly pushed developers to further maximise design quality (in relation to both properties and public realm). In the main, this was not resisted by developers but it did sometimes give rise to tensions between the importance of high quality place making (very much the priority of planners) versus the operational objective, held by all social housing providers, to maximise the number of units provided at a time of housing shortage.

4.6 However, as the quote below illustrates, it appears that these tensions could be resolved through effective early dialogue between all parties. The developer in this instance was a local authority taking its first foray in many years into house building. The dialogue between the developer and the planning team was reportedly made easier by the fact that this was an internal dialogue between different parts of the same organisation, providing an added incentive to agree a way forward.

> 'The urban designers and the architecture team want to create beautiful homes and places but the Housing Management team are driven to maximise the number of units they can provide. These issues between place making and operational management were fairly easily ironed out through dialogue and compromises were reached.' (Local Authority Housing Manager)

4.7 This dialogue appeared to result in positive outcomes, with the scheme in question having a smooth ride through the planning process, emerging with standard planning conditions. This was regarded as a positive and unlikely outcome in the context of the innovative nature of the scheme.

4.8 There were two more developments (both led by housing associations) where early dialogue (prior to the submission of a planning application) with senior local authority officers and local councillors, to develop their understanding of the scheme and the benefits it could deliver, had been key to securing their support. This in turn

had reduced the number of objections and the scope for complications at planning stage. The importance of early engagement with surrounding residents was also underlined in this context and is discussed in more detail in the next section.

4.9 Another developer reported more mixed experiences in relation to securing planning permission, but conceded that the difficulties they encountered resulted from their own decision to work within an existing planning permission. In this instance, planning permission was already in place for a number of traditionally constructed homes on infill sites prior to applying for IHP funding. This was initially felt to be an advantage in terms of allowing them to progress towards developing the sites more quickly but challenges arose when trying to incorporate a modular construction approach into fairly traditional designs to avoid making a new or amended planning application. The developer concerned has now concluded that the construction approach needs to be considered prior to embarking on the planning process to avoid the complications of retrofitting it to an existing design.

4.10 In another case, one developer expressed their frustration that the planning system didn't seem to be very responsive to proposals for temporary developments (in this case the development of temporary shipping container homes). In this instance, what was anticipated to be a relatively simple planning procedure was held up by the application being treated as a permanent development:

> ‘It was treated as a traditional development for planning consent as opposed to temporary. I think there’s probably a bit of learning to do with the local authority planning team.’ (Senior Officer, Housing Association)

4.11 Another point worth noting, which was raised by two developers, was that the planning stage of the development should be led by someone with experience of the planning system, who understands the relevant national and local policies, and who is used to navigating the associated challenges. In some instances, construction partners were charged with securing planning permission and despite being very knowledgeable in terms of the specialist type of construction proposed, they knew very little about the planning system. In general, developers appeared more adept at securing planning permission in a timely manner.

Resident objections and the importance of early dialogue

4.12 A number of respondents highlighted objections from local residents as being a source of delays and complications in obtaining planning permission. However, the nature of the objections appeared to relate less to the innovative nature of the schemes or to their IHP status and more to issues such as tenure mix and common sources of objections such as privacy and overlooking. Although there were examples of the unconventional appearance of some schemes causing concerns.

4.13 In one instance, objections from local residents led the local planning committee to hold a site meeting where residents expressed their concerns. The housing developer in question anticipated the objections made and held firm with their proposal. Planning committee members were also supportive of the scheme, in spite of objections, and were keen to see an IHP funded project developed in the area. In this sense, having the status of an IHP scheme was helpful in gaining the support of the local planning committee. Again, the developer felt that early dialogue (prior to the submission of a planning application) with the relevant senior local authority officers and local councillors, to develop their understanding of the innovative nature of the scheme and the benefits it could deliver, had been key to securing their support:

> ‘During the process we had an event for people within the council, some of the heads of service, housing strategy, the councillors, the local town council, where we presented the scheme and explained what Passivhaus was and why we were looking to do it, because we wanted to get local support for it and I think that helped the process because they felt they were involved then, so that was prior to submitting the planning application, so it meant the local councillors were aware of the project before it went to planning, so when they had queries from local residents they were able to work with them on that.’ (Development manager, housing association)

4.14 The importance of early and meaningful engagement with local residents and decision makers was also highlighted in relation to a shipping container project for homeless families. The scheme met with local resistance in relation to its appearance and concerns about the nature and circumstances of future (formerly

homeless) tenants on the site. These concerns were reportedly overcome through effective engagement with neighbours and local councillors via events led by the relevant housing association. Ongoing resident engagement reportedly plays an important role in relation to this project.

4.15 Schemes aimed at housing homeless people appeared to meet with a stronger degree of resistance and developers had to work more closely with local residents in relation to these schemes. In one case, resident opposition to a scheme for young homeless people led developers to re-designate the scheme for older people. In relation to this scheme, the developer and construction partner both felt, in hindsight, that more pro-active communication with residents about plans for this scheme could have mitigated some of these concerns at an earlier stage. Attempts to keep the developer's intentions for the scheme under wraps to avoid resident opposition backfired and caused local residents to mistrust the developer:

> ‘Plain language and being honest about it is key…in future we would do more involved consultation at the very start with local residents and perhaps offer the housing to local young people.’ (Construction partner to a housing association)

Unusual appearances

4.16 The unconventional appearance of a number of schemes, as a result of their innovative nature, was also thought to have led to resistance in some cases, particularly in areas with a traditional vernacular:

> ‘…it is definitely different to the surrounding aesthetics and the vernacular of the existing buildings, so it does look different and it feels different as well.’ (Senior officer, housing association)

4.17 While some developers made no apology for the unusual appearance of their schemes and felt that it was important that they represented a departure from traditional built forms, some schemes took the opposite approach and sought to mirror nearby housing to reduce planning resistance. This approach was reported to be successful in securing a relatively smooth ride through the planning process:

> 'In terms of the planning process we didn’t really come across any issues because they don’t look any different from a traditional bungalow, they look like a

standard house. I know you see in the media, a lot of innovative housing, they do look very different, that's not the case with these. So planning went through fairly quickly and fairly easily.' (Development manager, local authority)

4.18 Similarly, another developer was explicit about their attempts to 'disguise' the system built homes they were developing as something much more traditional. They felt this approach had paid off and reduced the number of objections they encountered:

'That was part of our objective, so people would dissociate it from some of the system build disasters of the 60s or whatever, even though it was part and parcel of what we were doing, it would be disguised so effectively that nobody would ever know.' (Development manager, housing association)

4.19 In relation to some design approaches, particularly Passivhaus, the orientation of the houses was crucial in terms of enabling passive solar gain leading to houses being unavoidably orientated differently to existing properties in the surrounding area. This reportedly gave rise to challenges in the planning process and in terms of resident objections:

'The big challenge there was that the orientation of the site didn't match the rest of the neighbourhood. Our houses are based on a code called passive gain, all the houses have to be? pointing south, so if your site is pointing east-west you have to then change the orientation of the site around, so you have quite a battle with the planners to get them to understand how, particularly for trying to address energy poverty, if you get 80% of the energy through the orientation of the site through the windows and doors' (Construction partner)

4.20 In this vein, a local authority construction manager who was involved in schemes funded under subsequent rounds of the IHP felt that a key lesson that he had taken away from the first round was to aim for a traditional appearance even when adopting an innovative approach to construction. He felt that developing properties that are both innovative in their performance and appearance proved too challenging in planning terms at this point in time:

‘We’ve had a second IHP grant also building to Passivhaus and with that one we made sure from the outset that the appearance was going to be acceptable, quite traditional really. So I think there was some learning there that perhaps being purist in terms of trying to deliver an energy efficient property that also looks very different was maybe a bit of a step too far and a shock to the planning system.’ (Construction manager, local authority)

The planning process and statutory connections to water and sewerage and highways issues

4.21 The issues highlighted in relation to essential services such as water, sewerage and highways were, for the most part, general issues that could apply to most housing developments. However, the difficulties encountered resulted in severe delays to a number of schemes and are therefore worth highlighting.

4.22 A number of respondents highlighted specific challenges related to the sequencing of applying for planning permission and progressing with securing water and sewerage connections- this was a common cause of significant delays in the completion of schemes. The issue here seemed to concern the fact that planning authorities look for assurance that water and sewerage connections are in hand yet progress cannot be made with these connections until planning permission is in place.

4.23 Similarly, developers and contractors described requirements by local highways authorities as, in their view, unnecessarily demanding, arguing that specifications for roads and standing surfaces are too stringent. This point links back to the broader point made earlier about the tensions that exist between place making and the operational objective to maximise housing output. Though many developers were committed to maximising housing design quality, this enthusiasm wasn't as marked in relation to the public realm or highways. It was also reported in a number of cases that discussions with the local highways authority on essential matters such as car parking arrangements and access roads proved very time consuming. In one case, these issues were felt to be more of a concern to the local planning authority than the unconventional appearance of the proposed houses. On this

occasion the developer was pleased that highways matters had focussed attention away from the appearance of the properties:

> 'There was more discussion of highways and parking than the houses, due to being on a busy mountain road. This dominated discussions, even though the houses look different to other housing in the area- so that worked in the project's favour in this instance.' (Development manager, housing association)

Early stage construction challenges

4.24 Developers and their construction partners were keen to speak at length about the construction challenges they encountered both prior to and during the construction phases of the funded projects. The issues raised largely related to supply chains for building materials and components and related delays in the construction process; issues around detailed design and concerns about the impact that these various challenges would have on the performance of the completed properties and the likelihood that their wide-ranging aims and aspirations for the schemes would be met. In relation to the latter point, very few of the developers were yet in possession of a full assessment of the technical performance of their completed properties (although many have commissioned them) or levels of resident satisfaction, therefore any remarks in relation to this are speculative.

4.25 The construction challenges raised by respondents intersect heavily with issues around supply chains and workforce that are discussed in more detail in later sections. It is also clear that most of the issues reported are likely to be experienced by any organisation attempting to take a relatively unconventional approach to housing development and are not unique to the IHP. The IHP (combined with Social Housing Grant funding), it appears, have merely created the conditions in which more housing providers can afford to experiment with more innovative approaches to construction. However, the accounts of developers and their construction partners in relation to the process of identifying a preferred construction approach; how this approach went in practice; the extent to which it met their expectations and their willingness to repeat it in future, yield important lessons for future rounds of the IHP.

4.26 The learning identified in this section is structured around the following key themes:

- Identifying the preferred construction approach
- Expectations versus reality in relation to preferred construction approaches
- Weather and ground conditions
- Willingness to apply the construction approaches trialled to future schemes

Identifying the preferred construction approach

4.27 In several cases developers had a clear ambition to adopt innovative construction approaches prior to making an application for IHP funding, but for most access to the funding offered the opportunity to adopt a more innovative approach than would have otherwise been possible.

> 'In the absence of the [IHP] scheme, we would have needed to take a traditional approach to the site for financial reasons as it would have maximised the number of units we could deliver and improved affordability. With IHP support, we were able to deliver the desired number of units as well as taking an innovative approach and achieving much better EPC ratings than we would have done otherwise.' (Head of development, local authority)

4.28 In a small number of cases, developers identified their preferred approach to construction through a structured assessment of a range of options with the aim of identifying the approach best aligned to their multiple aims. For example: one local authority commissioned an independent assessment which compared a range of innovative approaches in terms of energy performance; build costs, lifecycle costs and running costs for tenants. However, several developers lamented the absence of data to inform these choices. For example, the developer delivering a shipping container scheme pointed out that there was little existing knowledge regarding the energy and acoustic performance of such schemes, leaving them convinced of the benefits in terms of cost and build time but nervous about the eventual energy performance of the properties. This in turn led them to install more thermal and sound insulation that might have been necessary:

> ‘None of the SAP [Standard Assessment Procedure] modelling is designed to accommodate this type of construction yet. We were all concerned over transfer

of knowledge, particularly with the stigma of container housing, of having issues with noise and obviously thermal issues, so it's probably been over-specified quite considerably. Obviously it's led to lessons now because we've completed one but at the time there was no data cos it was a relatively new concept.' (Private construction partner)

4.29 In the absence of prior experience or reliable data on which to base their decisions, it appeared that many developers opted for approaches which inspired them (i.e. the Barnhaus approach or repurposing of shipping containers). Where developers had been inspired by an innovative approach, it appeared to encourage them to raise their ambitions and perhaps take greater risks on more innovative approaches due to the enthusiasm that they had developed for them. For some, participation in the scheme represented an opportunity to take a chance on approaches that were too expensive and felt too risky under normal circumstances. One developer commented that many social housing providers are very open to innovation and have a history of doing it but often lack the funding to pursue these ambitions:

'The [social housing] sector likes to be a guinea pig. Give us the financial support to take risks and do experiments and we'll do it.' (Development director, housing association)

4.30 Others were more cautious and practical in their decision making and were informed by the experiences of other social housing developers about which approaches were realistic and likely to be acceptable to key decision makers (i.e. board members; planning committees etc.) and to the eventual tenants. This approach tended to result in the rejection of highly innovative methods and a preference for tried and tested approaches:

'We considered thermal foundations but at that time there was only one project in the UK that started to use them and we spoke to the people involved in that project and they were having issues with it so we felt it was a step too far. Our board need to be reassured as well that what we were doing on these projects was deliverable.' (Development manager, Housing Association)

4.31 For other developers, the most appropriate construction approach was dictated by practicalities. For example: for one developer, the benefits of modular housing for infill and small sites were clear from the outset:

> ‘It was a perfect solution because it’s an existing live building with people coming and going, there really wasn’t much space to have a compound and to have a construction site, so … having your units manufactured in a factory really reduces the amount of space you need onsite.’ (Operational manager, local authority)

4.32 Another developer cited similar reasons for opting for offsite methods but they were also attracted by the greater scope to reduce construction waste, minimise disruption to existing residents and to speed up build times.

4.33 The outcomes of these processes of deliberation resulted in the following mix of construction approaches being adopted in year one of the IHP:

- Timber frame incorporating renewable energy/energy saving/energy storage technology (5 schemes)
- Traditional construction (1)
- Passivhaus or Passivhaus principles (5)
- Modular (volumetric/panel based etc.) (2)
- Barnhaus or similar (straw bale insulation) (3)
- Repurposed shipping containers (2)

4.34 Although the range of approaches exemplified is fairly diverse, this list does demonstrate a preference amongst developers for traditional approaches to construction with more innovative technological additions. Passivhaus was equally popular, ostensibly because it’s a relatively well established approach to developing low energy housing (although uncommon in the UK) and was also favoured for the perceived potential to alleviate fuel poverty.

Expectations versus reality

4.35 During the delivery phase, few schemes were without their complications. Even those that opted for a more traditional approach to construction reported complications around the integration of various technologies aimed at improving

environmental performance, including issues around orientation and adapting the detailed design to accommodate particular technologies.

4.36 Problems were also encountered across the five Passivhaus schemes, with respondents reporting that there was significant scope for the eventual performance of these properties to be compromised during the detailed design stage and/or through poor workmanship. There appeared to be significant concern around these issues, which stemmed from underlying nervousness, on the part of developers, about eventual tenant satisfaction and longer term maintenance requirements. In this vein, one developer who had taken a Passivhaus approach was keen to emphasise the need to take care throughout the design and construction process not to compromise the integrity of the end product:

> 'You need to make sure that all the drawings are nailed down before you start because the temptation is for architects to produce drawings as you go very specifically working out how you are going to provide access and use all your different services, pipes in, pipes out or circulations, but you have to do that in such a way that you do not then risk the integrity of the main envelope.' (Developer, housing association)

4.37 Other complications identified around the Passivhaus approach include: the need to identify suppliers (often outside of the UK) that can provide Passivhaus Standard materials, as these supply chains are underdeveloped in the UK; the potential for inefficient use of land due to the need to carefully orientate the properties for solar gain; delays in construction caused by the need for frequent air tightness testing at different stages of construction and the potential for the final product to fail to meet certified Passivhaus Standard. Overall, the Passivhaus Standard was felt (amongst those who had attempted it) to be a restrictive option, the very tight specifications of which limit developers in terms of detailed design, materials, workforce and layout of the site.

4.38 However, although Passivhaus does emerge as a challenging option, it's important to remember that several of the reported issues are not unique to such schemes. Similar issues such as underdeveloped supply chains; the need for careful orientation of properties and the potential for overall performance to be

compromised by detailed design and workmanship, are common across many of the schemes discussed and are common in general. The issues identified are therefore not unique to or caused by the IHP. Instead, it appears that the IHP has created the conditions in which more housing providers can afford to experiment with more innovative approaches to construction.

4.39 The quote below, which refers to the application of transpired solar collectors[10] to a traditionally constructed development, illustrates this point and also suggests that, for this developer at least, they accepted that there are many reasons why innovative approaches may not fully meet expectations regarding performance. Others struggled more to accept the level of risk.

> 'I think that the [transpired solar collector] was quite an experimental thing which we were fully up for in 2017, but we later discovered that it's not as efficient as it should be, but that's the nature of innovation.' (Developer, housing association)

4.40 Concerns and frustrations were also widely expressed about the carbon footprint of developments when measured on a 'cradle to site' basis. These concerns stemmed from the fact that many developers or their construction partners regrettably struggled to source key materials from within Wales. Anecdotes were shared about Passivhaus accredited timber frames being shipped from Ireland; straw bales arriving from Cambridgeshire for Barnhauses and glazing units coming from Austria. Moreover, many of these products were felt to be of poor quality on arrival and some had to be modified on site. Passivhaus and Barnhaus schemes appeared to be the most problematic in this regard.

4.41 As a result of these difficulties around supply chains, some developers had now conducted more detailed research and learnt of more local suppliers that they could use in future.

> 'Welshpool in particular has a number of good quality timber frame and timber panel manufacturers. We have noticed around here over the last 18 months or so a good step up in the standard of those products.' (Construction partner)

[10] A TSC is a skin applied to the outside of a building that harnesses energy from the sun to heat a property.

4.42 Some developers also acknowledged that they had relied too heavily on their architects or construction partners to source materials when maybe they should have led this process themselves or at least got more involved.

Weather and ground conditions

4.43 For respondents pursuing more traditionally constructed schemes, the most significant challenges had little to do with the IHP status of the schemes and arose as a result of the weather. Bad weather can result in delays and complications as a result of poor ground conditions; damage to materials and to properties under construction. Off-site manufacture was welcomed as a way of avoiding exposure to bad weather and maintain quality during the build process:

> 'The difference with a traditional form of construction compared to this more manufactured approach is that we potentially get less shrinkage and so on because it's in a factory environment, so less due to site conditions and it wasn't exposed too much to the weather.' (Regeneration lead, housing association)

4.44 Yet other accounts revealed that off-site manufactured schemes didn't entirely avoid rain and ground water damage. An example was given of finished volumetric modular units having to wait for ground conditions to improve before being properly installed and getting water damaged in the process of waiting. This particular scheme also needed a gas-proof membrane for insurance purposes and wet conditions made this impossible to install.

4.45 Wind exposure also created problems for some, particularly modular schemes that require cranes to put modules in position. However, the use of hydraulic lifts on such schemes rather than scaffolding represented an advantage in terms of being able to make progress in bad weather:

> 'It was an exposed site so there was more consideration about wind and the cranes rather than weather in terms of water and so on, because you could put it up in the rain but you couldn't really put it up in the wind. Rather than use scaffolding they'd have to use hydraulic lifts, so there was a saving there I suppose on scaffolding rather than having hydraulic lifts that you can quite easily put in place to work remotely.' (Investment lead, housing association)

4.46 In response to the issues reported, several respondents advocated more thorough early site investigations conducted jointly by developers and contractors to understand and anticipate potential groundwork and weather related risks that could cause delays. The need for thorough and early site investigations was underlined in relation to several schemes including one where a culvert was discovered running across the site (and in need of repair) during the construction phase. This caused considerable delays whilst various permissions were secured and suitable subcontractors appointed to make the necessary repairs. In this vein, there were also examples of developers and designers making assumptions about the site that were challenged through the planning process or once on site. For example, one developer and their design team assumed that some existing trees on the site could be felled to maximise solar gain when, in the event, the local authority opposed this.

Willingness to use the construction approaches trialled on future schemes

4.47 A commonly cited motivation for getting involved in the IHP on the part of construction partners was that it provided a welcome opportunity to develop their experience in relation to non-traditional construction methods.

4.48 Construction partners on three separate schemes (all SMEs) stated that they were keen to be seen as pioneers of the particular approaches they were being asked to deliver, in the context of Wales at least. Some also highlighted the potential publicity opportunities associated with involvement in the IHP. One developer, with many years' experience of traditional construction, commented that they had been keen to get involved in the scheme in order to:

> 'Step outside our comfort zone and turn our hand to more innovative approaches, recognising that the future of construction probably isn't going down a traditional route.' (Construction partner, SME).

4.49 Another construction partner similarly commented that getting involved with an IHP scheme was an opportunity to *'improve building standards and to innovate and experiment.'*

4.50 For most construction partners, participation had delivered on their expectations and whilst acknowledging that there had been challenges along the way, many seemed unfazed and were keen to deliver more innovative schemes in future:

> 'Contributing to an IHP scheme was attractive as it promised to be relatively high profile; afford good publicity opportunities and winning this contract made us the first company in Wales to build this type of home. We would do it again, with some fairly modest changes. The scheme appeared very innovative but if you're experienced you soon adapt to the new challenges.' (Construction partner, SME).

4.51 On the other hand, the developers leading these schemes felt that they were unlikely to repeat the more innovative construction approaches they had trialled through the IHP and planned to move towards more established methods such as traditional build with enhanced environment standards or modular construction. Many had gone on to secure funding under subsequent rounds of the IHP but expressed a reluctance to be as innovative as they had been in the first round. This view appeared to be driven by several factors including frustrations regarding ineffective or underdeveloped supply chains; difficulties with specialist contractors; the need to modify detailed designs on site and unpredictability around defect levels and future maintenance requirements.

4.52 Many of these factors were overlapping. Issues around supply chains are covered in more detail elsewhere in this report but a key issue related to considerable delays in receiving key materials and components, many of which were bought in (at high cost) from outside of Wales and even outside the UK. Specialist components and materials, in some instances, required specialist contractors to install them (usually accessed via the supplier) and the quality of the workmanship was reportedly questionable. Concerns about quality and the rarity of some of the construction materials used exacerbated concerns around defect levels and the long term maintenance burden.

4.53 The interviews also revealed issues relating to some of the most innovative approaches trialled under year one of the scheme, most of which related to the need to refine design specifications in a hurry once construction was underway. For example, it emerged during construction that the Barnhaus design did not work

without a secondary timber frame being put in place within the main steel frame to hold the straw bale insulation in place. This secondary frame had not been included in the original design. The need for additional modifications to ensure that the insulation materials were fire and weather proof also only became apparent during the construction process.

4.54 However, the views of construction partners were far more optimistic with several stating the belief that being amongst the first to apply innovative approaches in a new context will always bring its challenges but that they will decrease rapidly as the sector adapts. Some developers countered that construction companies have a short term stake in development and do not have to contend with potentially dissatisfied tenants and the long term maintenance burden. The Barnhaus scheme developed by a participating housing association provided an example of this- the construction partner felt that they had learnt some key lessons through the delivery of the scheme and felt confident that they could avoid many of the complications they had experienced in future. The developer, on the other hand, didn't yet know how tenants would respond to the scheme which, amongst other things, is very distinctive compared to its surroundings.

Workforce challenges

4.55 Many developers reported a range of workforce related challenges associated with their schemes. In line with the ethos of the IHP and the provisions of the WFGA, developers strived to identify contractors operating locally or at least within Wales. However, in doing so they encountered difficulties associated with a lack of contractors experienced in more innovative building approaches and skills gaps within the workforce.

4.56 Developer responses to these problems varied considerably. Some took a chance on less experienced local contractors and saw this as an investment in upskilling the workforce of the future and a small number worked proactively with local colleges on apprenticeships in modern construction techniques. Those with an in-house workforce took opportunities to develop the skills of their existing employees, although this happened under considerable time pressure. Others struggled to achieve good value for money given the lack of competition amongst suitably

qualified construction partners locally and decided to look further afield. In this vein, issues were also reported regarding the size of the year one schemes and how they were often too big to appeal to smaller local companies but too small to appeal to larger companies, thus limiting competition further.

4.57 However, most developers conceded that, in hindsight, there were more suitable contractors based in Wales than they had realised at the time and that the time pressures associated with mobilising the schemes (reportedly resulting from the tight timescales associated with year one of the IHP) had limited their ability to properly scope the local market.

4.58 The learning identified in this section is structured around the following key themes:

- Finding local contractors with the required skills and experience.
- Shortages of tradespeople and future trades needed to support innovative housing.
- Working practices and workmanship.
- Too small a job for large companies but too big a project for local SMEs.

Finding local contractors with the required skills and experience

4.59 In line with the WFGA and the ethos of the IHP, most developers had attempted to identify local construction partners but most reported that there were limited options amongst local and regional contractors. These difficulties are described by two different developers in the following quotes:

> 'There are limited appropriate regional contractors in this area- housing projects often go to big nationals/ multi-nationals so the economic benefits rarely stay in the area.' (Development manager, housing association)

> 'In the South Wales context it is quite difficult to get sufficient, suitable contractors to tender for schemes. We advertise but whatever we do we find it really difficult, particularly for the [small] size that this project is, to get a sufficient number of suitable contractors anyway.' (Development manager, housing association)

4.60 Despite reportedly having few to choose from, a significant number (11) of the funded developers did manage to appoint construction partners based in their region or at least within Wales. Difficulties finding local contractors really came to

the fore in relation to the more unconventional construction approaches that some developers were pursuing such as Barnhaus, Passivhaus and the adaptation of shipping containers, for example. However, one of the Barnhaus schemes provided an example of a developer taking a risk and awarding a contract to a local construction partner with no prior experience of this approach but who was keen to develop skills in this area. This decision appeared to have paid off with both the developer and construction partner on good terms and reasonably content with the outcome.

4.61 Another developer (a local authority), delivering a Passivhaus scheme, recounted a very different experience whereby, following a tendering exercise, they appointed an architect from outside of Wales. Due to their lack of experience of delivering Passivhaus schemes, they assigned control over supply chains to the architect (in line with the Architect's preference). This decision brought unexpected consequences regarding the workforce in so far as the specialist materials sourced by the architect required specialised construction expertise and therefore several suppliers of key components (i.e. Passivhaus standard timber frames) also provided contractors to install them. In this instance, the developer was disappointed that the in-house workforce they had hoped to use had made a limited contribution to the scheme and that opportunities for the in house team to learn from the specialist contractors were difficult to broker. In future this developer has committed to upskilling their workforce in the relevant techniques in advance and is also considering setting up their own timber frame workshop. However, they felt that the tight timetables for the mobilisation of IHP schemes made it difficult to undertake this sort of detailed preparation:

> 'There wasn't time to consider exactly how best to do things before we had to move to delivery and there wasn't time to learn the lessons between rounds of the scheme. The IHP timescales are just so tight.' (Architect, local authority)

4.62 A small number of developers found ways to avoid using or relying heavily on external contractors, moving quickly to upskill internal teams. One such example can be found in the case of a developer (a housing association) that anticipated and obviated potential problems associated with outsourcing from the outset by setting

up their own modular housing factory on site. This model was felt to have been successful and one they would repeat:

> ‘We put in mobile flying factories, erecting them under the supervision of qualified people and we built those units in those locations and then when we’re finished we’ll get that factory, when I say factory, some kind of container that we’ll kit out, and put that on the back of a wagon or lorry.’ (Development manager, housing association)

4.63 Similarly, another housing association ran an early programme of low carbon construction training for in-house staff at each site to avoid using external contractors and sub-contractors.

4.64 Another developer's favoured solution was to significantly reduce the size of the workforce required on site by opting for a volumetric modular approach which simply requires the joining together of factory produced modules.

4.65 However, while several in-house construction teams proved they could adapt to the challenge of delivering innovative housing when given the right training and support, organisations without in-house design and/or construction teams were forced to subcontract the detailed design of the schemes, which sometimes led to difficulties and a loss of control over some aspects of the schemes. The local authority delivering their first Passivhaus scheme cited above provides an example of this and it was also identified as an issue in relation to several MMC schemes.

4.66 In terms of the extent to which the workforce issues encountered are specific to the IHP, it is again clear that many of the problems reported relate to the delivery of innovative housing schemes more generally and specifically to the need for rapid upskilling of architects and the construction workforce. Some developers with in-house construction teams have managed to rapidly adapt their operations to avoid some of the challenges faced by those reliant on external contractors. However, it is also clear that the tight timescales on which the IHP operates does reduce the amount of time available to developers to identify the most appropriate partners, anticipate and mitigate challenges, and learn lessons between rounds of the scheme. One respondent underlined the extent of these time pressures,

commenting that the IHP timescales condense a design and build package that would normally take nine or more months to complete in to around four months.

> 'Time has been a massive challenge. The government wants up to upscale the projects but their timescales don't allow for this. I don't know if you know the application process and how long it takes to get planning for something of that size; it was an absolute miracle that we managed to get it through on time. So I think allowing the right amount of time for things is probably the biggest lesson.' (Developer, housing association)

Shortages of tradespeople and future trades needed to support innovative housing

4.67 Respondents also reported issues regarding the availability of specific tradespeople, such as carpenters. For some developers, their response had again been to up-skill their in-house workforce or bring in new apprentices and train them in carpentry, even if this meant they quickly moved on (once qualified) into self-employment and had to then be subcontracted by the lead construction partner or developer:

> 'Good carpenters are in short supply so we have to 'grow our own'. We have to get apprentices and train them up and usually when they get trained up and get efficient, especially in Wales, people buy a van and become self-employed, so that has some challenges but we usually then employ them as an indirect contractor.' (Construction partner)

4.68 This respondent made the point that carpenters will be particularly important in future, as we move away from traditional construction approaches and there is a strong case for diverting brick layers into alternative trades in response to this. Respondents also highlighted the shortage of women in carpentry:

> 'With the low carbon agenda and the work we do with timber and construction it's definitely a viable option to be able to take up a career in carpentry cos don't have that whole macho, hod-carrying culture, it's very much down to craftsmanship.' (Construction partner, local authority)

4.69 Apprenticeships and associated partnerships with local colleges had provided an important source of specialist labour for a couple of year one IHP schemes and also supported local employment aims:

> ‘We put together a 10 week training programme to offer an opportunity to have a taste of the main trades, it was much more successful than we thought it would be because within six weeks one of the people on the course was employed by our contractor because they were doing so well, and one of the other boys managed to get an apprenticeship with another subcontractor via our contractor and one of the other boys we’ve got an apprenticeship with our in-house contractor.’ (Development officer, housing association)

4.70 Despite these successes, there were still concerns about the lack of skills for innovative construction approaches amongst the workforce in Wales, especially as MMC become more common. In this vein, one respondent felt strongly that Welsh Government should be prioritising skills development for MMC in Wales in preparation for a greater reliance on this approach in future:

> ‘I do think that we don’t have the numbers or the local labour to manufacture some of the modern methods, like you have in Bristol, for example. The workforce that we’ve used were basically from England, not predominantly from Wales, I know we’ve got one or two firms in Wales that we’re considering but I think there are issues with sourcing MMC locally rather than going externally to England or further afield. So I think that’s one thing, from Welsh Government’s point of view, there needs to be a big push that needs to happen in terms of addressing new skills for modern methods of construction.’ (Senior officer, housing association)

4.71 Indeed, it could be argued that efforts should be made to upskill the existing and future workforce within Wales to meet the challenges of a range of innovative approaches to construction including and going beyond MMC.

4.72 In this vein, several developers were keen to emphasise that schemes like the IHP can play a key role in building up the experience of local contractors. One respondent reported their experiences of working with the same contractors across the three years of the IHP and observing them progressively mastering key skills

around timber frame construction and solar technology, reaching a position of significant competence by year three.

4.73 Despite concerns about a lack of appropriately skilled contractors within Wales, a number of developers had recently conducted more detailed scoping exercises and learned of more local suppliers that could have provided the skills and materials they needed. Again, the tight timescales associated with delivering the first round of IHP schemes were cited as a key reason why detailed market scoping hadn't felt possible until after the schemes were underway:

> ‘I also think at the time we started the project there didn’t seem to be many fabricators or companies out there that could help us do what we needed to do, but I think now we’ve learnt that locally there are other companies that could help us.’ (Investment lead, housing association)

> ‘So once the containers were purchased from Liverpool we did a procurement exercise to get value for money on selecting [a contractor] and they were the most competitive at that point. However, we could probably do it differently now knowing what we now know and could probably do that more locally.’ (Investment lead, housing association)

Working practices, workmanship and accountability

4.74 As previously noted, the Passivhaus approaches favoured in relation to five of the year one schemes generated a lot of discussion during interviews. The issues highlighted in relation to these schemes help to illustrate broader challenges around working practices, workmanship and accountability for build quality that emerged to varying degrees across most of the year one schemes.

4.75 As previously mentioned, the Passivhaus schemes had evidently challenged the working practices of many tradespeople, some of whom reportedly tend to work very informally and are so entrenched in their ways of working that they follow intuition and tacit knowledge rather than detailed plans. This approach was particularly problematic around the phasing of the key stages of construction which need to happen in a specific order when developing a Passivhaus:

'A lot of the subcontractors have worked with each other before, they've all grown up in the same place, they have a degree of communication and it does run smoothly off that social aspect alone, but there's just a lack of programming I think throughout the industry, a lot of stuff isn't written down.' (Construction partner)

4.76 Another developer pursuing a more traditional scheme had also encountered issues with the quality and finish of their scheme, which they attributed to the mainstream building industry struggling to adapt to new building methods and conditions. Other respondents commented that their contractors were using the IHP schemes as a learning exercise. Most were pleased to be playing a part in upskilling the workforce for future challenges, but also acknowledged the consequences of this for the quality of year one schemes.

4.77 Accountability for poor workmanship was also raised as an issue with some developers feeling unclear about whether the blame for problems encountered on site lay with those responsible for the preparation of detailed designs, the contractors building them out or the subcontractors working under them. In this context, it was remarked that because things like airtightness are a fairly new concern in housebuilding, it can be difficult to know who should be held to account where the standard achieved falls short of the mark.

'The main contractor can't hand over airtightness as a technical issue to a subcontractor. It's different with things like the lights, if they go out that's down to the electrical contractor. But if it's not airtight… who is responsible?' (Technical officer, housing association)

4.78 There was also evidence of some contractors attempting to rectify problems with the detailed design whilst on site (for example, integrating a timber frame to hold insulation in place, which wasn't specified in the detailed design) and while some contractors were happy to take this on, others felt they had been lumbered with unanticipated problems by the designers, some of whom were reportedly very distant during the building out of their plans. Such difficulties point to the need to involve contractors at the detailed design stage so that any technical or construction issues can be picked up in a timely manner.

4.79 However, it is important to note that not all of the construction approaches pursued were regarded as problematic by developers and their construction partners. It did appear that the more unusual the approach (i.e. Passivhaus; Barnhaus; shipping containers), the more complications arose. However, some of the more traditionally constructed schemes did not represent radical departure from existing practice, with only specific components presenting challenges. Overall, developers commented that the high quality of modular products caused minimal complications and this was attributed to quality control being maintained off-site. At the other end of the spectrum, those pursuing shipping container schemes were generally disappointed with the quality of the 'off the shelf' product they received from their supplier and were concerned that they wouldn't perform as well as they had hoped once in occupation.

Too small a job for large companies but too big a project for local SMEs?

4.80 Several respondents also highlighted how local contractors tended to be smaller and not as competitive in their pricing as larger companies in England or elsewhere. These respondents were eager to stress the importance of developing a workforce fit to meet the challenges of modern housing construction in Wales, forging a busier and more competitive marketplace.

4.81 Part of the reason why developers struggled to generate sufficient interest from local construction partners was felt to relate to the size and value of the IHP schemes plus the additional requirements around innovation. One developer felt that the developments they were pursuing were too large for a local SME but not big enough for a large company to consider, thus limiting the market place to one or two contractors with the obvious implications for price:

> ‘There are lots of [contractors] that could do a 3 or 4 million pound contract or less but when it gets up to 6 or 7 million with traditional service requirements and so on, we’re finding it’s the same two or three that are tendering for everything. So there is a concern, it’s not a cartel but it’s a very small pool, the same contractors all the time which doesn’t help on price of course. So that was a factor in us wanting to find another way of procuring this without having to go

down our standard design build route.' (Development manager, housing association)

4.82 Unlike many of the other workforce challenges described in this section, the scale of funding available through the IHP is something specific to the programme and the sort of 'medium sized' developments it leads to appear to represent an awkward fit with the marketplace. This situation had led several developers to adopt more innovative approaches to procurement, including finding (legitimate) ways to by-pass procurement rules and appoint a preferred contractor. This brought benefits in terms of speeding up the procurement process and allowing organisations to appoint contractors known to them without going through a protracted process:

'By chance almost we found there was somebody who'd done a small number of schemes for private clients in the area, the guy lived in the same town but his business was based in the next county. So because of the small size of the contract and the urgency with which we wanted to get it going, we used a provision in our contract procedure rules to go for a single tender for the appointment of this contractor and they were lined up to do the job.' (Construction partner)

4.83 In one instance, a developer had used IHP requirements around innovation and the tight timescales for delivery as a means of speeding up procurement and securing permission to directly appoint a company that had impressed them:

'Because we applied for the IHP funding it allowed us to almost, I wouldn't say bypass, but it helped us get through some of the issues we had with procurement, so because it was a pilot project and the speed of delivery is something that Welsh Government were looking at within the requirements of the funding, we argued that we needed to do a direct award with a company we went to see and liked.' (Operational manager, local authority)

4.84 There was also an isolated example of a construction partner working in almost equal partnership with a developer that they had a history of working with. In this instance, the construction partner brought a site to the developer for consideration as an IHP scheme. This approach offered advantages in terms of the construction

partner being fully invested in the scheme and led to more productive, efficient site finding and procurement processes:

> 'If a contractor comes to us with a site and with a proposal then that's extremely significant because it provides a means of getting sensible discussions with decent contractors who wouldn’t necessarily worry about going through a tender process, but are very happy to talk in detail about a specific proposal. That's very helpful if you want your contractor to be interested and to perform rather than just rattling through a spec.' (Developer, housing association).

5. How does the IHP compare to typical build programmes?

5.1 This section uses the data gathered through the interviews with developers and construction partners to make a comparison, as far as is possible, between the experiences of delivering housing through the IHP and doing so through more 'typical' build programmes. This section considers the similarities and differences in relation to the following aspects of the development process: build costs; building pace; construction waste; and energy performance. Experiences in relation to materials and supply chains are not covered in this section as they are well documented elsewhere in this report (see Sections 4.2 and 4.3).

Build costs

5.2 There was a majority view amongst respondents that the IHP schemes had cost more to build than traditional methods, with many respondents reporting costs being unpredictable and encountering unanticipated costs during the building process. This unpredictability was often associated with difficulties sourcing specialist materials and technical issues which had not been picked up at design stage. Securing statutory connections to sites and dealing with adverse weather conditions were also cited in this context but clearly these issues are not exclusive to IHP schemes.

5.3 The Barnhaus scheme was notable in terms of unpredicted costs, reporting a 12 per cent increase against projected build costs, much of which related to the unanticipated need to modify the design whilst on site to incorporate a timber frame to hold straw bale insulation in place. A Passivhaus scheme also presented significantly higher costs to the contractor due to the incompatibility of masonry build with Passivhaus standards. These sorts of difficulties are clearly related to the innovative and sometimes experimental nature of the IHP schemes, many of which represent the developer and their construction partners' first foray into non-traditional construction approaches. However, it is clear that these kinds of issues could apply to any attempt to pioneer innovative approaches in a new context and as such, it cannot be claimed that these issues are exclusive to IHP schemes.

5.4 The unexpected costs reported underline how vital the IHP funding, in combination with the Social Housing Grant, has been to incentivise developers and contractors to proceed with more innovative (and inherently more financially risky) approaches. In essence, this funding package provided a 'safety net' enabling developers and contractors to innovate, test and learn.

> 'I always considered innovative housing schemes to be tantamount to a long-term liability which would result in high defects and other maintenance problems that would be hard to predict. But the IHP funding combined with the Social Housing Grant allowed us to pursue more innovative approaches on this occasion- taking the financial sting out of the 'experiment.' (Development director, housing association)

5.5 There was also some concern that future builds would come at an even greater cost, as contractors learned from the expense of year one schemes and may increase their costs accordingly. However, greater initial costs were also attributed to the learning and training required when starting out with a new method, so there was broad recognition that those costs and the risk of unanticipated costs would decrease with experience. Build costs for low carbon homes like these may also come down as suppliers and materials become more widely available. Building at scale could also reduce costs for these small and experimental projects, although it was felt that delivering the same high specifications pursued through the IHP (at scale) may be challenging in the short term at least.

5.6 Rent setting parameters were a particularly important factor for several respondents when considering future affordability of innovative methods for Welsh social housing. The impact of higher build costs on rent was something that housing association and local authority respondents reflected on in terms of future rent setting, with some respondents considering higher rent levels for more energy efficient housing which theoretically offers lower energy bills. However, in the absence of specific information about likely rent levels and projected savings on energy costs, it's difficult to assess the validity of this position.

> 'I know some housing associations have adjusted their rent matrix to reflect energy efficient homes, so you can increase the rent against that, because if your

home is more efficient so your rent is more affordable.' (Development manager, housing association)

5.7 An interesting learning point was raised separately by an SME contractor and two housing association representatives who described life-cycle costings as being of equal importance to upfront capital costs in the context of innovative housing. They talked about how reduced energy costs over the lifecycle of homes could fundamentally shift housing association finances, in addition to delivering on environmental aims to reduce carbon. Yet, existing institutional frameworks do not currently adequately allow for these longer-term forecasts to be factored into the decision making process. One construction partner interviewed speculated that factoring life-cycle costs into decision making processes may foster more positive attitudes towards the development of more innovative housing.

'So you build a house at say £100,000 if you used a bog standard brick and breeze block thing but it might cost you £110,000 or £112,000 if you put in solar, but on the other hand you might say in a 50 year life cycle, there is a huge benefit of something like £30-35,000 on top of that in terms of cash to the tenants and people who live in the house, there's also a saving of about 75,000 tonnes of Co2. You've got to have a means of being able to cost those things into your initial capital costs but the existing evaluation criteria, which considers the number of units delivered for capital costs, doesn't allow for that, so that's a major institutional stumbling block.' (Construction partner)

5.8 While developers might perceive there to be higher (or unknown) defect levels associated with innovative methods, several respondents identified fewer defects with their innovative builds to date and attributed this to greater controls in off-site factory conditions. This was linked by respondents to reduced build costs and to savings in responsive repairs and planned maintenance- although this requires longer term monitoring to evidence.

5.9 These perspectives suggest that there are additional considerations when thinking about the future of innovative construction methods in a social housing context including the scope for higher rent levels if the potential for lower energy bills is realised and for savings in relation to longer term maintenance costs. If these

factors could be accommodated within existing decision making frameworks, they may well foster conditions conducive to more widespread delivery of innovative housing.

Timescales/pace of build

5.10 Overall, the schemes that had gone largely according to plan and without significant delays related to external factors (i.e. Covid-19 pandemic, groundwork or contractor issues) reportedly completed more quickly than a traditional build. For example, it was pointed out that whilst traditional housing development might take over a year to build, a timber frame construction might take less than six months.

5.11 As previously outlined, difficulties in securing specialist materials were a key source of delays for some schemes, as was the need to modify the detailed design once on site. Technical issues with ventilation systems also reportedly hampered some schemes. For others, keeping designs as simple as possible not only resulted in quicker construction but also conserved materials. For more technical construction, off-site manufacturing was considered to improve the quality and standard of components ahead of construction, leaving less room for error onsite with obvious advantages for build pace.

5.12 Challenges were also reported around mastering a new order to the build process, which often involved making structures weather tight before installing the insulation material (especially important in relation to the Barnhaus approach, and masonry Passivhaus buildings). Overall, there was a feeling that these delays were the problems of pioneers and would be much reduced if these approaches were repeated in future and that the detailed designs now in place after modifications made on site could be utilised on future schemes.

5.13 Delays were also reported around agreeing contracts with construction partners- this not only delayed the build time overall but in some instances, left the build process out of kilter and made it difficult to realise potential time savings associated with MMC. A key lesson here, identified by respondents, was to engage contractors as early in the development process as possible.

'We had issues getting the agreement in place with [company], it took a long time to agree the contract particulars with them for the construction round which was a problem because the idea of the modular approach is that you dovetail your work on site with your factory build, and that's where you gain a lot of time.'
(Operational manager, local authority)

5.14 Although these difficulties are not unique to IHP schemes, the tight timescales associated with the programme (as previously noted) were felt to have created added time pressures to agree contracts and start work.

5.15 There were also widely reported issues around securing statutory connections (gas, electric, drainage) to the sites which added significantly to build time, although this is unlikely to be specific to innovative schemes. However, these typical institutional barriers undermined the potential for some IHP schemes to realise the potential for a faster build pace. It was conceded by those reporting these difficulties that they could have been avoided if developers had submitted the relevant requests and applications closer to the outset of the development process.

Waste materials

5.16 A number of schemes reported good outcomes in relation to levels of waste materials, observing less waste than traditional builds (which have average waste levels of approximately 10 per cent) but respondents often struggled to be specific about levels of waste generated.

5.17 Timber offcuts were the greatest source of waste materials for those schemes using timber frames. Two respondents emphasised that there appeared to be little incentive for external contractors to minimise timber waste levels as scope for waste is built into the pricing of materials. The in-house construction team affiliated to one developer did make efforts to re-use waste material generated from the timber frame in the internal joinery but much was still wasted. Other materials that were felt to have generated a high level of waste included: plasterboard, dry lining and the tape and paper backing left from Passivhaus construction, which was difficult to dispose of or recycle. In terms of insulation materials, the pulped paper material (pumped in cells within a modular unit) used as insulation on one housing association's scheme generated virtually no waste, making it a favourable option

compared to insulation sheets which have to be cut to size. Straw bale insulation was also found to generate very little waste material.

Energy performance (SAP performance) and affordability

5.18 Understanding of energy performance and the affordability of running costs was somewhat limited in relation to year one schemes, partly due to delays in completions and lettings caused by Covid-19, but also due to delays and some uncertainty around arrangements for post-occupancy performance evaluation and the monitoring of energy savings technologies. Many schemes were also waiting for the results of SAP assessments on their completed properties and the issuing of Energy Performance Certificates. Some developers were unclear about where the funding for non-essential but desirable activities such as post occupancy evaluation and monitoring would come from, whereas others had gone ahead and commissioned studies, many of which combined technical monitoring with surveys and interviews with occupants.

5.19 Many respondents also planned, or recognised the need to plan for, a period of intensive resident engagement in the post occupancy period to support new occupants to adjust to their non-conventional homes and the unfamiliar technologies and systems within them. It was anticipated that some of the behaviour changes required to maximise the performance of these innovative properties would prove difficult to master for some (e.g. keeping windows closed in a Passivhaus or getting used to a low power shower). Residents' behaviour and approach to operating their new homes in the post occupancy period was a concern for a number of developers and it was also emphasised that the process of educating tenants would need to continue into the future as properties are re-let.

5.20 It appeared that many developers had experienced a steep learning curve in terms of understanding the relationship between different design approaches and SAP scores. Some had assumed that pursuing a low energy design approach would, almost naturally, result in the SAP rating necessary to achieve an A rating on the Energy Performance Certificate (EPC), whereas in the event, this had not always been the case. Illustrating this point, one developer described how it may be

necessary to add renewable energy sources to a Passivhaus in order to satisfy the criteria for an EPC A rating:

> ‘When we had our work done on the energy side of it, merely being a Passivhaus, although it might be incredibly airtight, efficient to run, low cost to the tenant, it might not necessarily achieve a SAP rating which would give is an A rating for EPC. We might, for example, have to put PV cells on the property to tip it over into an A. You might think, on the face of it, Passivhaus is going to be up there but the reality is whilst practically it might be very efficient, because of the way these things are scored and calculated, it doesn’t necessarily mean it would have an A rating.’ (Development manager, local authority)

5.21 However, some of these difficulties may be explained by the fact the SAP has not yet been updated to reflect some of the construction approaches exemplified through year one of the IHP. Therefore, a re-assessment at a later date might yield better results.

5.22 The need for careful orientation of properties to maximise the potential for passive solar gain and ensure optimal performance of photovoltaics was a recurrent theme across the interviews with developers, and resulted in complications during the detailed design phases as well as sometimes reducing the number of units it was possible to deliver on site. Some developers were also anxious about whether their schemes would achieve optimal performance where orientation was imperfect. This issue was particularly prominent in relation to more traditionally constructed schemes which followed a simple design and relied on added features such as PV panels and battery walls to boost their energy performance.

6. Progress against outcomes

6.1 This section offers some tentative insights into outcomes associated with the year one schemes. In most cases, it was too early to comment with any conviction about outcomes in terms of energy performance and the outcomes experienced by tenants (many of whom had not yet moved in or had been in the property a short time). It is possible, however, to offer some insights into outcomes in terms of speed of delivery; build costs and shifting norms in the development and construction industry. More detailed accounts of experiences in relation to speed of delivery and build costs can be found in Section 5.

Outcomes in terms of speed of delivery

6.2 As noted previously, most of the year one schemes experienced some level of delays during the planning and construction phases of the project. Some of the reasons for these delays are set out in Section 4 and relate to the challenges of appointing suitable contractors; navigating planning challenges and sourcing materials, etc. The approach taken to construction also had a bearing on the speed with which the schemes progressed through the planning and construction phases and as a general rule, the more innovative schemes encountered the most delays but construction partners stressed that many of these delays could be avoided in future.

6.3 From a construction point of view, MMC were considered to represent a faster approach to development when compared to traditional methods but unfortunately the time savings made by using MMC were sometimes undermined by the much slower provision of utility connections. One developer commented that they completed the buildings within two weeks but utility connections took a further three months to complete:

> ‘We still had the same issues with statutory water, electric functions, gas and so on, that were playing catch up, even though the construction went up quicker, some of the other services weren’t geared up to be so proactive. We would have put up the building within a week or two weeks, whereas it would have took us three months to get there with statutory services. So we were waiting for the

traditional services to be done while the building stood almost complete.' (Investment lead, housing association)

6.4 However, in another interview, a construction partner suggested that it is possible to speed up utility connections if developers are proactive in arranging them at the earliest opportunity:

'It took well over 12 months to get the legal agreements in place but if these sort of things were all signed up prior to contract, there would have been a smoother flow that would have helped on the construction side. We've nagged clients for years to get the [Section] 104 agreement in place before we start onsite so we can just plough on, we can connect to the drainage without leaving 20 metres or so of drainage out, and you can't do that until your 104 is in place.' (Construction partner)

6.5 Several schemes reported delays associated with the need to rethink who their schemes were aimed at. In relation to three or four schemes this was prompted by Covid-19 and the urgent need to house homeless people during the pandemic. However, there was also one example of a developer realising that some of their social aims for the scheme caused too many technical complications for the construction process and would have to be abandoned:

'The idea was to assist low income individuals that needed assistance in the area. The intention was that the scheme was going to be used to promote skills development amongst the youngsters who would be living in the scheme but it would have caused a huge headache in terms of the construction process.' (Investment lead, housing association).

6.6 However, this sort of change in direction was not commonplace and most schemes appeared to be adhering to their original vision for who would live in the completed schemes.

Outcomes in terms of build costs

6.7 Discussions with developers about outcomes regarding build costs were circumspect in nature and this appeared to be because, for many, the final financial position regarding their schemes was not yet clear. Several respondents

commented that it had been difficult to accurately assess the cost of the schemes at the outset due to the unconventional approaches to construction being adopted and uncertainties around materials and labour costs. In essence, it was difficult for developers to accurately cost a scheme that they've never attempted to deliver before.

6.8 A number of respondents reported taking a 'spend and monitor' approach rather than attempting to predict all costs up front. This kind of approach would previously have been considered too risky, but it was felt that the IHP funding had given developers the confidence to proceed with schemes where costs were difficult to accurately predict. One developer expanded on this point, commenting that uncertainties over costs associated with unfamiliar technologies (i.e. air source heat pumps or underfloor heating) may have deterred them from trialling innovative approaches in the past, but the IHP funding had given them the financial flexibility and therefore the confidence to try new things (even on schemes outside of the IHP) and to have more certainty over costs in future:

> 'I think it gave us that bit of flexibility and confidence to try new things for example, underfloor heating, we hadn't tried that before. But we're building another development at the moment which is just standard funding, not IHP, and again we're going for air source heat pumps with the underfloor heating, so it's given us that confidence that we could do this at a competitive cost.' (Developer and contractor)

6.9 Two or three developers commented that they thought their schemes would come in on budget and regarded this is a major success given the unfamiliar nature of what they were delivering:

> 'This project has come in on budget, so I regard that as quite a major success, in fairness that's attributable to the contractor as well as us. Figures which might well have been seen as a bit over the top at the time it was put together, have been robust enough to withstand bits of changes here and there, probably cost increases and that sort of thing, so it's literally come into the pound at the original expected figure.' (Developer, housing association)

6.10 In this instance, the developer attributes this success to taking a cautious approach to costing. They had initially thought they may have overestimated costs but in the event, the scheme came in almost exactly on budget.

6.11 Construction partners could all see scope for efficiencies in the construction process in future and were confident that, on the basis of the lessons they had learnt during year one, they could deliver the same scheme at a lower cost in future. Developers also acknowledged that costs were likely to come down as supply chains for specialist materials develop and the number of appropriately skilled contractors increase, for example.

Outcomes in terms of shifting norms in the construction industry

6.12 There was a clear sense that the year one schemes had been instrumental in shifting attitudes towards innovative approaches to construction amongst both developers and construction partners. There was a palpable eagerness amongst construction partners to master new skills and a keenness to learn the lessons from what was, for most, an early foray into unconventional approaches to construction. There was evidence of developers, construction companies and in-house construction teams readying themselves for the mainstreaming of approaches currently regarded as innovative. In practice this involved contributing to the upskilling of the workforce through training and hands on experience as well as apprenticeship schemes; scoping out new supply chains for sustainable materials; and there were even examples of housing associations, local authorities and construction firms setting up their own off-site manufacturing plants or timber frame workshops in response to the scheme. The vast majority of respondents felt confident that the approaches trialled under year one of the scheme would get easier to deliver with each year that passed and it was their involvement in the IHP that seemed to have instilled this confidence:

> 'We've got our own sustainability strategy now. The big agendas in Wales, and they certainly influenced the IHP, are decarbonisation, off-site manufacturing and Welsh timber. I think what we noticed is that several of our regular main contractors have started to set up their own off-site manufacturing plants and

factories cos they perceive that is the only way they’re going to remain competitive in the future, which is a great thing.' (Developer and contractor).

6.13 Reinforcing this point, there was evidence of developers and construction partner teams moving quickly to apply their learning from year one and also of them seeking to scale up provision of approaches trialled during year one through subsequent rounds of the IHP. These outcomes strongly suggest that participation in year one of the programme had significantly boosted confidence regarding innovative approaches to construction:

'This same developer has put together a package for us for another scheme which he wants to do to the passive house standard. We know one of the reasons he wants to do that is because he now wants to put into practice a number of things he’s learnt from this first one in terms of materials and subcontractors and all the rest of it.' (Developer, housing association)

'So we were successful in taking the lessons learnt from the active homes project, or homes as power stations project, and have up-scaled them tenfold and put that project in for round three.' (Developer, housing association)

6.14 There was also a strong sense that established assumptions about how a housing development should be heated and powered were shifting, ostensibly as a result of participation in the IHP. In this vein, one developer commented that participation in the scheme had inspired his organisation to take bold decisions such as finding alternatives to mains gas connections even where these are readily available on site:

'Normally we would just put mains gas straight in. On other sites looking forward, the decision will be are we going to do that even though there’s mains gas available?' (Developer and contractor).

6.15 Moreover, it was clear that developers and construction partners didn't just see it as a necessity to adopt more sustainable construction approaches or a means of making their business sustainable in the longer term, they were also very proud of the products they had delivered through the IHP. The standards they had achieved through the scheme had evidently set the bar higher for future schemes:

'No doubt the IHP funding and the architect, to give all credit to them, has given us some great ideas. We did raise a few eyebrows at times, but when we looked at the end product in terms of the design and specification and the standards we had achieved, we were all very proud of them.' (Development manager, housing association).

Outcomes for occupants

6.16 Not all schemes were occupied at the time the research was undertaken and satisfaction data was not yet available for those that were occupied. However, there was some anecdotal evidence from developers that had handed over their finished schemes, to suggest that initial resident satisfaction was high in spite of unconventional layouts and the fact that budget and time pressures meant that many developers weren't able to provide floor coverings or white goods:

'They were amazed at the quality of the build. It was slightly different, it was sort of open plan, it’s got a kitchen diner etc. In some circumstances we’ve had to put showers in or very small baths and we couldn't have floor coverings throughout but they took all that on board and were still very happy.' (Investment lead, housing association)

6.17 Developers who had opted for more unconventional construction approaches reported facing some challenges around convincing tenants and official bodies that their properties would make good homes. It was reported in relation to a Barnhaus scheme that their unconventional (metal clad) appearance led to some apprehension amongst local residents, challenging dominant perceptions about what a home looks like. However, the container homes scheme proved the most challenging in this respect, attracting significant opposition from local residents during the planning process and raising concerns amongst Welsh Government officials about whether a container can make a suitable home for a child:

'We started to get questions asked about our scheme from people like the children’s commissioner from Welsh Government, so we actually arranged for some site visits for the children’s commissioner and Cabinet. I kept saying "when you’re in them you won’t know you’re in a container, you’ll think you’re in a really nice flat" and of course when they were in they thought "wow, this is really nice"

so I said "so your choice is a hostel; a really small studio flat; or you have one of these which is a purpose built three bedroom flat". They're not as big as a normal three bed flat but if you’re homeless and this is a very short term provision while we sort you out a longer term housing solution, it’s ideal. It’s a bigger space, it’s warmer, it’s more comfortable and if you’ve got a large family its much better.' (Operational manager, local authority)

7. Key learning from year one of the Innovative Housing Programme

7.1 This report concludes with an overview of the key findings and learning points identified through the research. The learning identified will be of relevance to future rounds of the IHP; to the development of innovative housing schemes more broadly; and to policies and initiatives that seek to promote them. Some of the points identified are of a very practical nature and some are of more relevance to policy.

7.2 Some of the lessons identified are specific to the innovative nature of the schemes pursued in year one of the IHP, whereas others relate to general challenges that may be encountered in relation to most developments but raise relevant consideration for the future of the IHP.

Early stage challenges and benefits: planning, construction and workforce

7.3 This section focuses on the lessons identified through the interviews with developers and their construction partners in relation to the early stages of mobilising the funded schemes, including obtaining planning permission and navigating the planning process; assembling an appropriately skilled workforce and getting construction underway.

Navigating the planning process

- Early dialogue between developers and local authority planning teams (well in advance of the submission of a planning application) can help to resolve tensions between the importance of high quality place making versus the operational objective, held by many social housing providers, to maximise the number of units provided at a time of housing shortage.
- Early dialogue with local residents living in the vicinity of proposed schemes will also be important in avoiding potential objections relating to the potentially unconventional appearances of innovative schemes and the type of tenants they are aimed at.
- A number of developers felt that aiming for a traditional appearance even when adopting an innovative approach to construction successfully reduced concerns amongst local residents and planners.

- Applying for planning permission in advance of identifying a preferred construction approach or working within an existing planning permission is unlikely to speed up the development process. The construction approach should be factored in from the outset.
- Unconventional forms of development may face additional challenges in the planning process or represent unchartered territory (i.e. container homes) and there may be learning to do on the part of local planning authorities in order to be ready for such applications. Developers can help with this through early dialogue with planners and planning committee members, providing detailed information about their preferred construction approach and the advantages it offers.
- The planning stage of the development should be led by someone with experience of the planning system - construction partners are not always well positioned to do this.
- Having the status of an IHP funded scheme could be helpful in the planning process as local planning committees appeared sympathetic to the aims of the programme.

Construction challenges

- IHP funding has given participating developers the confidence and financial 'safety net' to adopt more innovative approaches to what would otherwise have been traditionally constructed schemes.
- In the absence of prior experience or reliable data on which to base their decisions about which construction approach to pursue, many developers opted for approaches which inspired them. This mostly worked well in terms of raising their ambitions and empowering them to take more risks.
- There was a clear preference amongst developers for traditional approaches to construction with more innovative technological additions and for Passivhaus approaches, ostensibly chosen because they're relatively well established and potentially offer substantial energy savings.
- In practice, Passivhaus was considered a challenging option to pursue and many of those who attempted it aren't minded to do so again in future.

- Many developers experienced difficulties with supply chains for specialist construction materials and also struggled to identify construction partners and contractors with the appropriate experience to deliver their innovative schemes.
- In the first year of the scheme developers needed to secure land, planning permission and building contracts in a short space of time, sometimes reducing the time available to identify the most appropriate construction partners and suppliers.
- Despite these difficulties, 11 of the year one schemes (out of a total of 18? schemes) did manage to appoint locally based construction partners but others were forced to look further afield.
- However, once the immediate pressure to deliver the schemes was off, some developers were able to conduct more detailed research into supply chains and contractors and, through this, many had identified local suppliers that they could use in future.
- Many developers concluded that they should have spent more time scoping local supply chains at the outset of the project, before they imported materials or deferred to their architects to make supply chain decisions on their behalves.
- Off-site manufacture can help to reduce the impact of poor weather on the build process, but high winds and poor ground conditions can still frustrate progress. Thorough and early site investigations conducted jointly by developers and contractors and detailed contingency planning can help reduce delays.
- Some construction partners had to rapidly rectify shortcomings in the detailed design of schemes whilst on site and as such called for detailed designs for innovative schemes to be kept as simple as possible to enable a smooth construction process.
- The more unconventional schemes (i.e.Barnhaus; Passivhaus etc.) pursued tended to suffer the most complications during construction whereas the more traditionally constructed schemes presented few challenges aside from issues around innovative components. Modular products were felt to cause the least complications.
- Construction partners were positive about the opportunities available under the IHP to prepare for the construction approaches of the future and felt that, on the

basis of what they had learnt through the scheme, they could deliver the same schemes more quickly and cheaply in future. Developers were less inclined to want to repeat highly innovative approaches citing concerns about unknown defect levels and long term maintenance.

Workforce challenges

- Developers strived to identify suitable contractors operating locally or at least within Wales but time constraints limited efforts to find suitably skilled contractors locally. These difficulties were most pronounced in relation to the more specialist construction approaches such as Barnhaus, Passivhaus and use of shipping containers. Responses from participants included taking a chance on local companies; rapidly upskilling in-house construction teams; or looking outside of Wales, with the former two options yielding the best outcomes.
- The size and value of the IHP schemes plus the additional requirements around innovation were felt to limit interest from construction partners and contractors. It was suggested that the developments being pursued were too large for a local SME to fulfil but not big enough for a large company to consider.
- Some suppliers of specialist components insisted on providing their own workforce to assemble the components on site. This reportedly led to issues around the quality of workmanship and undermined opportunities for local teams to upskill.
- Many of the workforce problems reported are not specific to the IHP and relate to the need for the design and construction industries to rapidly upskill. However, the tight timescales associated with the IHP reduced the amount of time available to identify suitable local partners.
- Apprenticeships and partnerships with local colleges provided specialist labour for some schemes and also supported local employment aims.
- Some construction contractors have established ways of working that are informal and rely on tacit knowledge rather than detailed planning- this was particularly problematic in relation to highly specialised construction techniques which require contractors to follow tightly defined processes.

How does the IHP compare to typical build programmes?

7.4 This section uses the data gathered through the interviews with developers and construction partners to make a comparison, as far as is possible, between the experiences of delivering housing through the IHP and doing so through more 'typical' build programmes. This section considers the similarities and differences in relation to: build costs; building pace; construction waste and energy performance.

Build costs

- Most respondents felt that the IHP schemes had cost more to build than traditional methods. Many reported encountering unanticipated costs during the building process often associated with difficulties sourcing specialist materials and resolving issues with the detailed design whilst on site.
- These unpredictable costs underline the importance of IHP funding in incentivising developers to proceed with innovative (and more financially risky) schemes and developing their experience.
- High and unpredictable build costs may act as a disincentive to developers delivering innovative schemes at scale in the short term, although it was accepted that build costs are likely to come down as innovative approaches are mainstreamed and processes become refined.
- Some developers were considering setting higher rent levels for more energy efficient housing to cover higher build costs and because such properties theoretically offer lower energy bills. However, it was difficult for them to reach a firm position on this without having reliable indications of likely running costs.
- Life-cycle costs associated with innovative housing may be of equal importance to upfront capital costs when considering the viability of innovative housing. Some respondents believed that significantly reduced energy costs over the lifecycle of homes could fundamentally shift housing association finances, yet institutional frameworks do not yet allow for these longer-term forecasts.
- Whilst likely defect levels associated with innovative methods were a concern for developers, several respondents identified fewer defects with their innovative builds to date than they would expect from traditional construction. This was

attributed to the greater level of quality control possible through off-site manufacture.

Timescales and pace of build

- Although most schemes reported faster completion times than would have been expected for a traditional build, many schemes struggled to meet projected timescales primarily due to delays in appointing appropriate contractors and sourcing specialist materials.
- Overall, there was a feeling that delays would be much reduced if these approaches were repeated in future and that the detailed designs now in place after modifications made on site could be utilised on future schemes.
- It was felt that where designs were kept as simple as possible this enabled faster construction and conserved materials. For more technical construction, off-site manufacturing improved the quality of components thus speeding up construction.
- Challenges were also reported around mastering a new order to the build process, which often involved making structures weather tight before installing insulation material.
- Delays were also reported around agreeing contracts with construction partners underlining the importance of engaging contractors as early in the development process as possible.
- Securing statutory connections11 added significantly to build time in several cases, undermining the potential for IHP schemes to realise faster build paces. Beginning these statutory processes as early as possible was felt by participants to be key.

[11] Statutory connections refer to the essential infrastructure connections (i.e. electricity, gas, water, sewage and communications) necessary for the development to function.

Waste materials

- Respondents struggled to be specific about construction waste levels but generally reported good outcomes in comparison to traditional builds.
- Timber offcuts were the greatest source of waste materials for those schemes using timber frames and there appeared to be little incentive for external contractors to minimise timber waste.
- High levels of waste were reported in relation to: plasterboard, dry lining and the tape and paper backing left from Passivhaus construction.
- Pulped paper insulation (pumped into cells within a modular unit) was praised for generating virtually no waste compared to insulation sheets and straw bale insulation was also found to be a low waste option.

Energy performance (Standard Assessment Procedure or SAP performance) and affordability

- Residents' proficiency in operating their new homes in the post occupancy period and when properties were re-let was a concern for some developers and many had planned a period of intensive resident engagement and support in the post-occupancy period.
- A number of developers assumed that pursuing low energy designs would result in the SAP rating necessary to achieve an EPC A rating. In some cases it had been necessary to add in additional renewable energy sources to achieve EPC A.
- The need for careful orientation of properties to maximise the potential for solar gain and ensure optimal performance of photovoltaics resulted in complications during the detailed design phases as well as sometimes reducing the number of units it was possible to deliver on site compared to traditional designs and layouts.

Progress against outcomes

7.5 This section offers some tentative insights into outcomes associated with the year one schemes. However, in most cases, it was too early to comment with any conviction about outcomes in terms of energy performance and the outcomes experienced by tenants (many of whom had not yet moved in or had been in the

property only a short time). It is possible, however, to offer some insights into outcomes in terms of speed of delivery; build costs and shifting norms in the development and construction industry.

Outcomes in terms of speed of delivery

- Most schemes experienced some level of delays during the planning and construction phases and these related to appointing suitable contractors; navigating planning challenges; and sourcing materials. These delays undermined the potential gains in build pace made possible by some innovative methods.
- Modern Methods of Construction (MMC) were considered a faster approach to development when compared to traditional methods but progress was still hampered by challenges around securing utility connections and weather conditions.
- As a general rule, the more innovative schemes encountered the most delays but construction partners stressed that many of these delays could be avoided in future.

Outcomes in terms of build costs

- For many, the final financial position regarding their schemes was not yet clear.
- Developers and their construction partners found it difficult to accurately cost schemes that they had no prior experience of delivering. However, access to IHP funding reduced the risks associated with uncertain build costs. Several commented that they would have more certainty over costs in future as a result of the knowledge gained in year one of the Programme.
- Several developers thought their schemes would come in on budget and regarded this as a major success in the context of an experimental scheme. Partly this was due to a cautious approach to budgeting by developers.
- Construction partners could all see scope for efficiencies in the construction process in future and were confident that they could deliver the same scheme at a lower cost in future.

Outcomes in terms of shifting norms in the development and construction industry

- Participation in year one of the IHP had evidently shifted attitudes towards innovative approaches to construction amongst both developers and construction partners. They were proud of the products they had delivered and felt the standards achieved through the IHP had set the bar higher for future schemes.
- Developers and construction partners were making significant contributions to preparing the sector for future construction challenges through provision of training; hands on experience; apprenticeships; scoping out new supply chains for sustainable materials and in some cases, setting up their own off-site manufacturing plants or timber frame workshops.
- There was also evidence of developers and construction partner teams moving very quickly to apply their learning from year one and also scaling up provision of some of the approaches trialled.

Outcomes for occupants

- Initial anecdotal indications of resident satisfaction (collected by x themselves) were promising with residents responding positively to their new homes in spite of unconventional features.
- Developers who had opted for more unconventional construction approaches reported facing some challenges around convincing tenants that their properties would make good homes- this was particularly an issue for unusual looking properties (i.e. Barnhauses) and container homes.

Annex A: Topic guide used in all interviews

Welsh Government Innovative Housing Programme

Interviews with funded housing providers and contractors

Topic guide

Before each interview:

- Send participant information sheet and consent form to interviewee by email.
- Read scheme application form and learning presentations for each scheme prior to interview.
- All questions to be asked of developers, unless otherwise stated. Levels of contractor involvement in scheme development will vary. Ahead of each interview with contractors, identify questions of relevance to contractor based on a review of the background information on schemes.
- Prepare scheme specific questions (Section 7).

1. Introduction

- Thank participant for agreeing to take part.
- Briefly re-cap on the purpose of the research, as outlined in the privacy notice:
    - we are aiming to speak to all housing providers funded during the first year of the IHP and their contractors to identify early construction messages.
    - ultimately this research will contribute to improving the delivery and effectiveness of the IHP in future rounds and
    - contribute to the development of effective solutions to future housing provision in Wales.
- Explain that the interview will take between 45 minutes and one hour, depending how much they have to say and that I will cover the background to their participation in the programme and their experiences of the planning, construction and workforce related challenges and benefits of taking part.

- Explain that, with their permission, the interview will be audio recorded to ensure the researcher can focus on the conversation rather than taking notes and to enable accurate analysis.

Start audio recorder if participant consents to this

- Discuss consent form (they should have sight of this) and explain how a signature will be secured remotely. Also get verbal consent.

2. Involvement with the IHP

- What motivated your organisation to apply for funding under the IHP?
- Was the approach you proposed in your application for funding different to your typical approach to housing development? If so, in what ways? And what motivated this departure from normal practice? Was this in response to the requirements of the scheme and/or for other reasons? To what extent did the IHP motivate you to adopt more innovative approaches? What barriers has the IHP allowed you to overcome?
- What have been the main benefits of participating in the IHP for your organisation and for your customers?
- Have there been any drawbacks?
- [In terms of process] Has it been different providing housing through this scheme than through your standard provision? *In what ways?*

3. Early messages (construction/planning/workforce)

3.1 Planning (developers only)

- Can you tell me about your experience of getting the scheme(s) through the planning process?
    - Probe: anticipated and unexpected planning barriers? Were timescales for approval as expected? What level of scrutiny did the scheme receive? Did the novel nature of the scheme cause any difficulties? To what extent were planning officers supportive of the scheme? Were planning conditions as expected? Public procurement barriers?
- How did your experience of the planning process in relation this scheme compare to your experience in relation to previous, more conventional schemes?

- Probe: in terms of timescales, attitudes of planning officers and committees; levels of support and complexity; decision and nature and extent of planning conditions.

- What are the key lessons that you've identified in relation to planning that you would like to highlight for others considering a similar approach?
- Is there anything you would do differently in terms of planning if you were doing this scheme again?

3.2 Construction (developers and contractors)

- Can you briefly re-cap on the approach taken to construction in relation to this scheme?
  - Probe: What were the innovative aspects of the approach? Why was this approach adopted on this occasion?
- Can you tell me about your experiences of the construction phase of the scheme?
  - Probe: What were the specific challenges of the approach adopted? How were these challenges overcome? What were the benefits?
  - Issues such as supply chain management, infrastructure (roads/ transport), technology?
- What are the key lessons that you've identified in relation to the approach to construction that you adopted that you would like to highlight for others considering this approach?
- Is there anything you would do differently in terms of construction if you were doing this scheme again?

3.3 Workforce and skills (developers and contractors)

- Can you outline the main workforce challenges in relation to this scheme?
  - Probe: How do you recruit your workforce? Casual or permanent employees? Was a workforce already in place prior to the award of funding? Why/why not? **[Key probe] To what extent were challenges encountered to do with the innovative nature of the scheme?** Were workforce challenges just related to construction workers or more broad than this?

- [If not already answered] Did you encounter any particular challenges in relation to findings a workforce with the specific skills required to deliver the scheme to a high standard?
    - Probe: What were the consequences of this? How did it impact on timescales, quality and cost of the scheme? How was this overcome? Was it addressed through training or other means?
- Are there any ways in which workforce issues impacted on the planning and construction processes?
- What are the key lessons that you've identified in relation to workforce and skills that you would like to highlight for others?
- Is there anything you would do differently in terms of workforce and skills if you were doing this scheme again?

- 4. IHP v typical build programmes (developers and contractors)

- What in your experience are the most significant differences between your experience of building housing under the IHP and through more conventional building programmes?
    - Probe: [be clear] are these differences specific to the IHP or do they relate to more innovative approaches in general?
- [If not already covered] What differences have you observed in terms of **build costs** between IHP and typical schemes?
    - Probe: what do these differences relate to? I.e. materials; workforce etc.
- [If not already covered] What differences have you observed in terms of **availability of materials** between IHP and typical schemes?
    - Probe: specifically which materials have proved difficult to acquire? How was this overcome? Alternative materials used? What was the impact of this?
- [If not already covered] What differences have you observed in terms of **construction waste materials** between IHP and typical schemes?
    - Probe: Were particular materials more problematic in this regard? What led to the waste? Were any mitigation measures adopted to reduce waste? Were there any impacts (costs) associated with these waste levels?

- [If not already covered] What differences have you observed in terms of **pace of build** between IHP and typical schemes?
    - Probe: what were the key factors behind faster or slower build times? What was the impact of faster or slower build times?
- **5. Specific challenges** (developers and contractors)

- Are there any challenges or benefits (not already covered) that you would like to highlight in relation to the specific methods of construction you have used on your IHP schemes?
    - Probe: particular issues around MMC, OSM and how they compare to more typical approaches.
- Are there any challenges or benefits (not already covered) that you would like to highlight in relation to the different types of sites you have used on your IHP schemes?
    - Probe: the challenges may differ due to factors such as: brownfield/greenfield; urban/rural; small/large; who owns the land; topography; condition of the site (need for remediation); conservation issues etc.

- **6. Outcomes and outputs** (developers) *Tailor questions to individual schemes using details of planned outputs and outcomes set out in application forms completed by successful developers*

- Overall how well did you do in terms of delivering the outputs and outcomes proposed in your original bid(s) during the planning and construction period and up to practical completion?

7. Scheme specific questions

Use this space to ask any scheme specific questions that have arisen from your analysis of the application forms and learning presentations, if these haven't been covered in the discussion so far.

- 8. Conclusion

- Reflecting on your experience of the IHP overall…If you were given the chance to do it all over again, what (if anything) would you do differently?

Thanks participant. Stop audio recorder and upload file to the project folder.