Department for Energy Security & Net Zero

Whole House Retrofit (WHR) and Social Housing Decarbonisation Fund Demonstrator (SHDF(D))

Joint Process Evaluation Report

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Disclaimer

This report reflects the SHDF Demonstrator and Whole House Retrofit projects up to June 2022. Some projects may have altered in delivery plans or scheme participation since this date. Where up-to-date information is available, full conclusions will be covered in the forthcoming outcome and economic evaluation report.

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Executive Summary

The Department for Energy Security and Net Zero (referenced throughout this report by its name at the time of delivery, BEIS) commissioned Ipsos and its partners Energy Saving Trust and Technopolis Group to conduct a process, outcome and economic evaluation of the Whole House Retrofit (WHR) and Social Housing Decarbonisation Fund (Demonstrator) (SHDF(D)) programmes.

This process evaluation report is the first of several reports that will be published from the evaluation. It draws upon evidence from an extensive review of secondary data sources, interviews with key informants and participant observation, as well as case studies of ten social housing retrofit projects.

This report covers scheme launch and project delivery to the end of June 2022. It assesses the performance of the WHR, SHDF(D), and their constituent projects, and their progress towards intended objectives.

Background

The UK has the least energy efficient housing stock in Europe (Green Alliance, 2019). Homes account for 35% of all energy consumption in the UK and 20% of the UK's carbon dioxide emissions (CLC, 2021). Effective action to reduce energy consumption from existing dwellings and to eliminate fuel poverty is critical for the Government to achieve its goal of decarbonising dwellings by 2050 (BEIS, 2021c).

A whole house approach takes a holistic and individualised view of the building to optimise efficiency savings while preserving or enhancing occupant health and wellbeing. When taking a whole house approach, retrofitters should install measures in a coordinated way to minimise disruption and maximise cost efficiency.

Launched in June 2019, WHR set out to test whether a whole house retrofit approach could be applied at lower cost through innovations and economies of scale. It responded to the 2018 Buildings Mission, which aimed to halve the cost of retrofitting existing dwellings to new-build standards by 2030. WHR awarded grants to four innovation projects, all led by social housing providers from across the UK, in Cornwall, London, Nottingham and Scotland.

SHDF(D) launched at the end of September 2020 as part of the Government's Green Economic Stimulus Package of energy efficiency schemes announced in the July 2020 Summer Economic Update. It used the same delivery partner as WHR, Ricardo PLC, and built on WHR's design and programme management systems. However, SHDF(D) was larger in scale, had shorter delivery windows, targeted social housing by design and carried additional ambitions to stimulate the retrofit market and local authority capability and capacity to do retrofits, as part of the UK's economic recovery from the COVID-19 pandemic. It also aimed to

provide learnings that could be used in developing the future waves of the SHDF programme (in line with the Conservative Party's 2019 election manifesto commitment in this area). The Table below provides an outline of the two programmes.

Table 1: Scope of WHR and SHDF(D) (correct to 30th June 2022)

	Whole House Retrofit	SHDF Demonstrator
Funding allocated	£7.7m	£62m
Coverages of social housing tenure	By competition outcome	By programme design
Initial projects funded	4	19
Initial households targeted	396 (470 including withdrawn projects)	2,273 (2,369 including withdrawn projects)
Target energy performance	EPC A-B	EPC A-C
Install cost-reduction target	5-15%	5-30%
Energy performance target	15-30 kWh/m2/yr	50kWh/m2/yr

WHR intended to close by April 2021, later extended to April 2023 to account for the unanticipated effects of COVID-19. SHDF(D) intended to close by December 2021 but was extended to December 2022 to account for the continued effects of the pandemic on delivery, among other reasons explained below. As of 30th June 2022:

- 14 WHR properties have been retrofitted (17% of the revised target), with 59 (71%) undergoing installation and a further 10 (12%) yet to begin installation.
- 255 SHDF(D) properties (14% of the revised target) were complete and a further 713 (39%) were underway, with 849 (47%) not yet started works.

Table 2: Overview of WHR and SHDF(D) delivery (correct to 30th June 2022)[1]

	WHR	SHDF(D)
Funding allocated	£7.7m	£62m
Initial target households	396 (470 including withdrawn projects)	2,273 (2,369 including withdrawn projects)
Selected households	83 (79% reduction)	1,817 (20% reduction)
Installations completed	14	255
Installations underway	59	713
Installations yet to start	10	849

[1] Source: Project monitoring and performance reporting to SHDF(D) and WHR Delivery Partner.

Key findings: WHR

WHR was designed as part of BEIS' Energy Innovation Programme with the purpose of testing whether whole house retrofit could be deployed at scale and through innovative methods to halve the cost per house of renovating buildings to a similar-to-new-build standard (in terms of quality and safety). It was designed on the basis of learning from the 2014 UK Research and Innovation Programme 'Retrofit for the Future' and was intended to generate understanding for BEIS that could be used in the rollout of future programmes. It also aimed to increase industry confidence in the affordability and value for money of deep retrofit when rolled out at scale, and industry's capacity to implement it.

However, WHR-funded projects faced unforeseen delivery challenges. Most notably, COVID-19 negatively affected project team staff availability, the wider supply chain's capacity to deliver, and project access to homes. This delayed delivery, and BEIS granted a six-month extension to all projects. There were also project-specific challenges, including protected roosting seagulls nesting in the roofs of target homes in Cornwall, further challenges with the supply chain in Nottingham City, and difficulties in procuring contractors who could install WHR Energiesprong Sutton's innovative technology. Evidence from interviews with the BEIS WHR delivery team suggests that the launch of SHDF(D) alongside WHR put pressure on an immature market, leading to supply and demand discrepancies.

All WHR projects were initially expected to complete work by April 2021, but the 18-month original timeline was extended to April 2023, with only two of the four WHR funded projects continuing to this point. Renfrewshire dropped out shortly after the programme's launch, citing procurement problems and associated increases in cost, and Cornwall withdrew in March 2022, citing delays to procurement which made the delivery milestones unattainable. The two remaining projects, Nottingham City Council's Destination Zero 1 project and Energiesprong Sutton required further extensions (and were ongoing as of end June 2022) and each reduced the number of homes treated from 195 to 68 and from 100 to 23, respectively. Moreover, the remaining properties are being treated to meet a lower standard of energy performance and innovation, finding original ambitions unachievable within programme budgets and time constraints caused by procurement and delivery challenges.

Key findings: SHDF(D)

There was a clear evolution in design from WHR to SHDF(D), with the latter taking on board numerous lessons learned from the former. The SHDF(D) team lowered the programme's energy performance and cost reduction targets (compared to WHR) but introduced the requirement to retrofit according to a prescribed process - the British Standards Institute's publicly available standard for domestic retrofit (PAS 2035). This standard was published but not yet mandatory across government energy efficiency schemes at the time of the WHR launch. Mandatory PAS 2035 compliance was intended to support consistency and quality of retrofit across SHDF(D) projects.

SHDF(D) attracted a substantial level of interest, with 36 project bids and 19 projects awarded funding. SHDF(D) attracted both local authority (with housing associations) teams with experience in deep retrofit - and ready-to-go designs - and newcomers to deep retrofit. Overall, the programme attracted a wide variety of projects in terms of their ambition, innovations to be developed and applied, housing stock, and type of resident.

Like WHR, SHDF(D) faced considerable challenges during implementation. Whilst the programme was launched as a Green Economic Stimulus scheme in response to COVID-19, the effects of the pandemic continued to significantly affect the supply of materials, availability of labour, and access to treated homes. All 17 projects which were in progress as of end of June 2022 had their timelines extended, and instead of closing in December 2021, projects continued through to March 2022 (one project), September 2022 (eight projects), and December (eight projects). The formal closure of the SHDF(D) is December 2022 and some projects will be continuing with residual delivery work into 2023 using match funding to complete commitments to tenants.

SHDF(D) had greater success than WHR in supporting projects to meet their target number of retrofits. However, almost all SHDF(D) projects had to lower their original ambitions in terms of building performance targets, cost reduction goals, and clean heat technologies in order to deliver in the challenging market conditions and timelines for spending of grant money. SHDF(D) projects faced similar delivery challenges to WHR: procurement blockages, supply chain immaturity, COVID-19-related access issues, and project-specific challenges related to the need to move electricity lines, or deal with unanticipated flooding.

Almost all SHDF(D) project teams report that PAS 2035 generated delivery challenges and delays. Several projects saw their costs increase due to preparatory works (e.g. extending eaves) to meet PAS 2035 requirements. Overall, project teams had mixed views on the standard. Despite the challenges of delivering to PAS 2035, some considered that the standard helped them achieve quality in installation and it increased their understanding of what is needed for a whole house retrofit. Others considered that PAS 2035 - and a whole house approach - was not efficient and limited the extent to which mass retrofit approaches could be undertaken.

The BEIS SHDF(D) delivery team initially drew upon WHR systems and templates for programme management, but later adapted these to meet the programme's specific needs. As with WHR, SHDF(D) also adapted its delivery expectations and targets to enable its overall objectives to be met. However, several aspects of SHDF(D)'s programme delivery generated inherent challenges:

- To fit economic stimulus objectives and ensure the support fell within the financial year 2020-21, BEIS distributed funds to English local authorities up front via Section 31 of the Local Government Act. While this gave certainty to social housing landlords and to the supply chain, it reduced BEIS' ability to hold projects to account for their spending and created some inefficiencies in monitoring and grant management in the next two financial years of delivery.

- The short-term economic stimulus objectives also drove very short timescales for grant applications and project delivery. This meant there was less time available for project design and set-up, which led to inefficiencies later in implementation, such as delays in procuring materials and labour which pushed up project costs (as prices had risen).
- These short timescales also reduced opportunities for flexibility and sequencing in the supply chain; the timescales meant that projects made similar demands on the supply chain (e.g. for specialist materials and products) at the same time with supply unable to meet demand.

The reporting requirements and site visits set by BEIS for monitoring project performance increased workloads on projects and were particularly time intensive for projects with limited resource. However, monitoring processes clearly contributed to BEIS and projects' learning, for example through the monthly Learning Community for WHR and SHDF(D) project managers.

Overall conclusions

"The Social Housing Decarbonisation Fund Demonstrator and Whole House Retrofit funds have made organisations sit up and realise that they have a role to play and try and find their way through that, and I think we're still very much at the beginning of that journey." - Insulation Manufacturer

The WHR and SHDF(D) programmes created a funding stream and a rationale for local authorities and social housing providers to implement a whole house approach to retrofitting their homes. In interviews and in project reporting, project teams reported that they would have been unlikely to have implemented the projects at all, or to the same scale and profile, without BEIS funding. Several projects used the funding to treat particularly hard-to-treat homes, some of which might have otherwise been demolished, and other projects used the funding to develop blueprints for ongoing deep retrofit across other parts of their housing stock.

Key successes of the programmes include:

- **The monthly Learning Community**: the SHDF(D) team invited all WHR and SHDF(D) project managers to join virtual group meetings at which they presented and discussed progress, common challenges, innovations and best practice. These led, for example, to several projects adopting an innovation to seal external wall insulation around meter boxes, originally designed by Leeds Council for its SHDF(D) project.
- **Resident engagement**: Some projects demonstrated best practice in engaging residents. This was the case where the resident liaison officer (RLO) had close and trusted relationships with tenants and was able to provide a holistic service, answering questions about well-being, timelines, and technical aspects of the build. Where homes were retrofitted in phases, and tenants were able to see the aesthetics and performance of a retrofitted home before fully signing up, this also often increased engagement.
- **Solutions innovation**: Projects deployed innovative responses to challenges without compromising on the whole house approach. These have included new ways of

minimising disruption to residents during the retrofit, and innovative ways to facilitate the administration of planning permissions.

- **Technical innovation**: Projects applied numerous innovations in the heating systems space with multiple companies offering unique and/or advanced solutions to insulation, heating, and ventilation. An example of this is the Q-bot, an insulation method using robots to minimise disruption to householders.
- **Sector development**: Projects have also driven activity in the retrofit sector, providing a pipeline of work for construction, architecture and technology supply companies to work towards. Interviews with the supply chain highlighted the view that the programmes compelled the retrofit sector to mobilise staff to support delivery of projects and to upskill to deliver to the PAS 2035 standard.

Both the WHR and SHDF(D) programmes set out to achieve multiple objectives, some of which were not wholly compatible. For example, both programmes aimed to encourage innovation and learning about how best to implement deep retrofit at scale, but then set short timescales within which this should be achieved; both also wanted to achieve high levels of retrofit quality and performance whilst still being affordable at scale.

The main hurdle in project set-up and delivery was the assumption that both programmes could be delivered within the 12 to 18-month timeframe. This did not take sufficient consideration of the time that would be needed to set up projects within local planning and other regulatory contexts, to engage residents, to carry out remedial works, to procure contractors, to respond to unanticipated challenges, or to make change requests.

The fact that the two programmes operated at the same time, and parallel to numerous other government-funded insulation and energy efficiency schemes (for instance, Green Homes Grant Vouchers and Local Authority Delivery), put some pressure on the retrofit supply chain, but also generated some valuable benefits. Delivery teams at both the programme and project levels could share experiences, knowledge and good practices, benefiting delivery. For BEIS, knowledge of the challenges and solutions across the programmes supported decisions around project change requests, how best to support projects and how to design future policy, in particular forthcoming waves of the SHDF Main Fund.

BEIS also benefitted from having two different programmes test different policy designs (e.g. mandatory whole house retrofit industry standard (PAS2035) compliance vs. no prescribed standard), monitoring regimes, and performance management approaches at the same time. The evidence suggests that this has generated greater learning about domestic retrofit in general, but also around how central government should best support deep retrofit, than would have been reached from just one approach.

1 Introduction

Chapter 1 – at a glance

- This Report describes the Process Evaluation of WHR and SHDF(D), covering the programmes' activity from January 2021 until June 2022.
- The Process Evaluation describes and assesses the performance of WHR, SHDF(D), and their constituent projects. It also provides information on the different models for delivering whole house retrofit at scale.
- An outcome and economic evaluation is ongoing, and a Final Evaluation Report will be published in 2023.

The Department for Energy Security and Net Zero (then BEIS) commissioned a joint process, outcome and economic evaluation of the Whole House Retrofit (WHR) and Social Housing Decarbonisation Fund (Demonstrator) (SHDF(D)) programmes to run from February 2021 to August 2023. The two programmes are evaluated jointly as they share similar goals, with SHDF(D) being launched as a scale-up of WHR. This report covers the Process Evaluation and describes findings common and unique to each programme. Reports evaluating the outcome and value for money of the scheme will be published in 2023.

This Process Evaluation describes and assesses the performance of WHR, SHDF(D), and their constituent projects in progressing towards the following goals:

- To contribute to the decarbonisation of the housing sector, and;
- To support innovation and learning to facilitate deep retrofit at scale.

It provides policymakers with a greater understanding of the different models for delivering whole house retrofit at scale, and the effectiveness and different consequences of these.

This research covers the programmes' inception, delivery, and some project closure activities which took place between each scheme's launch and the end of June 2022, combining findings from both WHR and SHDF(D). It evaluates each programme's design and Theory of Change (chapter 3), as well as the programme delivery processes (chapter 4). It then describes project design, and the different project 'types' supported (chapter 5), as well as evaluating project progress and effectiveness to date (chapter 6). The report concludes by setting out lessons learnt for future delivery (chapter 7).

2 Methodology

This section provides a brief overview of how the evaluation team conducted the research for this Process Evaluation. The evaluation approach and research methodology are set out in detail in the Technical Annex accompanying this report.

2.1 Evaluation approach and methodology

This Process Evaluation investigated the following questions (see Table 2.1). In addition, it evaluates programme design (chapter 3).

Table 2.1. Process evaluation questions

Focus	Process evaluation questions	Where this is covered in the Report
Programme delivery	How effective was the competition in attracting viable bids? What support was provided by BEIS and Ricardo to projects? What is the role of the PAS 2035 standard (a requirement in SHDF(D) and encouraged in WHR) in projects and installation quality?	Chapter 4
Project design	Why did WHR only fund social housing bids? How did scheme design influence project design? What was the rationale for local authorities' involvement in programmes? How do/did local authorities otherwise implement WHR in the absence of the programme? How do projects engage installers and residents? How did local authorities and installers form partnerships? How did projects undertake stock selection? What innovative products and methods have been introduced in projects?	Chapter 5
Project delivery	What were the key facilitators and barriers to success? How do local authorities deliver the projects? What demand exists in the retrofit market to engage in the programmes and with PAS 2035? What are the barriers and enablers to programme delivery?	Chapter 6

Following Magenta Book principles (HMG, 2020), the Process Evaluation examines the programmes' implementation and the pathways through which the programmes were delivered.

The evaluation draws upon data from interviews with multiple stakeholder groups and from secondary data sources, including project applications, project reporting, monitoring reports, Programme Board slides and minutes. Evidence was reviewed via a range of analytical activities, including Theory of Change development, process mapping, project analysis (including developing typologies of projects), case studies, and whole house retrofit market and landscape analysis. The evaluation team synthesised the findings from these analytical strands to generate the conclusions in this report.

Further details of the evaluation approach and the analytical strands are provided in the Technical Annex. The indicators, judgement criteria and data sources for each of these are detailed in the Process Evaluation Matrix in Appendix 2 of the annex.

This report draws on evidence from interviews, case studies and workshops with key stakeholders. The notes from primary data collections were organised in a thematic analysis framework for each strand, allowing for comparison of key themes across each interview during analysis. Table 2.2 provides an overview of the data collection targets and achieved sample sizes. Where specific groups were not covered in the Process Evaluation they are being targeted for interview in the Outcome Evaluation. Further information, including the sampling approach, is provided in Appendix 1.

Table 2.2. Primary data sources

Method	Participants	Target sample	Achieved sample[2]	Timing
Scoping interviews	BEIS and Ricardo	6	6	March 2021
Qualitative depth interviews	BEIS, SHDF(D) delivery team and partners	17	7	June - July 2022
Qualitative depth interviews	Project leads / team members	23	23	June – Sept 2021, Jan – June 2022
Qualitative depth interviews	RLOs	10	7	Jan – June 2022
Qualitative depth interviews	Withdrawn projects and unsuccessful bidders	10	4	April – June 2022, June – Sept 2021
Qualitative depth interviews	Manufacturers and experts	15	15	June – Sept 2021
Qualitative depth interviews	Whole House Retrofit industry representatives	10	11	June – Sept 2021
Qualitative depth interviews	PAS 2035 Practitioners	10	10	July 2022
Qualitative depth interviews	Participating and non-participating residents and installers	30	0	N/A
Project site visits	Project teams, project partners, installers / contractors, residents	5	5 (covering 9 projects)	May – July 2022
Shadowing Learning Community and	Project team members and BEIS	N/A	6[3]	April 2021,

[2] Achieved sample represents number of interviews conducted, with some interviews being conducted with multiple participants. Table A1. In the Technical Annex provides a further breakdown of the number of participants consulted.

[3] The six programme meetings which Ipsos shadowed were four Learning Community meetings, one project closure interview (of Warwick's REFINE project), and one project presentation (of the National Retrofit Accelerator) to BEIS and other stakeholders, Brixton.

Method	Participants	Target sample	Achieved sample[2]	Timing
other programme meetings				Feb - March 2022, April 2022
Workshops	BEIS and Ricardo	2	2	April 2021, July 2022

2.2 Research Limitations

As a Process Evaluation, this report does not provide evidence on the outcomes of WHR and SHDF(D), which will be covered in a separate Outcome Evaluation Report. The present Process Evaluation is subject to the following limitations:

Limited coverage of project handover and closure processes: By 30th June 2022, only one of 18 SHDF(D) projects and neither remaining WHR projects were complete. Only 255/1,817 SHDF(D) and 14/91 WHR properties had completed handover. As such, there was limited data available to the evaluation team on the retrofit closure process, at the time of writing.

Very limited representation of the views of tenants and installers: Tenant and installer interviews will be covered in full for the Outcome Evaluation. For the Process Evaluation it was not possible to conduct a 'pre-retrofit' wave of tenant and installer fieldwork as originally intended due to changes in project delivery timelines. To address this evidence gap, the research team spoke to residents, installers, and contractors during physical site visits, but otherwise relied on secondary evidence from interviews with landlords, RLOs, and industry representatives, and project reporting.

Limited representation of unsuccessful applicants: The evaluation team was only able to engage two unsuccessful applicants to the SHDF(D) from a target of ten. To supplement this data, Ipsos reviewed a small expression of interest survey that had been conducted by BEIS prior to the official launch of SHDF(D) and interviewed two project teams who had withdrawn from WHR and SHDF(D).

No representation of the views of non-applicant local authorities: Data sharing permissions in competition launch prevented the research team re-contacting local authorities who did not apply.

3 Programme design

This chapter provides an overview of programme design, including the policy context behind SHDF(D) and WHR, their rationale, Theories of Change, how the two programmes differ and their key delivery components.

Chapter 3 – at a glance

- Both programmes were designed in response to an interest from UK Government to understand whether whole house retrofit could be applied at scale to reduce energy consumption from the UK's existing housing stock.
- Part of the 2019 Energy Innovation Programme, WHR aimed to address the 2018 Building Mission to lower the costs of retrofit.
- SHDF(D) launched in 2021 as part of a suite of four Green Economic Stimulus programmes. SHDF(D) was a scale-up of WHR, though focussed on social housing and carrying greater emphasis on jobs.
- SHDF(D) supported 19 projects initially, later reduced to 17. WHR supported two projects (four initially).
- Both programmes succeeded in attracting bids diverse in size, geography, innovative approaches. However, the short application windows somewhat limited participation to experienced social landlords.
- The Theories of Change illustrate how the programmes expected to contribute to benefits for tenants, increased learning for industry and Government, setting up the Main Fund for SHDF, and stimulating the market for deep retrofit.

3.1 Policy context to the programmes

WHR was grounded in the 2018 Buildings Mission (part of the Clean Growth Grand Challenge), which aimed to halve the energy use of new buildings and the cost of retrofitting existing dwellings to new-build standards by 2030. In 2016, the UK Government had recognised the value of a whole house (or 'deep') approach to retrofit in its landmark report "Each Home Counts" (BEIS, 2016). WHR's primary objective was to test the hypothesis that large scale whole house retrofit projects (75+ dwellings) could deliver cost reductions and high levels of energy performance through a combination of economies of scale, design replication and procurement, technology and installation innovations. Secondary objectives for the programme included job creation, enhanced tenant comfort and fuel poverty reduction. Ultimately, WHR was expected to provide BEIS and the retrofit sector with a rich understanding of the drivers of cost and cost reduction.

The 2019 Conservative Manifesto committed to a £3.8bn Social Housing Decarbonisation Fund over a 10-year period to improve the energy performance of social rented homes, on the pathway to Net Zero 2050. The SHDF(D) was announced in July 2020, as part of the Government's wider commitment to deliver energy improvements in social housing and was launched as part of the Government's wider £3 billion COVID-19 Green Economic Stimulus portfolio. The Stimulus portfolio consisted of four programmes[4], which collectively aimed to support jobs in the (green) retrofit and construction sectors, ensure quality in retrofitting, improve outcomes for occupants (well-being, comfort and energy bill savings) and reduce carbon emissions. With a focus on the whole house approach, SHDF(D) also specifically aimed to reduce negative outcomes associated with poor ventilation. SHDF(D) was a scale-up of the WHR competition, but it had explicit objectives to boost the UK economy and safeguard jobs during the pandemic.

Following the launch of SHDF(D), the Government launched Wave 1 of the SHDF in August 2021. This awarded around £179 million of funding additional delivery from 2022 to 2023. Further, £800 million has been committed for the SHDF as part of the 2021 Spending Review Settlement. The competition for SHDF Wave 2.1 opened in September 2022. A big focus of SHDF(D) was therefore on developing the systems that would support the SHDF Main Fund and on generating learning in the sector that would motivate and enable housing providers and their project partners to apply to the Main Fund. Beyond SHDF, other net zero building schemes also ran simultaneously to WHR and SHDF(D).

3.2 Comparing the two programmes

The WHR and SHDF(D) programmes shared some commonalities and differences.

Table 3.1. The Outline of WHR and SHDF(D)

	Whole House Retrofit	SHDF Demonstrator
Tenure type	Any (though only social housing projects were selected for funding)	Social housing only
Funding allocated	£7.7m	£62m
Total projects	2 (originally 4)	17 (originally 19)
Initial target number of properties	396 (470 including withdrawn projects)	2,273 (2,369 including withdrawn projects)
Final target number of properties	83 (82% reduction)	1,817 (24% reduction)
Policy context	Innovation programme part of the Energy Innovation Portfolio (EIP)	Part of net zero buildings policy, launched as part of an economic stimulus package

[4] The Green Homes Grant Vouchers Scheme (GHGVS), the Green Homes Grant Local Authority Delivery Scheme (GHG-LAD, the Public Sector Decarbonisation Scheme (PSDS) and the Social Housing Decarbonisation Fund (Demonstrator) (SHDF(D)).

	Whole House Retrofit	SHDF Demonstrator
Initial programme timeframes	June 2019 – March 2021 (1.5 years)	September 2020 – December 2021 (1 year)
Final programme timeframes	June 2019 – March 2023 (3.5 years)	September 2020 – December 2022 (2.3 years)
Targets	Space-heating: 30 kWh/m2/yr, or 50kWh/m2/yr where 30 kWh/m2/yr is not practically viable. Cost reduction: 5-20%	EPC bands A- C Space-heating: 50 kWh/m2/yr Cost reduction: 5-30%
Innovation	WHR encouraged innovation from applicants by providing applicants with flexibility as to their whole house retrofit approach. The programme encouraged use of technology to reduce energy demand.	SHDF(D) did not constrain or specify particular areas for innovation. However, all projects had to be in line with PAS 2035 guidelines, thus limiting the extent to which unique innovation strategies could be undertaken.
Fund distribution mechanism	Milestone-based payments	Advance disbursement for English projects, milestone-based for Scottish projects
Management and monitoring	Monthly reporting by projects, submitted to BEIS setting out progress against work packages, milestones, challenges faced and risks. Compilation of project lessons and risks by delivery partner (Ricardo) into a monthly log	Monthly reporting by projects to BEIS setting out tasks completed, progress against milestones, delivery risks, lessons learnt and a financial overview. Outside of these, expected participation and content for project Learning Communities, and long-form of project narrative and benefits achieved ('Project-level Interim Benefits Report') Monthly site visit reports by delivery partner (Ricardo) into a monthly log
Links to other programmes	Built on learning from Innovate UK Retrofit for the Future programme which concluded in 2014. No anticipated follow-on programme at the time of design.	Built on learning from WHR, launched with a view to complementing other BEIS Green Economic Stimulus and heat and energy efficient building programmes, and designed as a demonstrator wave of an anticipated multi-wave (larger) fund.
Source: Programme documentation and delivery team interviews		

The general programme governance structure is highlighted below in Figure 3.1.

Figure 3.1: Summary structure of SHDF(D) and WHR programme key actors

It should be noted that this diagram is highly simplified, particularly in terms of the variation across projects – some of which involved more than one local authority or more than one registered provider of social housing.

3.3 Theories of Change

3.3.1 WHR

WHR was intended to support two BEIS strategic policy objectives:

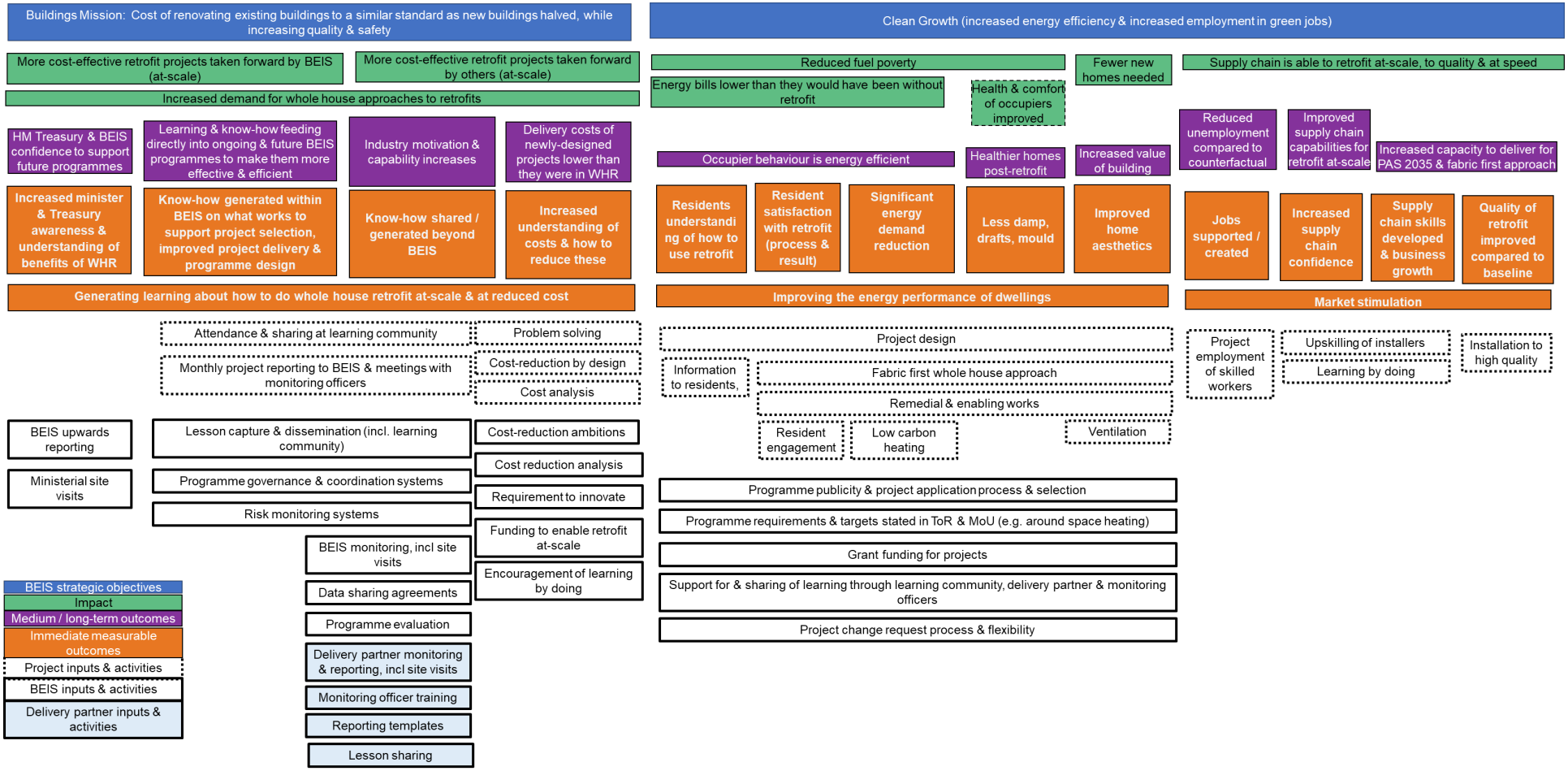
1. Halving the cost of renovating existing buildings to a similar standard as new buildings while increasing quality and safety
2. Increasing energy efficiency and employment in green jobs.

BEIS intended for the programme to increase demand for whole house retrofit amongst the home improvement and construction industry, homeowners, landlords and social landlords, leading to more cost-effective retrofit projects being designed and delivered. At a household level, WHR also intended to contribute to an improvement in dwellings' energy performance, as well as to market stimulation (increasing the supply chain's capacity to deliver whole house retrofit).

BEIS designed WHR to encourage projects to innovate and generate learning, and it set up monitoring and reporting systems to capture and record these lessons. These systems involved monitoring officers (MOs) and BEIS site visits, monthly and quarterly reporting, and lesson-sharing at monthly Learning Community meetings between BEIS and projects. BEIS shared project progress and emerging findings with more senior figures at BEIS with the aim of informing ministers in their ongoing and future funding and policymaking decisions. BEIS expected that lessons learned would also create a body of industry knowledge, through peer-to-peer learning and BEIS' internal knowledge-sharing, which could be applied to future whole house retrofitting at a reduced cost.

In terms of improving the energy performance of dwellings and reducing carbon emissions from homes, the programme provided grants to projects and specified energy performance targets for the projects to reach. The in-programme peer-to-peer learning would then also help projects to develop best practice in achieving the energy performance targets. It was expected that, through a programme of tenant engagement, combined with the improvements to insulation and air quality in retrofitted homes, residents would be better able to use energy more efficiently in their home, thus leading to reductions in energy consumption and carbon emissions from the treated homes. It was also expected that, by increasing the durability of the treated homes, it would reduce the need for demolition and rebuilding of homes, thus saving on carbon emissions from new construction.

Figure 3.2: WHR Programme Theory of Change



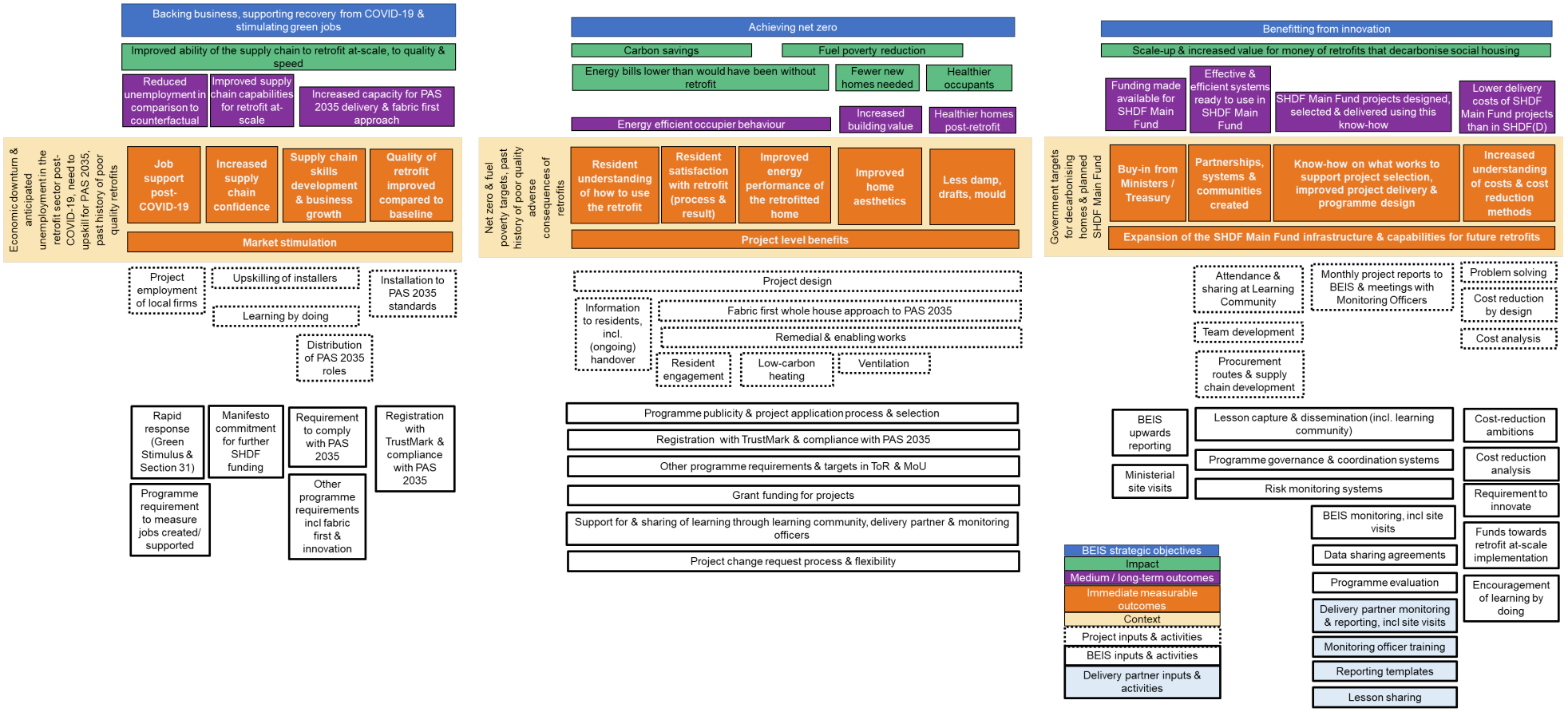
3.3.2 SHDF(D)

As with WHR, SHDF(D) was designed to improve the energy performance, safety, and comfort of retrofitted homes by funding high quality retrofits; and to demonstrate how a whole house approach could be delivered at a reduced cost through innovation. As SHDF(D) was launched as part of the Green Economic Stimulus Package, BEIS also intended SHDF(D) to support jobs in the short term. In the longer term, in view of the upcoming Main SHDF, BEIS wanted to use SHDF(D) to increase supply chain confidence, increase skills, and improve whole house retrofit capabilities in the supply chain and LAs and HAs. As the first 'demonstration' wave in an anticipated series of SHDF funding rounds, BEIS also planned to use SHDF(D) to develop systems, knowledge, and partnerships that would facilitate the smooth running of the SHDF Main Fund.

To provide rapid support for jobs, BEIS opted to disburse funds via Section 31 of the Local Government Act 2003. This enabled the SHDF team to provide full grants to English local authorities up-front, to ensure that funding reached project teams as quickly as possible. To support longer term confidence and capability in the supply chain, BEIS required projects to comply with PAS 2035, and expected that this would enable project teams to build their skills in whole house retrofit. More findings on PAS 2035 and the up-front funding mechanism are provided in chapter 4. By linking the SHDF(D) to a future pipeline of funding through the SHDF Main Fund, BEIS also expected the programme to provide a market signal that would increase supply chain confidence. BEIS considered that projects would contribute to this group of outcomes by employing local suppliers and staff, upskilling installers, learning by doing, and by implementing PAS 2035 for their retrofits.

To contribute to net zero, BEIS designed a competition process with eligibility requirements designed to encourage projects which would support quality retrofits with high levels of energy performance. It provided grant funding for projects which were then expected to support tenant satisfaction and tenant understanding of how to use the retrofit. These direct outcomes would then lead to residents being more efficient in their energy use behaviour, and this would then both bring down energy bills and reduce carbon emissions from the home. By increasing the air quality and comfort of homes, BEIS intended projects to make homes healthier to live in, contributing to occupant well-being. By improving the aesthetics and longevity of homes through retrofit, SHDF(D) would then reduce the need for homes to be demolished and rebuilt, which would also have a positive effect on reducing carbon emissions from construction.

Figure 3.3: SHDF(D) Theory of Change



4 Programme delivery

This section discusses the delivery processes described in the programmes' Theories of Change. The extent to which programme processes have influenced project design and delivery are assessed in Chapters 5 and 6.

Chapter 4 – at a glance

- SHDF(D) disbursed funds to English local authorities up-front, limiting financial leverage to manage projects to performance and time.
- Delivery timelines for both programmes were overly ambitious and all projects had to modify original plans. Programme management of change was slower than aimed for, usually due to quality issues with project requests for change, and BEIS' escalation processes. These created a barrier to project delivery.
- SHDF(D) built upon WHR's management systems, adapting these to its distinct objectives and greater size. However, there were notable time-burden and quality issues in monitoring regimes for both schemes (e.g., reporting data was found to be of higher quality when a dedicated company was managing a project).
- PAS 2035 compliance added additional steps to project resourcing, retrofit design and delivery and monitoring on SHDF(D).
- BEIS, its delivery partner, and project teams set up various channels for sharing delivery lessons, but interpersonal site visits and stakeholder meetings were considered the most effective programme activities to support project delivery.

4.1 The application process

WHR and SHDF(D) gave applicants eight and seven weeks after launch to develop and submit proposals, respectively. A majority of applicants interviewed for this evaluation reported that they found these bidding timelines to be restrictively short. In the feedback survey circulated by BEIS after the SHDF(D) application process, short timescales were the most commonly cited reason for local authorities not submitting an application. Project leads interviewed for this evaluation commented on the impact of the application window for designing and applying to SHDF(D).

"It was a frantic application with a lot of things to pull together in a short period of time." – SHDF(D) applicant

"It isn't a case of three separate companies writing down what they want to do in the project. It's about developing an innovative process and project in itself and that can take a very long time." – SHDF(D) applicant

At interview, project leads reported they had only been able to meet these timescales because they already had an experienced partner or consortium in place. The rapid window for submitting proposals meant that most projects had a considerable amount of design and preparatory work still to do once the grants were awarded. This included surveying housing stock, finalising the retrofit approach and design, seeking approval of local governing bodies and planning permission, and procuring installers and other suppliers. Such activities reduced projects' resource and time to deliver retrofit installations within programme windows. SHDF(D) also placed an embargo on successful projects announcing their award until a ministerial announcement that would allow BEIS to communicate this to the public. This took BEIS three months, during which time some projects refused or were not able to start works, in cases where local government depended upon a public announcement to approve and start works.

Despite the tight timelines for bidding, BEIS was satisfied with the level of interest attracted for both programmes. WHR attracted 25-30 expressions of interest and eight full bids. The SHDF(D) Supplier Day on 28 September 2020 attracted 88 local authorities and 58 housing associations. SHDF(D) finally attracted 35 eligible bids. One unsuccessful applicant commented positively on the scheme's scope / requirements:

"I liked the competition. I thought it lent itself well to doing something a bit different as a demonstrator and I liked that it was focused on whole house and allowed for innovation, [as well as] how you appraise a dwelling before and after." – SHDF(D) applicant

Both programme teams were also overall satisfied with the range of project applications they received, although the WHR programme team reported that they would have liked to have seen a wider geographic spread of projects and projects covering other types of tenure in addition to social housing. This would have allowed the WHR team to better test whether whole house approaches could be delivered at scale in housing contexts other than social housing.

4.2 Projects supported

The two programmes supported a variety of projects located across England and Scotland. As described in chapter 5, these projects varied not only in terms of their design, but also the housing stock they covered, and geographic context (rural/urban, located closely together or spread over multiple locations), the type of measures installed, the relative amount of funding and match funding and the number of properties covered.

The projects also varied in terms of the measures they installed. All were required to take a 'fabric first' approach to whole house retrofit, meaning that the projects took steps to improve air tightness and insulation first.[5] This often involved the introduction of roof insulation and external wall insulation, as well as underfloor insulation in some cases. Several projects installed mechanical ventilation with heat recovery (MVHR) across all or some of their properties, whilst others introduced low-carbon heating including solar panels or heat pumps,

[5] Fabric first is a principle that states that heat demand should be reduced as far as possible by improving the building fabric and its construction before introducing new energy systems.

and some also introduced heat controls or smart systems. Some projects also upgraded tenants' windows and doors. Table 4.1 provides an overview of some of these features for all projects originally selected for WHR and SHDF(D) grants.

Though WHR was able to fund the retrofit of privately-owned homes, only one WHR application targeted this sector and the bid was unsuccessful, as the bid assessors considered the project timescales unfeasible for recruiting homeowners. Under SHDF(D), a housing provider, One Manchester, initially set out to retrofit both social housing and leaseholder properties, but had to limit the scope to social housing only due to the challenges associated with securing separate funding for the leaseholder properties (which were ineligible for SHDF(D) funding). These findings support wider policy research, which indicates that social housing providers often exclude leaseholder or shared owners from energy performance works over difficulties in gaining buy-in but also over difficulties recouping costs from these tenure types (IFF, 2020; RemoUrban, 2020).

Table 4.1. WHR and SHDF(D) projects supported, by project value and properties reached (correct to 30th June 2022)

Project Name	Region	Place	Value[6] (£, millions)	Match fund[7] (%)	Target Properties
Walkways 21Zero (RBKC[8]) – SHDF(D)	London	Urban	32.3	60%	367
Social Housing Retrofit Accelerator (GLA[9]) – SHDF(D)	London	Urban	26.4	64%	270
Destination Zero I (Nottingham City) – WHR	East Midlands	Urban	10.2	60%	195
Clarion Housing Group Advanced Retrofit Project (Fenland and Tonbridge) – SHDF(D)	South-East	Rural (Fenland) & suburban (Malling)	9.0	50%	160
Whole House Retrofit Project (Leeds City) – SHDF(D)	Yorkshire & Humber	Urban	8.9	53%	190
Northampton Whole House Retrofit (West Northamptonshire) – SHDF(D)	East Midlands	Urban	5.6	47%	150

[6] Total project value, including grant and match funding.
[7] Under both programmes, match funding had to comply with the State Aid Regulation, which states that state aid should amount to 25% of total project costs. However, exemptions could be sought, in line with Article 25 of the EU General Block Exemption Regulation, where the funding supported 'experimental development' to develop new or improved products, processes or service, which could raise the state's contribution to 60% (if, for example, the project was led by a small or medium-sized organisation, was led in partnership with a research organisation, or the results were disseminated with open-source software). Ultimately, match funding varied project to project and was not dictated by programme specifications.
[8] Royal Borough of Kensington and Chelsea.
[9] Greater London Authority.

Project Name	Region	Place	Value[6] (£, millions)	Match fund[7] (%)	Target Properties
Energiesprong (Sutton) – WHR	London	Urban	8.6	64%	100
Camelford Net-Zero (RBKC) – SHDF(D)	London	Urban	8.5	60%	89
Morland and Talbot Grove House (RBKC) – SHDF(D)	London	Urban	7.8	60%	79
Xtra-Z Cross-Tenure Retrofit (Manchester City) – SHDF(D)	North-West	Urban	7.8	60%	164
Retrofit of Electrically Heated Homes (Wychavon) – SHDF(D)	West Midlands	Rural and urban/ suburban	7.7	25%	236
Destination Zero II (Nottingham City) – SHDF(D)	East Midlands	Urban	5.5	59%	104
DORIC (Aberdeen) – SHDF(D)	Scotland	Urban	5.2	58%	100
WHRI Cornwall[10] – WHR	South-West	Rural	5.1	75%	100
Social Housing Retrofit Accelerator (Cornwall) – SHDF(D)	South-West	Rural	4.0	75%	75
Warmer Homes (Argyll and Bute) – SHDF(D)	Scotland	Rural	4.9	75%	130
EnerPHit at Scale (Renfrewshire)[11]* – WHR	Scotland	Suburban	4.5	60%	75
Gloucestershire SHARe and CaRe Demonstrator (Stroud) – SHDF(D)	South-West	Urban and suburban	2.3	56%	50
Orbit Housing Incremental Whole House Retrofit Scheme (Stratford) – SHDF(D)	West Midlands	Suburban	3.6	60%	69
REFINE (Warwick)[12]* – SHDF(D)	West Midlands	Suburban	3.0	54%	50
Fatfield Decarbonisation Project (Sunderland)[13] – SHDF(D)	North-East	Suburban	1.6	45%	46
Net Zero Carbon Housing Demonstrator (Nottinghamshire) – SHDF(D)	East Midlands	Suburban	1.5	50%	25

[10] Withdrawn in June 2022, claimed £119,000 BEIS grant and no match funding at time of writing.
[11] Withdrew in January 2021, claimed no BEIS grant and no match funding at time of writing.
[12] Withdrew in April 2022, , claimed £185,000 BEIS grant and no match funding at time of writing.
[13] Withdrew in August 2021

Project Name	Region	Place	Value[6] (£, millions)	Match fund[7] (%)	Target Properties
Alva Community Regeneration (Clackmannanshire) – SHDF(D)	Scotland	Suburban	0.8	60%	15

4.3 Grant conditions

The WHR and SHDF(D) programmes initially had timelines of 18 and 12 months respectively. Whilst these were extended in the case of both programmes, many project teams commented that the short timelines had an adverse effect on activities such as procurement and design.

"The timescales imposed on the project are one of the hardest things that we are having to deal with. There is high pressure on everyone to deliver." – Project Lead interview

"[I]t would need at least six months to procure the works even without the pandemic – the tight timeframe provided by BEIS was therefore problematic". –Project Lead interview

The assumption that the programmes could be delivered within the 12 to 18-month timeframe did not appear to take due consideration of the time that would be needed to set up projects within local planning and other regulatory contexts, to engage residents, to carry out remedial works, to procure contractors, to respond to unanticipated challenges, or to make change requests. It reflected an optimism bias which also spilled into projects (see section 4.4 below). There was sufficient precedent from previous energy efficiency schemes to show that short-term stimulus programmes have a negative effect on the construction sector (and that the supply chain was mistrustful of Government schemes for this very reason). An evaluation of the Green Deal found that PAS 2030-registered installers (PAS 2030 is the predecessor of PAS 2035) invested a significant amount of capital in preparing for the Green Deal and the ECO, which led to undermined confidence in the policy landscape when changes to ECO where announced. However, this learning was not effectively factored into the design of SHDF(D).

Within the context of COVID-19 and the effects of Brexit and other challenges on supply chains, the timelines became even more ambitious (see section 6.4). At the time of SHDF(D)'s launch, WHR was exhibiting significant delays in delivery, but the timelines set for SHDF(D) did not reflect this experience. This was because SHDF(D) was launched as part of the Green Economic Stimulus package of funding, which was intended to be short term (in order to deliver an economic boost to the retrofit sector in the face of anticipated stagnation in the market following COVID-19). Finally, all projects had their timelines extended beyond their original deadlines (see Chapter 6).

The WHR programme provided funding to projects on a milestone basis. BEIS issued grant payments in 12 tranches for Energiesprong Sutton and 18 for Destination Zero I. At grant award stage, WHR-funded projects were required to sign a grant funding agreement and proceed through due diligence, financial and organisational checks, which created some

delays for BEIS in providing the grant funding to project teams. Nonetheless, the delivery partner MOs, maintained that the milestone-basis for grant funding made it easier to monitor and ensure projects delivered to funding conditions.

To disburse SHDF(D) funds quickly, in line with it being an economic stimulus, BEIS used the Local Government Act 2003 for successful bidders in England and Wales and the Industrial Development Act 1982 for successful Scottish bidders. Using the Local Government Act ('Section 31') to provide funding up-front to English-based projects created some challenges for SHDF(D) programme delivery. First, it limited central government financial oversight and in practice meant that BEIS had little power to incentivise more rapid progress or achievement of project targets. Second, it meant only local authorities were eligible to lead applications and manage funds from a legal perspective. This created additional administrative complexity in English project teams where housing associations, rather than local authorities, were the stock owners and leading projects in practical terms.

4.4 Performance management

WHR launched first, developing programme governance and reporting systems that entailed a report from a delivery partner MO on a monthly and quarterly basis. SHDF(D) initially adopted WHR approaches. However, as the SHDF(D) programme evolved, it introduced its own systems, templates, and management approaches, including extensive risk monitoring and lesson capture systems. These systems were introduced in response to the fact that SHDF(D) was a larger programme with greater political scrutiny (because it was a COVID-19 economic recovery programme), and the first instalment of an anticipated £3.8bn committed to social housing decarbonisation over 10 years in the 2019 Conservative Manifesto, so had a lesson learning objective. Subsequently, SHDF(D) applied a risk-driven methodology for the delivery of the programme, which was more intensive and time-consuming than that of WHR but was necessary to better understand the delivery challenges and progress.

"From the start of SHDF(D), there was a condition of having a robust risk management process. [This involves] BEIS looking at what possible blockages might exist to delivery and working out mitigations to minimise risk realisation and impact and, where issues occur [...] This is the foundation of the relationship with the Minister and decisions they make on delivery confidence." – BEIS Delivery Team

SHDF(D) also had a larger number of governing committees and stakeholder bodies to which it had to report and be accountable as it was introduced at pace through the Green Economic Stimulus package. This meant that SHDF(D) was rapidly implemented and characterised by considerable 'learning by doing' at both programme and project level. This was a consistent viewpoint across BEIS, the delivery partner and project teams.

"When the Demonstrator started the systems were not in place. We were designing and creating [for instance, the PCR system], while delivering." – BEIS Delivery Team (SHDF(D))

Both WHR and SHDF(D)'s monitoring systems involved monthly meetings conducted by the delivery partner and reporting by project teams. Delivery partner monitoring was mainly virtual

due to COVID-19 restrictions. For WHR, MOs completed a monthly progress report, which highlighted achievement against work programmes, a risk register and the project progress plan. The delivery partner then summarised these reports in a monthly report tracker and in quarterly progress reports, which they shared and discussed with the BEIS WHR delivery team. SHDF(D) entailed more extensive monitoring risk reporting and lesson sharing requirements from the project lead. Nonetheless, delivery partner staff considered both WHR and SHDF(D) templates difficult to interpret, leading to additional work for projects and MOs to complete, and many fields difficult to analyse due to differences in interpretation between different project leads.

The quality of performance management information was highly variable. At interview, BEIS delivery staff expressed dissatisfaction with the information provided by projects, particularly around how grant funding was being spent. They considered this a consequence of the up-front funding mechanism for English SHDF(D) projects, which reduced incentives to report spend thoroughly. MOs agreed in part but considered the main difference in quality to be dependent on the resource of the project lead, noting that some project teams 'rushed' reporting more than others. Ipsos' review of documentation found that, in general, reporting data was of a higher quality among projects who had contracted a dedicated company to project manage. Overall, the lack of accurate intelligence into project progress created additional workload for the delivery partner and frustrations for the BEIS SHDF(D) team.

"The project could be reporting on expenditure of millions of pounds and they mark it as 'went on subcontractors. There is an argument that as money is going to local authorities, it is up to the authority to govern and monitor spending. But this becomes a problem when project progress no longer looks right for the amount of money being spent". – BEIS SHDF(D) delivery team member

In March 2022, SHDF(D) introduced additional monitoring and site visits for projects that were not progressing as hoped. This followed concern about the high volume of project change requests and a feeling that intelligence obtained from monitoring reports was insufficient. Due to the timings of the evaluation (whereby most project leads were interviewed before the site visits took place) the evaluation has not explicitly collected the views of project teams on site visits. However, there is evidence to suggest that projects would have benefitted from them:

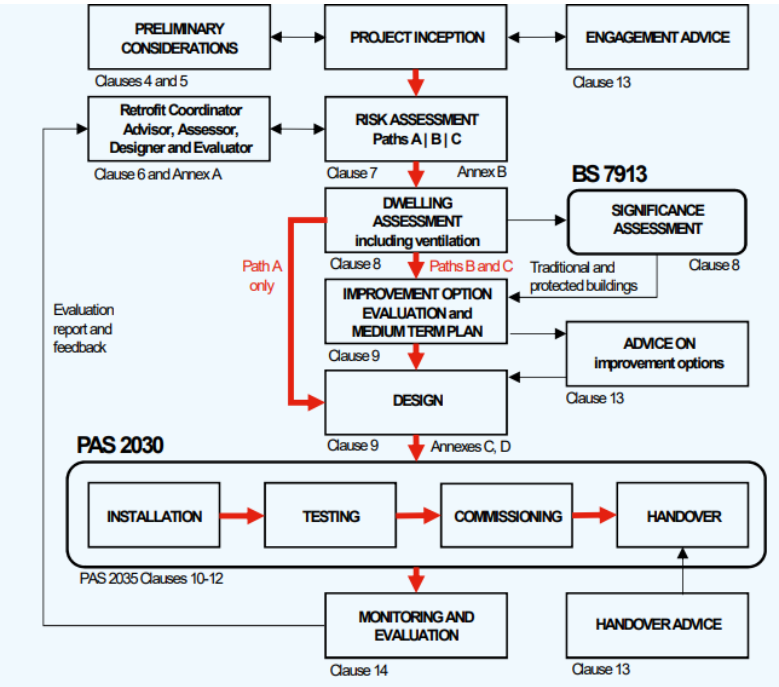
- Ipsos observed that site visits were well attended, with project teams ensuring that tenants, installers and suppliers, and project partners were well represented. This indicates that the project teams gave importance to the site visits.
- BEIS delivery teams reported that projects fed back positively to them about the direct contact and the opportunity to discuss their projects (and project challenges) directly with BEIS.
- Several project teams highlighted direct interaction with BEIS as important to them, not only for future funding opportunities and demonstration of effectiveness, but also for learning.

4.5 Compliance activities – PAS 2035:2019

PAS 2035:2019 is a specification for whole house retrofit (more information is available from Retrofit Academy CIC (2019)). It offers an end-to-end framework for the application of energy retrofit measures to domestic buildings and provides best practice for their implementation. It is one of a range of standards for whole house approaches, comparable to Passivhaus (Passivhaus Trust, 2012) and EnerPhit (Passivhaus Trust, 2011). Industry experts interviewed for this evaluation considered it to represent the best of the standards and to be a benefit to the market.

"The industry leaders in my opinion, there are lots of them that, are the ones operating under PAS 2035" – Industry Expert

Figure 4.1 The PAS process for retrofit (BSI, 2019)



At the launch of WHR, PAS 2035 compliance was yet to be mandated for all government-funded domestic energy efficiency projects. In the programme's Competition Guidance Notes (BEIS, 2019), WHR projects were only encouraged to "become familiar with [the standard] and refer to [it] where relevant" (BEIS, 2019). In contrast, PAS 2035 compliance was required on all SHDF(D) projects (BEIS, 2021b).

PAS 2035 had a significant influence on the way projects were designed and delivered. First, the introduction of the standard delayed delivery start as project teams adjusted their procurement, technical design and partnership structures to meet the requirements. Secondly, it mandated that projects follow standardised pre- and post-retrofit assessments, and specific processes on design and planning. In addition, it required an individualised approach to each dwelling being retrofitted. Pre-installation, projects were required to appoint PAS 2035-accredited Retrofit Coordinators, Assessors and Designers. This affected decisions around project partners and the qualifications of team members. Furthermore, it restricted the installer

contracts to PAS 2030-accredited businesses[14]. This delayed delivery while businesses and installers applied for certifications. Lastly, PAS 2035 increased administrative burden: as Retrofit Coordinators are required to provide a detailed handover to help residents correctly use the house post-retrofit, and a plan for six months' building performance monitoring post-retrofit, and to record the works with TrustMark, the government endorsed quality scheme.

The effects of PAS 2035 requirements on WHR and SHDF(D) projects are discussed in section 6.4.3.

4.6 Managing change

When WHR or SHDF(D) projects could not deliver works under the original conditions of their funding agreement, they were required to undergo a formal project change request (PCR) with the scheme authorities to update their spend profile. A consequence of the short competition timelines was that projects lacked time to develop robust delivery forecasts before grant acceptance and had to modify them as plans developed afterwards. Consequently, PCRs became a significant element of programme management.

"Projects have a tendency toward optimism – they underestimate everything. This makes it hard to plan. BEIS were 'banging the drum' for greater certainty from projects". – WHR delivery staff, BEIS

Between February 2021 and June 2022, Energiesprong Sutton, WHRI Cornwall and Destination Zero I submitted a total of 15 PCRs. SHDF(D) projects submitted 53 change requests between February 2021 and June 2022, with the largest numbers received in December 2021 (eight received) and February 2022 (six received). Each project submitted at least one PCR.

Project teams typically requested time extensions to spend the grant funding and complete construction. In some cases, they requested an extension to the overall project delivery, including ancillary design and start-up costs. Others – often the more innovation-focussed projects – proposed reductions in design complexity or property selection to complete within the time available.

According to SHDF(D) and WHR team governance procedures, the delivery partner and BEIS delivery teams each aimed to review PCRs within five working days. In practice, BEIS teams took longer to reach decisions, an average of 36 calendar days per request. However, some PCR decisions took up to three months, when BEIS teams were not sure whether SHDF(D) would gain permission to be extended (December 2021). This layer of uncertainty added to the response time of BEIS teams to PCRs.

There were several challenges in BEIS managing change and responding to PCRs:

[14] PAS 2030 is a certification which businesses can achieve to demonstrate the compliance of their installations. Unlike PAS 2030, PAS 2035 is not a certification; it is a standard that sets out the specifications which compliant retrofitting must meet (Retrofit Academy, 2019).

- The delivery partner and BEIS teams reported that projects struggled to provide sufficient evidence in their case for change. This meant that the request had to go through several iterations before project changes could be formally accepted.
- Programme teams did not anticipate the volume and profile of changes needed and struggled to resource the process.
- The scheme protocols to control change were not necessarily proportionate – for instance, properties removed from project scope due to tenant withdrawal required Ministerial or HM Treasury approval of the change. Lower grades of BEIS project leadership were only able to sign off on low impact changes to scope or timescales that did not affect the BEIS grant.

Slow decision-making at BEIS level had two impacts on projects. First, delays on PCRs increased uncertainty for project teams. In some cases, projects were forced to choose between withdrawing procurement exercises, halting delivery or continuing to deliver at risk. Second, it impacted relationships with local authorities. The delivery partner reported that the delays to PCR decision-making made it challenging for MOs to rally projects and encourage projects to stick to their deadlines.

"MOs have to communicate to local authorities a deadline set by BEIS, but then BEIS do not stick to their deadlines, so local authorities wonder whether they should adhere to their own." – Delivery partner MO.

Further details as to the rationale and reasons for the submission of change requests is discussed later in the report (section 6.3).

4.7 Lesson learning

Both WHR and SHDF(D) had systems and processes in place for learning to support in-flight delivery and generate lessons that will increase social landlord and government capability to deliver retrofits.

For example, BEIS hosted a monthly 'Learning Community' - virtual conferences involving participating social landlord project leads. These provided the opportunity for teams to present issues they were facing within their projects and share emerging examples of good practice. They also provided an opportunity for cross-programme learning, as both WHR and SHDF(D) project participants could attend.

When interviewed, all project leads spoke positively about the Learning Community. In SHDF(D) Sunderland's project closure report, the project team quoted lessons shared by other project teams at the Learning Community, indicating these influenced project thinking. However, one project team member commented in an interview that the Learning Community should have been open to a larger number of project team members (only one team member was allowed to attend each meeting, a conscious BEIS decision, with the intention to make meetings manageable). The delivery partner also did not attend the meetings. Two stakeholders separately commented, in interviews for this evaluation, that they considered this an omission given the wealth of knowledge that the delivery partner held on the projects.

In SHDF(D) Project-level Interim Benefits Reports, projects also provided examples of independent approaches to lesson sharing and capability-building. Across Stratford's Orbit Housing Incremental Whole House Retrofit Scheme and Wychavon's Retrofit of Electrically Heated Homes project, Orbit, Citizen and Rooftop Housing regularly exchanged project experiences via their shared project management consultancy, Savills. The consortia delivering the National Net Zero Retrofit Accelerator and Gloucestershire SHARe and CaRe Demonstrator coordinated lesson-sharing across the three or more social landlords and local authorities participating in these projects. Some projects, for instance, Leeds Whole House Retrofit and Clackmannanshire Alva Community Regeneration, organised their own site visits for lesson-learning. Others participated in regional fora that cut across the demonstrator and main waves of SHDF and involved participants of other BEIS funding programmes, such as the Green Homes Grant Local Authority Delivery (GHG-LAD) scheme.

One project lead interviewed in Summer 2021 expressed some scepticism as to how BEIS would use the learning.

"We're learning all of this stuff and we're sending it back and it's going into a void and we're not having any conversations and I think there's a real danger that any lesson learned is essentially discarded at the end of the project." – SHDF(D) Project Lead

However, BEIS delivery team members reported in interview that learnings from SHDF(D) fed directly into future policy making and informed numerous policy developments, including: the update of the PAS 2035 standard and Standard Assessment Procedure (SAP), supply chain resilience policy in central government, and adaptation of programme management processes for delivering SHDF Main Fund. The extent to which learning has generated positive effects and results for the SHDF Main Fund will be further investigated in the SHDF(D) Outcome Evaluation.

5 Project design

This chapter describes the projects funded under WHR and SHDF(D) in more detail, providing an overview of key points of difference and how these provide typologies of projects.

Chapter 5 – at a glance

- There is good evidence that WHR and SHDF(D) projects would not have been implemented, or not to the same scale, without BEIS funding.
- Projects participated either to generate learning that would increase their future retrofit capability, to fund extensive maintenance, to address problems within a particular estate or group of homes, or to meet climate change commitments.
- Project teams differed in the ways they partnered with other organisations and regions of the country, and in their project management and delivery approaches. They also differed in terms of procurement routes, which had differing levels of effectiveness at mitigating supply chain issues and labour shortages.
- Projects used innovative technology and processes to either maximise the benefits of the retrofit or to reduce costs. Some of the most interesting innovations came out of a need to respond to unanticipated project challenges – such solutions innovation has application to future retrofits and scale-up.
- Projects took distinct approaches to resident engagement, driven either by the extent to which resident satisfaction was a primary objective (or not), the unique needs of the participating residents, and the extent to which the project employed a dedicated RLO or not. Some approaches, such as using early adopters as 'good news examples', seeking additional funding streams to enable leaseholders in the community to participate, and having team members able to build trust amongst tenants, were particularly effective for engagement.

5.1 Project rationale for participation

In interview and in project design documents, projects cited a variety of reasons for taking part in WHR and SHDF(D). The WHR Cornwall, Nottingham City and Sutton projects participated to generate learning on how to carry out effective whole house retrofits at scale and at a reduced cost at inception stage. This mirrored the WHR's primary innovation objectives.

Within SHDF(D), motivations were more varied. Three SHDF(D) projects (Clarion Housing Group Advanced Retrofit Project, Nottingham Destination Zero II, the Social Housing Retrofit Accelerator) focussed on learning for the social housing provider or solutions provider, so that a standard approach could be rolled out across more of the providers' housing stock. The SHDF(D) Social Housing Retrofit Accelerator, and Energiesprong Sutton, which both formed

part of GLA's Retrofit Accelerator programme (Mayor of London Assembly 2022), were also focussed on testing particularly innovative pieces of technology and process innovation.

The grants provided an opportunity for some social housing landlords to treat particularly hard-to-treat homes. This was the case for six SHDF(D) projects (Gloucestershire SHARe and CaRe Demonstrator, Social Housing Retrofit Accelerator Cornwall, Alva Community Regeneration through Decarbonisation, Warm Homes Argyll and Bute, Wychavon Retrofit of Electrically Heated Homes, Northampton Whole House Retrofit).

Also for Gloucestershire SHARe and CaRe Demonstrator, as well as Project DORIC, Xtra-Z, and all Royal Borough of Kensington and Chelsea projects, the focus was on addressing problems within a particular estate or group of homes. Gloucestershire SHARe and CaRe Demonstrator supported retrofits within assisted care buildings for older people; the Manchester Xtra-Z project and the three Royal Borough of Kensington and Chelsea projects were partly aimed at improving the aesthetics of the estates to increase community pride in it and the community's sense of safety and cohesion. These projects are located in particularly deprived areas of the cities of Manchester and London.

In Argyll and Bute and Nottinghamshire, the local authorities did not own housing stock but nonetheless instigated the process of developing the grant bid (bringing social housing providers into the SHDF(D) bid) in order to meet their local climate change commitments.

5.2 Project team structure and formation

Projects varied significantly in team structure. Projects differed in the type of organisation leading the project, as well as in how responsibility for key aspects such as design, resident engagement, actual works, and project management were distributed. Whilst PAS 2035 roles had to be assigned (see section 4.5), there was also no uniformity in how the roles were distributed.

Three projects (Gloucestershire SHARe and CaRe Demonstrator, Social Housing Retrofit Accelerator and Clarion Housing Group Advanced Retrofit Project) were delivered by consortia, which looked different in formation compared to non-consortia projects.

- The Clarion project covered two non-adjacent regions of England (Fenland district and Tonbridge and Malling Borough) and was led by Clarion Housing Association with the two Councils forming a consortium with a mix of technical providers (retrofit provider Equans, construction company United Living, technical retrofit consultancy Enhabit, a strategic consultant and cost consultancy support).
- Gloucestershire SHARe and CaRe Demonstrator brought together three small areas of distinct housing in neighbouring areas of the county to see whether efficiency gains could be made by coming together as a consortium.
- The National Net Zero Accelerator project comprised six 'mini-projects' across London Boroughs (Barking and Dagenham, Haringey, Lambeth, Hammersmith and Fulham, Ealing and Enfield) coordinated through a Programme Assurance Director and Project

Lead at London Borough of Barking and Dagenham, programme management and delivery support provided by Turner and Townsend and Energiesprong UK and various solution providers (Engie, United Living and Osborne) supporting teams in each borough.

The Wychavon Retrofit of Electrically Heated Homes and the Orbit Housing Incremental Whole House Retrofit Scheme (Stratford) were also delivered together as an unofficial consortium sharing the same subcontracted project manager (Savills). This created synergistic opportunities in delivery, as resources and learning were shared between the two projects, leading to the projects being able to meet timelines more efficiently (as whilst a contractor was used on one project, another contractor could focus on the other one, and vice versa). Conversely, the Royal Borough of Kensington and Chelsea was awarded three separate grants to deliver what is essentially being managed by the local authority as part of a single integrated project: the Lancaster West Estate refurbishment following the Grenfell Fire tragedy.

Local authorities owning property instigated the design of the project in ten project areas: Aberdeen, Argyll and Bute, Clackmannanshire, Leeds, Nottinghamshire, Royal Borough of Kensington and Chelsea, Warwick, and Wychavon. In other projects, social housing providers, Clarion, One Manchester, Nottingham City Homes and Orbit, led the design of the project. In the case of Energiesprong Sutton and the National Net Zero Accelerator, the project design and delivery were driven by solutions-providers (Energiesprong and Turner and Townsend). Finally, in the case of Cornwall, the housing stock is owned by the Council and the Duchy of Cornwall, which is also co-funding the project. BRE, Cornwall Housing, and PRP are also involved.

Individuals within project teams also played a catalytic role in project effectiveness and efficiency. This evaluation's interviews with project teams and observations at site visits point to the importance of individuals and skilled teams in driving forward project progress despite challenges. Two projects cited examples of when key people involved in delivery at the local authority 'turned the project around'. The first highlighted that, following a period of high staff turnover, the appointment of a dedicated person to lead and manage the project long-term ensured the project could be delivered without interruption. The second described the passion and ability of one of the technical leads that resulted in improved delivery to a 'neglected' project when this individual had more time to dedicate to it. Several project leads and RLOs interviewed stressed the importance of building close relationships with residents and going beyond their expected role to overcome challenges. One example cited of this was of an RLO with excellent interpersonal skills (as reported by the project lead) who made efforts to carryout face-to-face meetings with residents who had indicated their intention to withdraw from the scheme. This officer was able to reassure and convince some of these residents to reconsider and helped minimise tenant dropout.

5.3 Procurement routes

Delays in procuring contractors and other suppliers within the programme timescales, or even at all, was a major barrier to progress in both programmes. As documented in BEIS'

programme reporting, delays were driven by many factors outside of the programmes' control, such as the temporary blockage of the Suez Canal in March 2021 (BBC News, 2021), the effects of COVID-19 lockdowns on supply chains during delivery, and ongoing problems with distribution channels caused by legal and trade uncertainties following the UK's withdrawal from the EU.

Other drivers, which are more systemic, and which were – to varying degrees – within BEIS' power to address or influence, include the short programme delivery timeframes, the mismatch between the demands of the programme and supply in the market, market saturation, as illustrated in the following quotes from SHDF(D) project leads:

"In our experience the construction industry is not ready for wide scale upscaling of this type of retrofit project. Current funding windows are too restrictive to allow for deep and considerate design solutions to be undertaken and the volatility of materials market in terms of both availability and cost make it difficult to accurately budget from a client's perspective." – SHDF(D), Project-level Interim Benefits Report

"During [COVID-19] lockdown, all social housing providers stopped capital improvement projects. As things started to open up, tenders were all released to the market at the same time. Tenderers could therefore pick and choose what they bid for. SHDF(D) projects were smaller value projects for many, meaning there was little incentive for suppliers to bid". – SHDF(D) project lead, in interview

"It is clear that the market is saturated at present, and deadlines do slip. Elements such as the brick slips[15] look great, but the supply chain is not well experienced in their application, and reluctant to use them as they are time-consuming which adds to the pressure when they have deadlines by when to spend and complete." – SHDF(D), Project-level Interim Benefits Report

WHR and SHDF(D) projects were also affected by problems, unrelated to the programmes, which affected the retrofit market over the delivery period. For instance, Vaillant was unable to acquire microchips which resulted in the cancellation of orders with multiple customers across the two schemes. This required the Leeds Whole House Retrofit SHDF(D) project to research and identify alternative heat pumps that would meet the strict planning requirements around noise. This delayed installation and caused some tenants to live with temporary oil heaters for much longer than planned.

Some projects were able to mitigate initial procurement challenges through either the contracting instruments they had in place, or because they had existing relationships with contractors. Where projects had in place existing procurement frameworks, this sometimes reduced some of the supply chain issues affecting other projects, but in other cases housing provider framework contracts were obstructive.

"We are in a slightly advantageous position on this… we have our own framework contractor who is working with us. They have already got the materials and supply chain to be able to provide for the Whole House Retrofit". – SHDF(D) project lead, in interview

[15] Brick slips are purpose-made, thin brick tiles or veneer to replicate the appearance of clay-facing brick walls over external wall insulation.

Project documentation shows that two-thirds of SHDF Demonstrator projects utilised external resource to conduct procurement process, most notably Savills, Turner and Townsend and Focus Consultants. Of two that did not, one had a long-term supplier call-off agreement in place. The remaining projects awarded works directly.

"It was not possible to subcontract the retrofit assessor and the architect we wanted, as they were not on the relevant Council framework contract – we would have needed to get an exception from the Council Cabinet, which would have taken a long time. We drew on our existing relationships with the solutions provider, who, in turn, drew on existing relationships with the architect and assessor." – SHDF(D) project lead, in interview

Where projects utilised a design and build contract, through which the main contractor both designs and builds the works, this had mixed effects of delivery efficiency. The Clackmannanshire Alva Community, Leeds Whole House Retrofit, and Social Housing Retrofit Accelerator Cornwall projects report that design and build contracts worked well and created some delivery efficiencies. However, the Energiesprong Sutton project faced challenges when the original subcontractor for their third phase withdrew, and the project team needed to procure the role again.

Where projects used the same contractor for works this did not guarantee them the same price. One project reported that they were using the same main contractor as another project, but that their costs for External Wall Insulation (EWI) were higher than for the other project which was only a few weeks ahead in delivery. Clackmannanshire County Council agreed a fixed cost per property with its main contractor for the Alva Community project, and MOs interviewed for this evaluation consider that this contract approach contributed to the project meeting its target number of properties close to the original timeline set.

One of the principal barriers to whole house retrofit is the cost. Due to the technical nature and types of materials of whole house retrofit projects, the associated costs are felt to be typically higher.

"Whole house retrofit is considered higher risk work compared to normal refurbishment, repairs and maintenance, therefore there are greater costs associated." - Whole house retrofit industry expert, in interview

According to industry experts interviewed for this evaluation, there is concern amongst contractors and government that, through PAS 2035, the Retrofit Coordinator is given considerable authority over what elements of the project are included and therefore the costs. A considerable challenge is that contractors often tender for work that is below actual cost to secure the contracts, therefore are forced to cut corners, or opt for sub-standard materials. Even in early 2021 (before the increase in supply chain costs of 2022), delivery costs were rapidly increasing, and – according to industry experts, costs could increase by 20-30% compared to the original proposal.

"If they [contractors] quoted for the work at the actual cost they know that they wouldn't get the work. Builders don't mind doing better work as long as they are paid for it." - Whole house retrofit industry expert, in interview

5.4 Project innovation

WHR and SHDF(D) were innovation and demonstration programmes aiming to test and identify strategies to reduce time and costs to whole house retrofit. Projects across both programmes emphasised innovations of various kinds in their project proposals: technological, solutions-based, process-based and business model innovation.

5.4.1 Technological innovation

Energy Saving Trust conducted research into the deep retrofit market for this evaluation and found evidence of considerable innovation in the heating systems space with multiple companies offering unique and/or advanced solutions to heating, cooling, and ventilation. Some of this was integrated into WHR and SHDF(D) projects.

Industry experts interviewed for the evaluation consider Q-bot, which was successfully used in the Destination Zero I project, to be one of the most innovative technologies in terms of fabric measures. Q-bot uses robots to spray insulation under floor with minimal disruption to householders. The insulation immediately reduces heat loss and provides the option of under floor insulation to a tranche of households that previously were not able to carry out this work due to access or expense. Several other projects which withdrew from the programmes had intended to use Q-bot (Sunderland, Warwick, Cornwall), based on their original bids.

The Gloucestershire SHARe and CaRe Demonstrator project used a ‘Vericon Systems Intelligent Autonomous Technology’, which was an ‘ecosystem’ of devices and tools including temperature sensors, fire detection and ground source heat pump monitoring that was expected to support in reducing draughts, damp and mould.

Clarion Housing Group advanced retrofit project utilised several innovative materials and products including reinforced glass with plastic for window fixings (as opposed to timber) to improve performance and reduced cost, and Klober roof tile for ventilation in place of gable wall ducting.

To meet the ambitious post-retrofit monitoring requirements of SHDF(D),15 social housing landlords from 11 SHDF(D) projects used commercial smart thermostats in combination with smart heating controls, and monitoring sensors (temperature, humidity, air pressure, CO2), in a selection or all properties receiving installations. These smart-meter-enabled thermal efficiency ratings (SMETERS) use algorithms to calculate the heat transfer coefficient (HTC) of occupied homes using live data. In contrast to Standard Assessment Procedure (SAP), which models energy efficiency based on a one-off survey of the building energy source and fabric, SMETERS provide a far more accurate heat transfer coefficient estimate, and assess other building performance outcomes, operational emissions, and energy use.

Four projects – One Manchester, Clackmannanshire Council, Cornwall Council (WHR and SHDF(D)), and Warwick District Council – formed multi-disciplinary research partnerships to combine analysis of tenant interviews and in-house data loggers. This contributed to increasing the funding levels for the project and aligned with the goals of both schemes to generate learning and support innovation.

WHR Nottingham City and Energiesprong Sutton both integrated the innovative heating system Ventive into their design but faced considerable challenges in implementation. In phase 3 of the Sutton project, the project team switched to a Monodraught system, but the change in design created redesign costs and delivery delays.

5.4.2 Solutions innovation

'Solutions innovation' refers to innovative responses that projects developed in response to unanticipated challenges that arose within projects. Such innovations were described in projects' interim benefits reporting for SHDF(D). Four particularly unique innovations from WHR and SHDF(D) projects are described in the boxes below. These show how the requirements of the programmes, cost considerations, and consideration for tenants inspired projects to think and deliver their projects innovatively. The success of such innovations will be investigated for the Outcome Evaluation.

Manchester Xtra-Z developed an innovative approach to insulating that would cover ineffective historic EWI without the need for removal / demolition that would have otherwise been more costly. The project also developed the innovation of using the air transfer inherent in the no-fines building fabric alongside an air source heat pump (ASHP), hot water cylinder and decentralised Mechanical Ventilation with Heat Recovery (dMVHR) to stabilise the temperature and ventilation in the property.

For the **Leeds Whole House Retrofit** project, energy meters were located on the outside of the treated properties interrupting the continuation of the external wall insulation. Rather than move the meters, which would have raised costs and increased disruption for tenants, the project team designed a box which would insulate the meters whilst continuing to provide access. The Leeds team shared the solution with other projects at the Learning Community workshop, which led to several other projects applying the approach (which is now also patented).

The unique 'energy service plan' (also known as the 'comfort charge') within the **WHR Energiesprong Sutton** project also provides an example of a solutions innovation. Through the service plan, money saved on energy through the retrofit's 'net zero' design is replaced by a lower 'comfort charge' of £8-£10/week, which would be used to fund the works (retrospectively) and fund the retrofit maintenance. In theory, the 'energy service plan' charge would be less than the electricity and gas bills of the residents prior to retrofit installation, so would still represent an energy bill saving for the resident whilst covering some of the costs of the retrofit.

At the time of writing this report, the **National Net Zero Retrofit Accelerator Ealing** were considering installing NextGen's Graphene Heating system (also known as Electric Wallpaper). The innovation has had very little application in the UK, but developers claim it can be installed at a third of the cost of an air source heat pump and has double the lifespan. The product is also thought to minimise damp and mould with targeted placement.

5.4.3 Process innovation

Process innovation refers to unique ways that projects tailored their delivery to reduce costs, address challenges and support tenants. Some distinctive approaches are set out here:

- **Tenant-led design**: The Royal Borough of Kensington and Chelsea project was delivered via a Lancaster West Neighbourhood Team, investing extensive resource in tenant engagement. This approach was innovative in the extent to which the team co-designed the retrofit with residents, actively involving them in choices of materials, property design, and communal area development. Resident co-design was also adopted by Energiesprong Sutton, with residents in the third phase of works given the opportunity to choose the colour of their door. Although a small measure, the project team reported positive responses from residents.
- **Staged approaches**: Manchester piloted retrofits across its three archetypes to feedback learning to the contractor and suppliers and set them performance targets. Although all properties were consistently 'no-fines' archetypes, the properties differed in the number of bedrooms, and where they were situated on the terrace (end or mid). The pilot properties were also chosen as none had residents in situ. This enabled surveying and modelling work to continue in the face of social distancing property access issues.
- **Use of permitted development**: As set out in the Xtra-Z project's Interim Benefits Report, the team also carried out "extensive iterative dialogue" with the Manchester City Council planning department to establish a 'Permitted Development design' that could be agreed with the department for use across all the homes, thus removing the need for planning permission. Clarion also used permitted development rules to support efficient delivery.
- **Rolling approaches:** The Leeds Whole House Retrofit project, by contrast, took a fast-paced rolling approach to its retrofits. Where a delivery challenge was encountered in one property block (e.g. a resident refusing entry), the team would move onto another block, keeping contractors on-site thus preventing delays from contractors moving onto new jobs or contracts.
- **Single project comparative approaches:** Destination Zero I trialled two different approaches to whole house retrofit. The first, supported by Energiesprong UK focused on an 'all-at-once' approach to retrofit, employing multiple innovations to achieve cost and delivery efficiencies. The second workstream has been designed to align with the way that social housing typically carries out planned maintenance. By comparing the approaches directly, the project team hoped to determine the most replicable and relevant way to deliver whole house retrofit in their area.
- **'In stereo' delivery:** The overarching strategy for achieving cost reductions for Clackmannanshire's SHDF(D) Alva Community Regeneration through Decarbonisation project relates to the timing and coordination of retrofit works. Rather than a delivery plan that relies on staggering works across properties, this project aimed to complete all works of the same type (e.g. roofing) to all properties at the same time – an approach they referred to as 'in stereo'. This particularly saved money on scaffolding costs as all scaffolding was erected in one stage, all work at height was completed across all

properties, and then all scaffolding was removed. This prevented any need for multiple rounds of erecting and dismantling scaffolding as the project moved from property to property saving time and costs.

5.5 Resident engagement and property selection

5.5.1 Property selection

For projects whose primary motivation for programme participation was to address hard-to-treat homes, target properties were very clearly defined. In other cases, most notably the Social Housing Retrofit Accelerator Cornwall, Warmer Homes Argyll and Bute, Aberdeen's DORIC project, and the Net Zero Retrofit Accelerator, property selection was not so straightforward. Project teams needed to carry out an intensive analysis of housing stock and retrofit needs before selecting properties. This added to project delays and reduced value-for-money, as deselections in stock increased the planning overheads per completed property, and necessitated resource-intensive PCRs with programme management.

5.5.2 Engaging eligible tenants

Several projects (WHR Energiesprong Sutton, and SHDF(D) projects Leeds Whole House Retrofit, the Clarion Housing Group Advanced Retrofit Project (Fenland and Tonbridge), and the Net Zero Retrofit Accelerator) experienced difficulties convincing residents to participate in the retrofit. Within the Gloucestershire SHARe and CaRe Demonstrator project, Stroud District Council reported challenges engaging older residents in the properties targeted, as they were reticent to undergo disruption when they did not think they would benefit for many years thereafter. Across all projects, the risk of the spread of COVID-19 through participating in the project played a role in reducing tenant sign-up. This was especially pertinent in properties of vulnerable or at-risk people, such as in Wychavon where 30 residents refused works due to shielding or vulnerability during the pandemic, according to monitoring information.

Delivery partner MOs and project teams highlighted several engagement strategies as effective in aiding resident engagement across projects. Using early adopters as 'good news case studies', enabled Clackmannanshire's Alva Community Regeneration through Decarbonisation, Nottingham City's WHR project, and Leeds Whole House Retrofit to increase participation in the retrofits once they had one property completed. As residents saw and appreciated the improved aesthetics of buildings already treated, they were more likely to accept, or actively ask to participate. This lever often involved little or no activity from the RLO or project team. MOs participating in the 2022 workshop for the evaluation flagged the importance of transparent communications to residents.

"It is important [for project teams] to ensure that residents understand the length of the process and what will happen. Engagement is important here. You need to inform residents of the length of the process as well as what is involved". – Delivery partner MO.

One MO noted that referring to the original housing contract, which required tenants to give access to the landlord worked well as a lever for gaining access. One council participating in

SHDF(D) needed to take legal action to overcome obstructions from a tenant – fatigued from multiple visits throughout the works, who refused access to obligatory building health and safety checks post-retrofit.

External factors also encouraged tenants to commit to works. Several tenants who spoke to Ipsos during site visits stated that they were motivated to participate due to a growing concern over the affordability of energy bills triggered by the energy crisis that began in February 2022.

5.5.3 Reasons for non-participation of residents and subsequent engagement

Whole house retrofit approaches require insulation to be applied continuously to the whole building to 'seal' the building and prevent thermal bridging: the heat escaping to less conductive surrounding material in the wall, creating areas of condensation. Where retrofitted homes form part of a block of properties (as a terrace or flats), it is preferable and sometimes necessary for all properties within the building to be retrofitted to reach the target energy performance, mitigate thermal bridging, and provide a cohesive aesthetic to the building. Further, where residents first agree to participate and later withdraw, this can create costs.

Delivery partner MOs, participating in a workshop for this evaluation, provided several reasons for residents declining to participate in the retrofits:

- Sometimes older people preferred not to have the disruption or were reticent to adapt to new technologies.
- For some residents the retrofit would have negatively affected elements of their home set up to address accessibility needs.

"In one house, once work started to put the scaffolding on for EWI, the man was reluctant to continue the works because with the scaffolding's position he would not have been able to remain in the house because the scaffolding would have prevented his car from parking there and he had accessibility issues." – Delivery partner MO.

- Some residents attached sentimental value to open wood fires, which would be removed through the retrofit.
- In some areas, mistrust between residents and the social housing landlord drove some residents to refuse to participate.

Many SHDF(D) and WHR projects operated on sites with mixtures of social housing and privately owned tenures. The funding requirements for SHDF(D) limited the budget and resource available to project leads to properties housing social housing tenants only, while WHR remained open to properties of all tenure, even though it only attracted applications from social landlords. Wychavon's Retrofit of Electrically Heated Homes, the Leeds Whole House Retrofit project, and Nottingham City's Destination Zero all sought non-WHR/SHDF(D) funding to enable leaseholders to benefit from building insulation. However, the Manchester Xtra-Z project, which was initially designed to use SHDF(D) funding for social housing tenants and matched funding to retrofit the homes of leaseholders in the same area, ultimately had to reduce its scope to cover only social housing projects because it was unable to secure funding for leaseholders' roofs and EWI to be completed.

Although non-participating residents were not interviewed for the Process Evaluation, limited evidence from site visits and monitoring data provides some evidence of non-participating resident dissatisfaction with the works:

- At one project site visit, a non-participating resident reported issues of noise and disruption to television satellites from the erection of scaffolding.
- In project interim benefits reporting, the Clarion Housing Group Advanced Retrofit, Leeds Whole House Retrofit, and Northampton Whole House Retrofit projects reported that they had experienced delays during the pre-installation phase, because owners of neighbouring houses were not willing to sign party wall agreements. Manchester's X-tra Z project also experienced significant party wall issues.
- The Nottinghamshire Net Zero Carbon Housing Demonstrator reported (in its Interim Benefits Report) that non-participating residents refusing access delayed delivery.

5.5.4 How resident engagement was managed

Neither WHR nor SHDF(D) specified how resident engagement should be delivered. However, almost all project teams assigned at least one RLO or an alternative staff member to resident engagement. This person would then usually have the role of a day-to-day point of contact for residents, transmitting messages to participating or potentially-participating households, following up with residents to arrange 'touchpoints' – i.e. visits by installers, contractors, surveyors and (sometimes BEIS, project team and Ipsos site visits). Some RLOs had a broader role in the project and they were involved in the design and delivery of events to initially engage or to sustain interest in the project. The MOs supporting both programmes highlighted the importance of contractors and project teams respecting residents, particularly when engaging them to accept changes to their homes and disruption in their home.

"For example, residents might have to reduce or change the size of a cupboard because the new boiler is bigger, and [the contractor] says 'residents need to get rid of their 'junk' in the cupboards'. But to residents this is not junk. This is not to say that residents' views are dismissed, but there is an issue with language". – Delivery partner MO.

Within several projects, the RLO's daily activity was the cornerstone of the project and they had to employ a wide range of skills. For instance, the RLO of the Leeds Whole House Retrofit project was responsible for retaining spare keys to participating households' homes, engaging homes not willing to participate, coordinating work by installers, and for explaining technical aspects of the retrofits to residents. They therefore needed strong coordination, technical and people skills with the ability to gain people's trust.

On all projects, engagement activities were not exclusively performed by RLOs, with additional team members such as asset management, site managers or project leads often performing at least supplementary engagement tasks. Given the limited primary data evidence of resident experience collected for this Process Evaluation, it is not possible to assess the extent to which different approaches to resident engagement led to differing levels of tenant satisfaction, though this will be assessed as part of the Outcome Evaluation.

6 Project delivery

This chapter describes programme delivery to date, the challenges that projects faced and how these were overcome. It assesses the enabling and hindering factors that have driven or halted project progress and brings out learning for future programming.

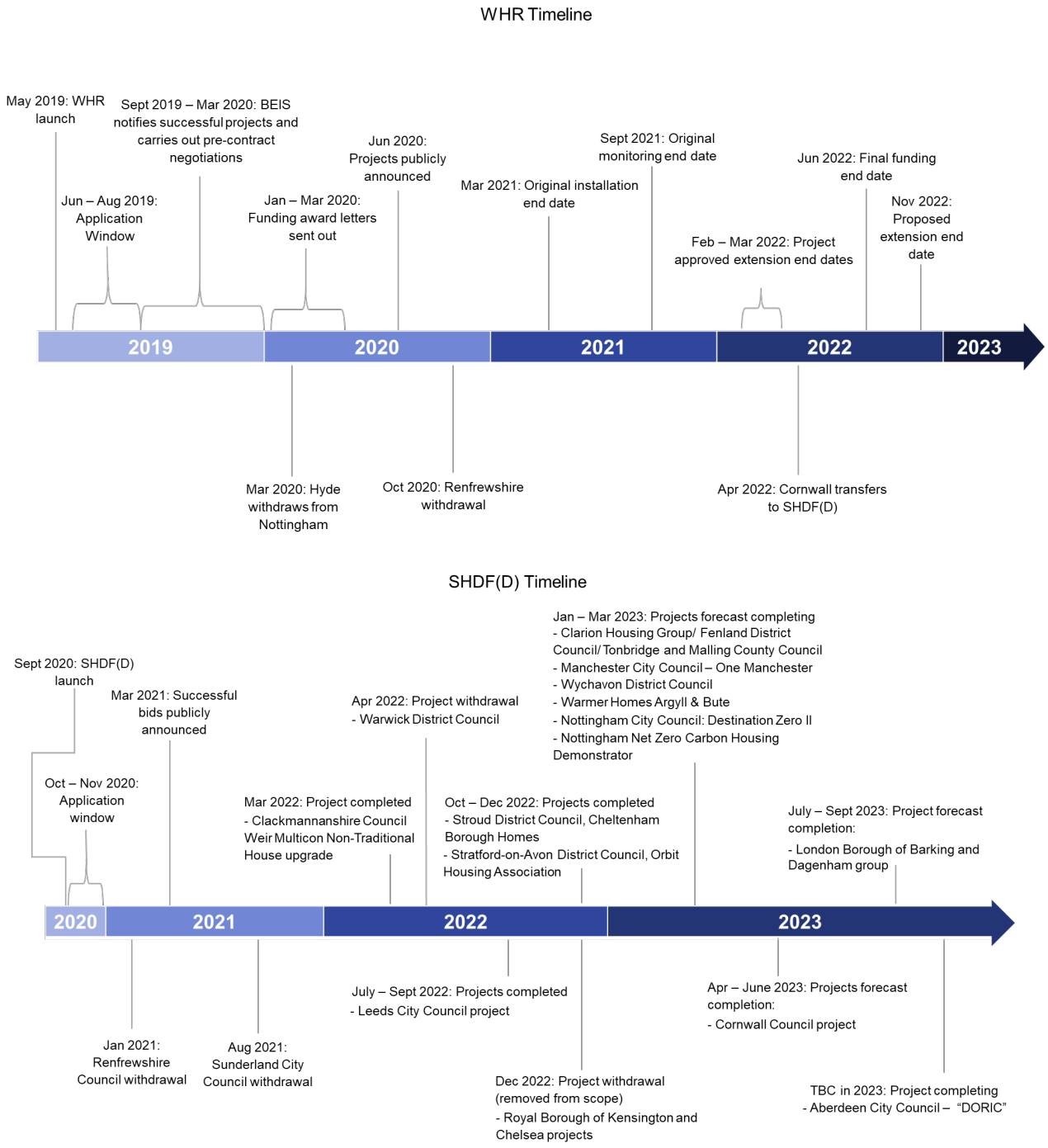
Chapter 6 – at a glance

- WHR projects were initially expected to close by April 2021 but then extended to April 2022 due to the impacts of COVID-19 lockdowns. SHDF(D) projects were expected to close in December 2021, but were also all extended due to delays.
- These delays were driven by procurement challenges, familiarisation with new PAS 2035 standards, and the technical and logistical difficulties associated with whole house retrofit at-scale.
- Project outputs can be classified in four categories:
    - Jobs, skills, and capabilities
    - Business growth and supply chains
    - Energy efficiency and healthier homes
    - Further deployment and scaling-up.
- Some evidence of outcomes is emerging, but this will be investigated in much more detail for the Outcome Evaluation.

6.1 Project delivery to timelines

As ambitious, high-specification infrastructure projects, delivered in an acutely challenging context of national lockdowns due to the COVID-19 pandemic, the WHR and SHDF(D) programmes were subject to significant change and adaptation. The timelines in Figure 6.1 overleaf set out key milestones in delivery. All project timelines were extended, across both programmes, and only Clackmannanshire (SHDF(D)) completed works within the 2021/22 financial year. In June 2022, the majority of SHDFD projects reported expectations to complete by December 2022, though the Royal Borough of Kensington and Chelsea Walkways 21Zero, Morland and Talbot Grove House and Camelford Net Zero projects are likely to run until 2024.

Figure 6.1. Past and anticipated milestones in WHR and SHDF(D) as of June 2022



6.2 Current status of projects

Table 6.1 describes the status (as of 13th June 2022) of the 24 projects initially awarded funding. By this point only the smallest project, Clackmannanshire Alva Community Regeneration through Decarbonisation, which retrofitted 15 (later revised to 17) properties had completed works for all its properties. Five of the largest projects, with a combined total of 901 target homes (Argyll and Bute, the Social Housing Retrofit Accelerator, and the three Royal Borough of Kensington and Chelsea projects), had only reached installation for 6% of properties (45), and only 1% (6 properties) had reached handover. Amongst the projects which

withdrew from the programmes, Renfrewshire withdrew due to delays in procurement which generated (likely) cost overruns and delays in delivery timelines. For WHR Cornwall, the project reduced in scope from its original target number of properties due to delays in the council and primary contractor signing a framework contract. Later, a further delay caused by the acquisition of the primary contractor by another company meant that it would not be possible to complete the project by the June 2022 deadline, and so Cornwall withdrew. Sunderland withdrew because costs for measures such as solar PV and battery storage increased, which meant in the current form the project was not economically viable, and Warwick District Council was unable to sign their Principal Contractor by March 2022 which was a requirement for the funding extension therefore they withdrew from SHDF Demonstrator.

Table 6.1. Project status, WHR and SHDF(D) combined, as of 13th June 2022

Project status	Number	Project title
Projects fully closed	1	SHDF(D): Clackmannanshire Alva Community Regeneration through Decarbonisation
Projects expected to close by July 2022	3	SHDF(D): Clarion Housing Group Advanced Retrofit Project, Gloucestershire SHARe and CaRe Demonstrator, Social Housing Retrofit Accelerator Cornwall
Projects expected to close by September or October 2022	6	WHR: Nottingham Destination Zero I SHDF(D): Leeds Whole House Retrofit, Northampton Whole House Retrofit, Orbit Housing Incremental Whole House Retrofit Scheme (Stratford), Retrofit of Electrically Heated Homes (Wychavon) and Xtra-Z (Manchester)
Projects expected to close later than October 2022 or with high risk of non-completion	9	WHR: Energiesprong Sutton SHDF(D): Nottingham Destination Zero II, Warmer Homes Argyll and Bute, Social Housing Retrofit Accelerator, Royal Borough of Kensington and Chelsea Walkways 21Zero, Morland House and Talbot Grove House and Camelford Net Zero, Nottinghamshire County Council, Project DORIC (Aberdeen)
Projects withdrawing post-scheme launch	5	WHR: WHRI Cornwall, SHDF(D): REFINE Warwick, Fatfield Decarbonisation Project (Sunderland)
Projects dropping out (before formal launch)		WHR: EnerPHit at Scale (Renfrewshire) SHDF(D): EnerPHit at Scale – Achray drive (Renfrewshire)
TOTAL	**24**	
Source: Project and programme reporting, including board meetings		

6.3 Project changes and their drivers

Section 4.6 described the system of PCRs within both projects. All final SHDF(D) and WHR projects made at least two PCRs – only Renfrewshire and Sunderland, who both withdrew in 2021, did not make any. The reasons cited for PCRs varied across projects, however, there were some common motives for the PCRs, including:

- **Supply chain challenges**: Projects experienced a shortage of labour and materials, this meant that projects had to re-profile and re-structure their projects. These supply chain challenges affected all projects to a greater or lesser extent and was cited as the reason for PCRs for seven projects.
- **COVID-19:** Existing challenges were exacerbated by COVID-19, which was cited as the reason for five PCRs where lockdowns generated delays in supply and materials, particularly during the early stages of the SHDF(D) programme.
- **Changes to project costs:** Supply chain challenges, retrofit market saturation, and COVID-19 all contributed to rising labour and material costs. Projects had to re-profile their project finances to accommodate nationwide cost increases. Costs and budgeting were cited as a cause of five SHDF(D) PCRs. For example, Stratford-on-Avon District Council reported that contractors struggled to deal with the increased prices and supply shortage with the average tender cost for an air source heat pump rising from £9,000 to £16,000.
- **Delays in approvals**: As part of the delivery process, and particularly during the early stages, projects had to seek various approvals including planning permissions, design approvals, or technical viability assessments. Several local authorities encountered delays in these processes, which forced PCRs. For example, Wychavon District Council and Leeds City Council both submitted PCRs due to delays in obtaining planning permission, which (in the case of Wychavon) delayed the finalisation of design and early ordering of materials.
- **Reduction in project scope**: Increased pressures generated by price increases, material availability and time delays led several local authorities to request a reduction in project scope. For example, both Stratford-on-Avon District Council and Stroud Council estimated that the scope had to be reduced to stay within budget.
- **Changes to delivery timelines due to processes taking longer than expected**: Some projects needed more time to engage and inform tenants, or additional time to perform home surveys or items related to specific project work packages.

Table 6.2 illustrates the change (variance) in total project spend and in the number of properties covered from the original design to delivery (as of 30th June 2022).

Table 6.2. Variance in project expenditure and number of properties reached

Project Name	Total Spend (variance), £ millions	Properties reached (variance)
WHR		
WHRI Cornwall	£0.51 (£-4.56)	0 (-100)
Destination Zero I	£1.57 (-£8.63)	68 (-127)
Energiesprong Sutton	£1.28 (-£7.29)	23 (-77)
EnerPhit at Scale	£0 (-£4.56)	0 (-75)
SHDF(D)		
Domestic Optimised Retrofit Innovation Concept (DORIC)	£1.46 (-£3.77)	50 (-50)
Warmer Homes Argyll and Bute	£4.37 (-£0.55)	130 (-)
National Net Zero Retrofit Accelerator	No info	240 (-30)
Alva Community Regeneration through Decarbonisation	£0.80 (+£0.025)	15 (-)
Social Housing Retrofit Accelerator Cornwall	£3.86 (-£1.69)	52 (-23)
Clarion Housing Group advanced retrofit project	£8.99	120 (-40)
Leeds Whole House Retrofit	£12.01 (+£3.14)	192 (+2)
Xtra-Z (cross-tenure retrofit achieving zero carbon)	£7.75 (-£0.05)	94 (-70)
Destination Zero II: The Next Step	£1.73 (-£3.74)	68 (-36)
Nottinghamshire Net Zero Carbon Housing Demonstrator	£1.67 (+£0.17)	25 (-)
EnerPHit at Scale	£0 (-£0.72)	0 (-18)
Walkways 21Zero	£18.60 (-£13.66)	367 (final revised number TBC)
Morland and Talbot Grove House	£2.04 (-£5.80)	79 (final revised number TBC)
Camelford Net-Zero	£8.50 (-£0.01)	85 (final revised number TBC)
Orbit Housing Incremental Whole House Retrofit Scheme	£3.62	69 (0)
Gloucestershire SHARe and CaRe Demonstrator	£3.09 (+£0.83)	46 (-4)
Fatfield Decarbonisation Project	£0.09 (-£1.64)	0 (-46)
Radical Decarbonisation of social housing through whole house retrofit (REFINE)	£0.19 (-£2.98)	0 (-50)
Northampton Whole House Retrofit	£7.20 (+£1.59)	150 (-)
Retrofit of Electrically Heated Homes	£7.69 (-£0.02)	185 (-10)

6.4 The drivers of project delivery delays and challenges

The drivers of project delivery delays and challenges were various, though they can be characterised as falling within one of four categories, as discussed below.

6.4.1 Individual project contexts

The unique contexts of projects played a significant role in enabling or hindering the overall project delivery.

- **Scale**: Some of the SHDF(D) projects experiencing some of the greatest delays (Warmer Homes Argyll and Bute, Social Housing Retrofit Accelerator and Royal Borough of Kensington and Chelsea Walkways 21Zero) also targeted the largest number of properties. However, project scale was not a uniform determinant of (lack of) progress, as the Leeds Whole House Retrofit and Wychavon Retrofit of Electrically Heated Homes projects both targeted high numbers of properties and did not experience the same levels of delays.
- **Project location / accessibility**: Projects in rural areas (Argyll and Bute and Cornwall), had to deliver installations across a large area, though installation of low carbon heating solutions was made easier by target properties usually being off the gas grid, which meant that there was no existing gas boiler that would need to be taken out. Accessibility challenges in rural areas were especially pronounced because installers were reticent to travel to remote, rural locations. Likewise, properties located near the coastline endured coastal weather fronts, which make them more likely to suffer from water ingress, damp mould, condensation issues and storm damage. Retrofitting in these areas was particularly challenging due to the higher levels of humidity and salt content in the atmosphere risking degradation to the external components of the houses, resulting in additional retrofit costs.

Warm Homes Argyll and Bute

The Argyll and Bute local authority area is spread across 11 islands and the mainland. Some of the selected properties are in remote, hard to reach areas and require companies and workers to travel from other regions of Scotland in order to deliver the works. Argyll and Bute is a popular holiday destination and the local economy is particularly dependent on seasonal tourism and seasonal workers. The SHDF(D) project was due to be delivered during the summer months 2021 and had expected to experience some challenges for accommodation. However, as a result of COVID-19, there were more domestic tourists in the region than expected and the Council was not able to source accommodation for the retrofit workers. This caused delays of three months while alternative accommodation was found and while the project team waited until the peak tourism season had concluded.

- **Non-standard building construction**: Some project locations had non-standard building construction elements (e.g. granite walls, uninsulated concrete structures, mansard roofs or timber frames) that made some typical elements of (whole house)

retrofit (EWI, PV solar heating, thermal bridges) challenging and are sometimes referred to as ‘hard to treat’. For example, the timber frame of the Wier Multicom archetype for Clackmannanshire created damp issues, requiring remedial work and the installation of underfloor insulation to prevent thermal bridging.

Manchester Xtra-Z

Built in the early 1970s, Grey Mare Lane Estate is a ‘no-fines’ construction: the larger aggregate is bound by a cement slurry coating rather than the fine aggregate usually mixed with concrete. Because of this, connected voids are found throughout the walls with adverse effects on heat retention, air tightness and resistance to moisture. This can present specific issues when applying internal wall insulation due to problems with interstitial damp, necessitating external wall insulation instead, provided that the wall is strong enough to hold the fixings. Although the knowledge of retrofitting this construction existed, performing this at the scale of the project (a proposed 164 properties) was a challenge to the project team.

- **Climate and local environment considerations**: Project leads also highlighted that factors, such as being on a hill and ‘exposed to the elements’ or in a valley with less access to daylight for solar technology, affected retrofit outcomes. Two projects faced challenges because target properties were located next to drainage channels, increasing the risk of flooding.
- **Effects of fauna**: Bats and then roosting seagulls delayed construction in Cornwall, as there were prohibitions on the disturbance of fauna in construction activities.
- **Coordination with utility companies**: Delays caused by the challenge of coordinating distribution network operation companies to relocate electricity and gas boxes in Fenland, and to move power cables affecting changes to roofing in Wychavon, also created significant delivery delays for these projects.

6.4.2 Contract management

As reported in PCRs and in programme governance notes, projects experienced issues with setting up contractors to deliver, manage their procurement frameworks and deal with the legal obligations that are required for retrofitting. In some cases, projects had a central project management team which facilitated the oversight and management of procurement frameworks and contracting processes but others did not.

Contract challenges projects reported include:

- Aberdeen City Council faced challenges in setting up a consortium contract and in planning the contingency required for installation works and tendering process.

- West Northamptonshire had a principal contractor delivering the work but due to contractor's limited capacity another was needed to be brought in, which resulted in significant delays.
- Argyll and Bute experienced lengthy procurement issues preventing them from starting installations, accompanied by delays in on-boarding a contractor who is expected to be in place by August 2022.
- Nottingham also experienced similar issues in delays in contracting the principal contractor and experienced the loss of their EWI provider.
- The National Net Zero Retrofit Accelerator had a complex system for establishing partnerships between the local authorities and the retrofit providers. Ultimately, the project's commitment to whole-solution providers (Engie, Osborne and United Living) constrained the projects.

6.4.3 PAS 2035 delivery

During delivery, SHDF(D) projects had to adapt their approaches to address emerging challenges of the build whilst continuing to meet the PAS 2035 standards. The SHDF(D) programme design rationale for this is described in section 4.6. WHR projects did not set the same condition; instead, the projects were expected to be familiar with PAS 2030 and PAS 2035 and refer to those in the bidding stage, but only had to comply with PAS 2030 and PAS 2035 guidance where applicable.

Prior to implementation, retrofit industry experts interviewed during this evaluation were broadly supportive of the standard. While some project leads acknowledged it as constructive to driving quality, almost all mentioned PAS 2035 as a driver of delivery challenges and delays.

First, most projects reported significant difficulties at the start procuring professionals accredited to deliver to the new standard. In Scotland, for example, there were three live SHDF(D) projects in September 2021, but only two practicing accredited PAS2035 retrofit coordinators.

"*Many contractors we're working with did not have Trustmark or PAS2030 accreditation prior to SHDF (D) and found applying for this resource- and time-intensive".* - SHDF(D) Project Lead, in Project-level Interim Benefits Report

PAS 2035's high standards on thermal bridging frequently increased labour and material costs incurred by projects. Several projects were required to extend the eaves of the roof of houses to ensure sufficient overhang around the top of an external wall, triggering full planning permission and more intensive designs. On one Clarion property, PAS2035 compliance required the builders to retile the entire roof of some properties even when only a small eave extension was needed. This added over six months' delay to completing this property, tenant fatigue, and significant labour and material cost to delivery. Similarly, PAS 2035 required extensions of EWI below the damp proof course, significantly increasing delays and costs to insulating properties. Not only did PAS 2035-required EWI extensions increase the material and labour costs, but the alteration to the property footprint also required legal costs for

planning permission, higher design costs and technical complexity to mitigate the consequent increased risk in damp.

In this case, the SHDF(D) team fed this example through to the PAS 2035/2030 steering group to help inform an ongoing update process of the PAS 2035/2030 documents. This demonstrates the impact of BEIS schemes to promote the development of industry standards, and the possibility to update the PAS 2035/2030 documents in response to experiences or lessons learned as delivery continues across the BEIS schemes.

On the whole, there was mixed feedback from participants on PAS 2035.

"PAS 2035 requires implementation property by property. This makes it difficult to apply to mass programmes like this one". – SHDF(D) project lead

"[…] We're having to submit every property's design plans, even though it's a cut and paste." – PAS 2035 Retrofit Coordinator

"It has been a steep learning curve and we have benefited a lot from applying [PAS 2035], but it is likely that we will not attempt to retrofit to PAS 2035 again immediately". – SHDF(D) project lead

PAS 2035 practitioners pointed to administrative and logistical elements of the PAS 2035 and PAS 2030 processes that increase unnecessary administrative burden on multi-property projects. Many retrofit coordinators familiar with Trustmark Data Warehouse, the administrative platform, expressed the view that it was unsuited to large-scale projects. Interviewees cited lack of capacity to input/ upload data and duplication, and the automation of more demanding risk pathways for even relatively simple multi-property building designs. In contrast, project leads tended to be more critical of the role of PAS 2035 overall, questioning whether a whole house approach was ultimately incompatible with the long-term Net Zero goals for mass retrofitting. While reflecting that PAS 2035 has ultimately helped them achieve quality and increased their technical understanding of how to deliver quality retrofit, a few project leads were not sure they would adopt PAS 2035 in future, in the absence of government grant conditions.

6.4.4 Views on the viability of whole house retrofit as an approach for at-scale delivery

Whilst project teams considered that whole house approaches to retrofitting can benefit tenants and increase the quality of the retrofit, many considered the high cost and individualised approach to be incompatible with large scale rollout, as set out in Project-level Interim Benefits Reports. One project team also reported the whole house approach was "too disruptive for many residents and too costly for most landlords to do in one go". The same team expressed the following view:

"Whole house approaches "mean one house will be done in 2022 whilst another will have to wait 20+ years, […] This becomes very inequitable and hard to justify to tenants who all pay the same rent." – SHDF(D) project lead, in Project-level Interim Benefits Report

Whilst projects expected to be able to apply similar approaches to each retrofit across building 'archetypes', houses often varied to a much greater extent than anticipated, meaning that it was not possible to apply the same approach to several properties. This diversity across building archetypes arises from the historical legacy of housebuilding in the UK, with different and experimental construction methods being used over the decades in the 20th Century (Guardian Newspaper, 2014). Housing stock has also been subject to changes and adaptations, as part of maintenance or remedial works creating variations between properties through the years.

6.5 Emerging outputs from projects

This report focuses on the programmes' launch, delivery and the closure activity that has occurred to date. However, some of the early emerging outputs from WHR and SHDF(D) programmes are explored below. The aim of this section is to highlight and demonstrate early and emerging evidence where progress has been made to date. Outputs will be explored in detail in the Outcome Evaluation.

6.5.1 Jobs, skills and capabilities

Project teams needed to recruit and deploy additional staff to deliver the projects. SHDF(D) project monitoring reports that the SHDF(D) programme supported 786 jobs across project delivery (Ricardo, 2022), including site labourers, administrators, site managers and tenant liaison officers. Five projects (Leeds Whole House Retrofit, Destination Zero II and the three Royal Borough of Kensington and Chelsea projects) also employed apprentices. According to one Project Lead, the fact that there is an SHDF Main Fund makes it more likely that the jobs and skills supported will be sustained.

"If this demonstrator is rolled out at scale, then it will definitely send a signal to the market and local contractors to upskill and reskill existing gas engineers to include heat pumps. There is also opportunity for construction companies to widen their supply chain as more accredited PAS 2035 installers will be required. Existing businesses are being used for the works, but this may result in the training of the local workforce to establish a wider supply chain going forward." – SHDF(D) project lead, in interview mid-2021

The extent to which this sustainability in the job market materialises will be reviewed during the next phases of the evaluation.

6.5.2 Business growth and supply chains

SHDF(D) appears to have been successful in attracting construction and design firms with lots of experience, as well as no experience in whole house retrofit, with some project leads interviewed signalling that the programme opportunity catalysed them into thinking more about energy efficient upgrades and whole house retrofit approaches to upgrading their housing stock.

"[There was] no pre-existing strategy in place. This project was a catalyst to us getting started." - Project lead interview

Several project leads stated in interview that participation in SHDF(D) and WHR enabled the supply chain to understand the requirements and overall needs for whole house retrofit activities, making them better prepared and equipped to meet the demands of the future. Manufacturers interviewed for this evaluation noted that some improvements, for instance, around quality materials and products were being driven by the importance given to PAS through SHDF(D) and ECO.

There was also evidence of industry enthusiasm for whole house retrofit in the manufacturer and project lead interviews conducted for the evaluation.

"Clients are being driven towards adopting whole house retrofit because they have found work that has been done in the past is inadequate, and they want to do it better. They may not be intrinsically interested in whole house retrofit, but they want to overcome historically poor performing installations." – Industry expert

This, and an increased understanding of the requirements of a whole house approach, are important given the ongoing delivery of SHDF Wave 1 and the launch of Wave 2 as part of the Main Fund.

"The Social Housing Decarbonisation Fund Demonstrator and Whole House Retrofit funds have made organisations sit up and realise that they have a role to play and try and find their way through that, and I think we're still very much at the beginning of that journey." - Insulation Manufacturer.

6.5.3 Energy efficiency and healthier homes

Monitoring records indicated that retrofits of completed installs are already having the desired effect on home energy efficiency. The 15 completed homes retrofitted through the Clackmannanshire Alva Community Regeneration through Decarbonisation project had improved from EPC rating D/E to B/C (Ricardo, 2022), and the properties' lifespans had been extended to a minimum of 25 additional years. Similarly, the Clarion Housing Group advanced retrofit project has so far improved 55 homes to EPC B.

6.5.4 Further deployment and scaling-up

Early evidence suggests SHDF(D) has catalysed further whole house retrofit activity where neighbouring private properties have wanted to replicate retrofit works. Such is the case in Clackmannanshire, where to date 10 privately owned properties have installed EWI and replacement windows with some also opting for PV and battery systems, with an additional 11 private owners also awaiting the works to be completed. Nevertheless, despite the increased interest of private owners around the site area, project teams report that costs act as a disincentive for further private uptake.

Project partners noted in interviews that the delivery process for WHR/SHDF(D), has allowed them to generate better systems, in order to be more efficient in delivering retrofit works in the future.

7. Conclusions

Chapter 7 – at a glance

- Projects supported by WHR and SHDF(D) were expected to deliver innovative projects in a very challenging societal, market and economic context. This severely impacted projects' ability to deliver to intended timescales and designs.
- The fact that the two programmes operated at the same time generated both advantages for delivery in terms of opportunities for knowledge sharing and some disadvantages, including increased pressure on the supply chain.
- Despite both programmes having a delayed delivery, there have been some elements that have excelled across the portfolio of projects, including solutions innovation, tenant engagement, and – for some projects – project management.
- Overall, both programmes have generated significant learning about the necessary processes, timescales and good practices that enable deep retrofit at scale going forward.

7.1 Overall findings

WHR and SHDF(D) were ambitious and innovative programmes, aimed at testing and demonstrating (respectively) whether and how deep retrofit can be performed at scale within social housing in the UK. Neither programme has been delivered to the timelines nor the scale that was originally anticipated, but both have generated significant learning about the necessary processes, timescales and good practices that enable deep retrofit. In addition, the diverse models and settings of the projects have enabled rapid identification of challenges that might slow or hinder at-scale social housing decarbonisation, the circumstances under which deep retrofit is less feasible, too costly, or inefficient for the goals it is trying to achieve.

Similarly, it has demonstrated the opportunities that deep retrofit can bring in terms of providing ‘healthier homes’ for residents. There is emerging evidence from this Process Evaluation that the programmes have had an effect on upskilling parts of the supply chain, that they have generated beneficial learning and knowledge amongst social housing landlords and their partners, and that they have provided innovators with an opportunity to test the scalability of their solutions.

WHR and SHDF(D) shared several commonalities of design and purpose. Both programmes sought to achieve energy savings and better outcomes for occupants by issuing grants for retrofit projects taking a fabric first, whole house approach. Both programmes also sought to demonstrate how deep retrofit could be performed at a reduced cost and test innovative approaches.

The WHR programme has not been able, ultimately, to support at-scale deep retrofit, where at-scale comprised of 75 properties. Of the two (out of an initial four) projects which moved beyond the immediate set-up phase, neither will install close to their original ambitions (Destination Zero I is likely to retrofit 68 houses (out of an originally targeted 195) and Energiesprong Sutton will retrofit 23 dwellings instead of its target of 100). These two projects have lowered their energy performance targets.

The SHDF(D) programme has had greater success in supporting projects that have met their target number of retrofits, but almost all SHDF(D) projects have had to scale back their original retrofit ambitions in terms of measure specification, and number of properties reached. Only one project (Clackmannanshire's Alva Community Regeneration through Decarbonisation) is complete at the time of writing to its original target scale, though five look set to also complete their original number of retrofits and a further five look set to complete to only a slightly reduced scale. Should these projects complete as currently forecast, then they would demonstrate that a deep, whole house retrofit approach (one aligned with the PAS 2035 'whole house' standard) is possible at scale, where scale refers to retrofits that cover 15 to 190 properties at once. The projects have already demonstrated that delivery of such projects needs longer than 12 months.

7.2 Programme design

Both the WHR and SHDF(D) programmes were highly ambitious by design. For SHDF(D), there was an 'added' complexity of the programme testing at-scale application of the PAS 2035 standard and part of a broader Green Economic Stimulus package of schemes to support green jobs during the COVID-19 pandemic. However, whilst PAS 2035 increased costs and timelines, and made delivery more challenging in some respects, it may also have facilitated the retrofit process by providing a guideline for teams to work towards and a bar against which to measure the depth and effectiveness of the retrofit. Overall, project teams have been positive about the standard.

In interviews for this evaluation, BEIS delivery staff recognised that, for both programmes, applying whole house retrofit – with its entailed high energy performance and quality standards, individualised and occupant-centred approach – and reducing costs was not wholly compatible. Yet this was why the programmes were innovative: they aimed to test whether through specific designs and delivery approaches this challenge could be mitigated. Innovation programmes will always have a high threshold for risk.

A central aspect of programme design was the short timescales for delivery (of 18 months for WHR and 12 months for SHDF(D)). At interview, several SHDF(D) staff expressed the view that these seemed unrealistic at the time of SHDF(D)'s launch. The WHR programme team had less precedent on which to base their timescales, but they also acknowledge that they could have done more 'soft testing' of timescales before the programme's launch. By setting short timescales for bidding and for delivery (particularly when, later, there was some leeway to change these), the Government reduced the amount of time available for design and set-up, which led to inefficiencies later in project delivery. The short timescales also reduced

opportunities for flexibility and sequencing in the supply chain; the timescales meant that projects made similar demands on the supply chain at the same time. Parallel to short timelines for delivery, BEIS also set time-intensive project reporting requirements, and increased project workloads through its site visits too. However, this intensity of monitoring clearly contributed to BEIS and projects' learning, and the pressure of being 'observed' may have had a positive effect on performance.

7.3 Programme delivery

Several aspects of the programmes have worked well: project teams valued the monthly learning communities and the peer-to-peer learning opportunities they presented, the WHR team at BEIS considered their own monitoring and reporting systems and their relationship with the delivery partner Ricardo highly effective and fit-for-purpose, while the SHDF(D) team had a preference for the systems which they adapted over time and which entailed greater involvement and time contributions from BEIS into monitoring. There were some inefficiencies within both programmes, however. There were delays within the WHR programme in issuing grant agreement letters and both programmes experienced delays in approving PCRs which had negative effects on BEIS' relationship with projects and on project delivery. The funding mechanism which SHDF(D) used to award grants up-front reduced BEIS' ability to hold projects to account for their spending and created some inefficiencies in monitoring and grant management.

The fact that the two programmes operated at the same time generated both advantages and disadvantages for delivery. Delivery teams at both the programme and project levels could share experiences, knowledge and good practices supporting and benefiting delivery. BEIS reported that knowledge of challenges and solutions across the programmes better informed decisions around project change requests, ongoing programme design, and how best to support projects. It appears that, by experiencing the retrofit challenges 'live' at the same time, the two groups of delivery teams were more driven to exchange learning than perhaps they might have been had one programme already closed. There were also potential benefits from having two different programmes within BEIS (governed via distinct portfolios and with slightly different policy agendas) testing different policy designs (e.g. PAS vs. no PAS compliance), monitoring regimes and performance management approaches. It is arguable that this has generated more learning around how central government should best support deep retrofit than would have been reached from just one programme approach being tested.

Having both programmes deliver in parallel also had some adverse effects. First, it increased the pressure on the supply chain, which some stakeholders believe contributed to some of the price increases in materials and technology and some of the problems of accessing installers and contractors, because, once SHDF(D) was available, it made the smaller WHR projects less attractive to supply chain players (and project delivery more costly). Second, it increased pressure for projects who delivered under both programmes, or who decided to bid for SHDF(D) or SHDF funding during delivery. This is evidenced by the fact that three funded WHR projects had parallel or follow-on projects funded under SHDF(D) and many SHDF(D) projects are also receiving wave 1 funding under the SHDF Main Fund.

7.4 Project design

The WHR and SHDF(D) programmes supported a wide range of projects. Projects varied in size, retrofit approach, procurement approach, team structure, housing types treated and local (environmental, geographical) context. Both programmes were largely additional in the support they provided, because they either catalysed project teams to implement a whole house approach where previously they would have upgraded homes through single measures only, or because they accelerated the timeframes within which housing providers made the changes; or because they increased the quality or performance that housing providers were able to achieve for the properties and residents by enabling project teams to implement deeper retrofits, or reach a larger number of properties through the funding.

Project team motivations for applying to the two programmes varied. Projects were motivated by the change that they hoped to create through the retrofits, and 'Theories of Change' broadly fell into three categories: projects which participated in order to generate learning around 'what works' so that they could roll out the retrofits (e.g. amongst the housing provider's other buildings) at a larger scale; projects which used the funding (and the whole house approach) to treat hitherto hard-to-treat homes that had not been picked up / addressed as part of the housing provider's standard maintenance programme; and projects which were using the funding to support a particular group of residents or estate in order to address particular issues of vulnerability, well-being, fuel-poverty or to build relationships between the community and the housing provider. Because projects were aiming to meet specific energy performance targets and (under PAS 2035) quality conditions, this drove them to adapt their retrofit methodologies in innovative and unique ways which has created solutions that – in at least one case (the Leeds insulated electricity meter box) – can be applied more widely to the retrofit sector.

Because the projects varied so much, it is challenging to single out a 'typical' or common retrofit approach. It is also challenging to identify, with confidence, what works, since some approaches to retrofit will work in some contexts, but potentially not in others. The Outcome Evaluation will investigate further the extent to which different features of projects drove differences in performance.

7.5 Project delivery and overall programme performance

Projects supported by WHR and SHDF(D) were expected to deliver innovative projects in a very challenging societal, market and economic context. COVID-19 affected every aspect of delivery, from greater tenant refusal, delays on imported materials, to labour shortages. All stakeholders consulted for the evaluation shared the view that the supply chain was not ready for at-scale delivery of whole house retrofits. In some cases, for the SHDFD projects, this was because the retrofit market was still adapting to the newly introduced PAS 2035 standard. Project teams had to spend longer on their first retrofits resolving implementation challenges that arose because (due to the idiosyncrasies of the building) the measure had to be adapted to ensure the PAS standard was met. They had to develop bespoke designs for products such as brick slips that would enable the insulation to be completed to PAS 2035 without overly

compromising speed of installation. Where projects aimed to meet PAS through use of particular types of insulation techniques, these were not always available at the scale required. Where delivery to PAS 2035 meant that projects were developing first-of-a-kind processes or implementing them in their locality for the first time, project teams were not always able to develop accurate specifications for their builds at the time of contracting companies to deliver them.

The deep retrofit approach also meant landlords encountered greater than usual delivery challenges:

- Risks of installer error, installing atypical measures to higher standards.
- Difficulty attaining resident buy-in for more intensive and disruptive renovations, and behaviour change post-works.
- Attracting suppliers for highly complex works with high delivery uncertainty.
- Coordinating with planning departments and utilities companies.
- Uncovering and addressing long-term structural building issues (e.g. mould or animal infestations).

Projects across the portfolio have experienced delays in delivery, leading to a reduction of treated homes, and a reduction in energy efficiency ambitions leading to some (five) projects withdrawing due to their inability to deliver within the agreed scope, time and budget. With one project completed, nine due to be finishing by October 2022, and nine expected to close later than October 2022 or have a high risk of non-completion, there is a clear variation from the original estimated end date for all projects of December 2021 (SHDF(D)) and April 2022 (WHR).

Given the varied nature of the projects, it is not possible to pinpoint a single barrier to project delivery, but rather a combination of factors. Project timelines were already considered ‘short’, so the additional challenges of procuring contractors, gaining resident buy-in, complying with PAS 2035, and meeting planning requirements made delivery to plan problematic. In addition, unexpected project challenges and the pressure of an already-stretched supply chain and workforce, meant that any delay was significant and had a notable outcome on project delivery.

Despite both programmes having a delayed delivery, there have been some elements that have excelled across the portfolio of projects. One of the goals of the programmes was to develop and deploy innovative solutions to retrofit works. Several of these innovations, such as Leeds insulated meter boxes came about when the project teams had to respond to unanticipated challenges that arose within projects, or in response to the particular circumstance of the property, as with Manchester Xtra-Z’s use of the inherent air flow in no-fines buildings with ASHP.

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