
Unlocking Retrofit at Scale

A Practical Toolkit Towards Net Zero



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INTRODUCTION

The UK is required to achieve net zero by 2050 and a 78% reduction in carbon emissions by 2035 in line with the Climate Change Act 2008 and subsequent revisions in 2019 and 2021.



The first volume of our Retrofit Toolkit was released at a time in which retrofit was still being considered as a strategy to decarbonise housing stock. The country was still in the grips of a pandemic, Euro 2020 had just concluded with a disappointing penalty shootout (for the English, anyway), the Tokyo Olympics were wrapping up, and a limited number of Local Authorities and Registered Social Landlords had been selected to take part in the Social Housing Decarbonisation Fund (SHDF) Demonstrator project. With the funding scheme largely unproven, bidding for SHDF Wave 1 funding was, at best, a mid-level priority for many Local Authorities and their consortia.

At the time, the toolkit was well received; a view of the landscape with the backdrop of decarbonisation, it started with the why and finished with the how. It provided transparent, industry specific cost information - details that could be used for both a pricing exercise and a retrofit design.

Perhaps most successfully, it provided cost and design information for various property archetypes, building a clear expectation around what EPC 'C' aspirations, kWh/M² targets and full decarbonisation would cost.

With so many organisations either still digesting 'retrofit' as a concept, or in the early stages of planning pilot projects for which they hoped to secure Wave 1 funding, the size of the challenge facing the housing sector was not yet fully realised. This is nobody's fault of course; like with any new concept, a certain level of scrutiny is expected before a growing body of evidence proving its value to the market makes it a new paradigm.

Three years later, and how things have changed; we have seen well over £1bn funding announced through the three waves of SHDF Funding (Waves 1, 2.1 and 2.2) and the meteoric rise of retrofit has led to it becoming one of the leading workstreams in the social housing sector. But while the industry has accumulated a host of important learnings to surmount individual challenges, there's still one major, overwhelming challenge to overcome:

RETROFIT DELIVERY AT SCALE

How do we deliver retrofit at scale?

Given the value that Volume One of our Retrofit Toolkit brought to those grappling with the why and the how of retrofitting their housing stock, we now present Volume Two. This update to our existing guidance draws upon more than 4 years of learning across £100m worth of retrofit projects – but most importantly, it provides a blueprint to achieve retrofit at scale.

Government Retrofit Evolution

October 2015

Each Home Counts Review published considering advice, protection and standards

May 2019

PAS 2035:2019 Standard launched as a result of Each Home Counts review

July 2020

Social Housing Decarbonisation Fund (SHDF) plans launched with the initial Demonstrator Round (£50m funding)

March 2021

SHDF Demonstrator Results announced with a fund total of £61m across 18 projects and 16 organisations

February 2022

SHDF Wave 1 Results announced with 69 projects and a fund total of £179m funding

March 2023

SHDF Wave 2.1 Results announced with 107 projects focused on scale with £778m in total funding

September 2023

After consultation and for continuous improvement, amended version of PAS 2035 launched (PAS 2035:2023), becoming mandatory from March 2025

March 2024

SHDF Wave 2.2 Results announced with 42 projects and a total of £75m in funding; seen as a continuation of Wave 2

May 2024

SHDF Wave 3 guidance released, anticipating £1.25bn in funding spend over 3 years

September 2024

WH:SHF Wave 3 guidance published with funding to be confirmed at the autumn statement

Baily Garner's Retrofit Evolution

January 2020

BG put 5 team members through PAS2035 Retrofit Coordinator Training

May 2020

BG Appointed on a number of Energiesprong Pilots for management and sustainability advice

February 2021

BG appointed for PM Support and design guidance for two SHDF Demonstrator Projects

August 2021

BG release original Retrofit Toolkit

March 2022

BG appointed on eight SHDF Wave 1 projects to provide RC, RA, RD and PM services

June 2022

BG release updated 'version 2' of the original Retrofit Toolkit

July 2022

BG engaged by Turner & Townsend to provide technical expertise to client organisations as part of their Social Housing Retrofit Accelerator scheme

September 2023

BG appointed on eleven SHDF Wave 2.1 projects to provide RC, RA, RD and PM services

March 2024

BG appointed on four SHDF Wave 2.2 projects to provide RC, RA, RD and PM services

May 2024

BG release summary of SHDF Wave 3 guidance released

September 2024

BG engaged by Turner & Townsend to provide technical expertise to client organisations as part of the Retrofit Information, Support and Expertise (RISE) scheme

THE NEED FOR A RETROFIT PROGRAMME/PROJECT MANAGER

The Problem

The latest round of SHDF Funding intended to accelerate the roll out of retrofit, building upon the lessons learnt from previous waves, the natural development of a robust supply chain and the implementation of innovative solutions. This is easier to say out loud than to deliver, as many organisations have found through their programmes of work. As with any complex problem, there is no easy solution, however, it is our view that the way retrofit schemes have been conceptualised and delivered is often flawed, lacking what any large, complex project needs – robust foundations underpinned by strong project management principles.




There are standards developed to aid the assessment, design and delivery of retrofit projects. The most common of these is the PAS 2035 standard, but there are others that are equally well recognised, such as the RICS' Residential Retrofit Standard. However, what these standards do not cover (and nor should they) is how to truly deliver retrofit at scale.

The Role

We hold the PAS 2035 standard in high regard, as it creates a robust framework for the management of retrofit risk. Additionally, we believe that the Retrofit Coordinator should be someone who has a detailed understanding and experience of working with existing buildings. The Retrofit Coordinator must be active and present during delivery – not hiding behind a computer screen in another part of the world (this has been made clear through the requirements under the latest iteration of the standard).

However, it is equally true that this individual should not be responsible for the management and running of any retrofit project. To demonstrate this, a responsibility matrix has been illustrated to demonstrate where we believe the responsibility starts and ends.

Responsibility matrix

 Item	 Retrofit Coordinator	 Retrofit Project Manager
Development of a retrofit scheme and delivery approach	NOT RESPONSIBLE	RESPONSIBLE
Creation of a Project Execution Plan	NOT RESPONSIBLE	RESPONSIBLE
Development and management of a project programme	NOT RESPONSIBLE	RESPONSIBLE
Management of the construction contract	NOT RESPONSIBLE	RESPONSIBLE
Management of overarching Project Risk	NOT RESPONSIBLE	RESPONSIBLE
Management of the project financials	NOT RESPONSIBLE	RESPONSIBLE
Overseeing the PAS 2035 requirements and ensuring compliance	RESPONSIBLE	NOT RESPONSIBLE
Analysing the retrofit assessment and development of suitable energy efficiency measures	RESPONSIBLE	NOT RESPONSIBLE
Overseeing energy modelling and development of the medium term plan	RESPONSIBLE	NOT RESPONSIBLE
Undertaking inspections during delivery to monitor installation quality	RESPONSIBLE	NOT RESPONSIBLE
Undertaking post-completion evaluation	RESPONSIBLE	NOT RESPONSIBLE

Thoughts from the Industry

To truly unlock delivery at scale, the role of a 'Retrofit Project Manager' must be deployed. What is important to make clear is that this need not be a new role, but it is vital to ensure there is a shared ethos and project management principles in place. These principles should be the driving force of the project, rather than being solely lead by any particular retrofit standard, such as PAS 2035.

David Pierpoint, Chief Executive of the Retrofit Academy, believes that project management experience is a necessity for Retrofit Coordinators, and construction/management experience is a qualifying requisite of the course; The PAS 2035 standard lays this out.

PAS 2035:2023; 3.29, Retrofit Coordinator: Person qualified as a specialist retrofit project manager, taking overall responsibility for overseeing the assessment of dwellings, the identification, specification, inspection and evaluation of EEMs for installation at a given dwelling as a single project, and their subsequent monitoring and evaluation.

There is a general feeling that Retrofit Coordination should sit alongside other similar roles where comparisons could be drawn, such as Building Surveying or Project Management. There is also a worry that in the rush to satisfy supply chain, there is an emergence of multiple organisations across the board that can lead to an effective two-tiered approach to coordination; this is from education providers through to delivery partners, inclusive of all PAS roles.

We have seen examples of large-scale projects that have, in essence, been driven by PAS 2035, with properties assessed at random based upon access availability and energy modelling exercises resulting in improvement measures that don't fully consider property constraints. The result has been issues arising during design development and further inspections creating mounting costs and significant resident fatigue, before finally arriving at the delivery phase much later than anticipated and without a coherent approach. This may sound familiar to many, and it's a mould that needs to be broken.

The successful delivery of large scale construction projects has been contingent on strong project management principles throughout history, and we believe retrofit should be afforded the same treatment. The overlay of PAS 2035 principles within a project management based project is what is required to create successful delivery at scale.

PAS 2035, RETROFIT AND THE RIBA PLAN OF WORK

The RIBA (Royal Institute of British Architects) have developed a well-known and respected process for briefing, designing, constructing and operating building projects which has been divided into eight stages.

These stages detail the core tasks, outcomes and information to be exchanged at each step along a project.

The RIBA Plan has also been overlayed for specific projects types; such as Passivhaus, engagement and Smart Buildings. These take the principles of the RIBA Plan of Work and include specific requirements for these bespoke project types.

An overlay is yet to be produced for Retrofit Projects detailing the requirements of retrofit and relevant standards such as PAS 2035, aligned to the RIBA Plan of Work. This is something that we feel strongly about, and so have produced our own interpretation.

[RIBA Plan of Work: RIBA Plan of Work \(architecture.com\)](https://www.architecture.com)

Retrofit and the RIBA Plan of Work









There is however more to Retrofit than the requirements of PAS 2035 and we have therefore included our interpretation of the additional core activities to unlock retrofit at scale.

There is also still a large amount of misunderstanding, underdeveloped understanding and frankly lots of jargon that is introduced by PAS 2035 and retrofit which means that delivery can be difficult. The alignment between PAS 2035, Retrofit and the RIBA Plan of Work for many is a lightbulb moment where suddenly it begins to make sense – and it is important not to reinvent the wheel.

Alignment of the RIBA Plan of Work, Retrofit and PAS 2035



Roles and Responsibility Table

	STAGE 0	STAGE 1	STAGE 2	STAGE 3	STAGE 4	STAGE 5	STAGE 6	STAGE 7
RIBA Plan of Work Stage	 Strategic Definition	 Preparation and Brief	 Concept Design	 Developed Design	 Technical Design	 Construction	 Handover and Close-Out	 In-Use
PAS 2035 Work Stage	Preliminary Stage	Intended Outcomes	Dwelling Assessment Improvement Option Evaluation Risk Assessment	Improvement Option Evaluation	Retrofit Design	Installation Testing and Commissioning	Handover Claims of compliance	Monitoring and evaluation
PAS 2035 Core Tasks		<u>The PAS 2035 roles (Retrofit Coordinator, Assessor, and Designer) are appointed.</u> <u>The Intended Outcomes are defined and agreed.</u>	<u>The dwelling assessment is undertaken, including an RDSAP assessment, condition report, ventilation assessment and occupancy assessment.</u> <u>Air permeability tests are undertaken.</u>	<u>Energy modelling is undertaken to analyse Energy Efficiency Measures.</u> <u>Production of the Improvement Option Evaluation and Medium Term Plan.</u> <u>Production of the ventilation strategy.</u>	<u>Production of the Retrofit Design for the energy efficiency measures and ventilation upgrades.</u> <u>Analysis and design to manage thermal bridging risk.</u> <u>Analysis of overheating risk.</u>	<u>PIBI completion.</u> <u>Delivery of the installation meeting the PAS 2030 standard.</u> <u>Completion of testing and commissioning.</u>	<u>Handover of the installed measures to the client and occupant following a soft landings approach.</u> <u>Completion of lodgement process to TrustMark.</u>	<u>Undertake Basic evaluation.</u> <u>Evaluate the Intended Outcomes.</u> <u>Undertake Intermediate Evaluation (where required).</u> <u>Undertake Advanced Evaluation (where required).</u>
Retrofit Project Manager Core Tasks	<u>Strategic Advisor appointment.</u> <u>Development of a Retrofit Strategy.</u> <u>Development of programme of works.</u>	<u>Undertaking archotyping exercises and studies.</u> <u>Data gathering and sample inspections to verify data.</u> <u>Development of technical compliance documentation.</u> <u>Development of resident and occupant strategy.</u> <u>Financial modelling.</u> <u>Production of a project execution plan.</u>	<u>Administration of Project Execution Plan Activities.</u>	<u>Administration of Project Execution Plan Activities.</u> <u>Archotyping design exercise and identification of property constraints.</u>	<u>Administration of Project Execution Plan Activities.</u>	<u>Administration of Project Execution Plan Activities.</u> <u>Quality assurance protocols.</u> <u>Programme management and reporting requirements.</u>	<u>Administration of Project Execution Plan Activities.</u> <u>Handover protocol.</u>	<u>Administration of Project Execution Plan Activities.</u> <u>Property data monitoring.</u> <u>Lessons learnt and feedback.</u>



STAGE 0 – STRATEGIC DEFINITION

Where an organisation does not hold in-house expertise, an expert should be appointed

The delivery of retrofit projects is a complex task with a plethora of things to consider, made more challenging by an existing skills shortage across the built environment. Initiatives have been put in place to combat this, particularly with large scale, government backed funding supporting approved training courses for domestic energy assessment, retrofit assessment and retrofit coordination. However, in reality, these courses only scratch the surface of delivering retrofit, along with all of its complexities. It is only with experience that reasoned and informed advice can be provided.

Many organisations have in-house expertise that positions them well to develop the tools needed to deliver retrofit at scale, but they should look to third-party experts to assist them on their journey. An organisation with experience in providing strategic and tailored advice should be appointed. They will need to 'get to know' the inner workings, so the developed retrofit strategy can supplement and align with existing policies, particularly as retrofit is becoming 'business as usual' and more and more organisations are adjusting their existing asset management policies to incorporate retrofit delivery.

When searching for a suitable organisation, it is important to test and understand their experience in these areas. This can be achieved through interviews, seeking feedback from their other clients, qualitative based questions and evidence of successful delivery. Getting the strategy right is of the utmost importance and this investigation will ensure that the developed strategy is robust. Appointing the right advice is crucial to establishing solid foundations for delivery and will pay dividends as challenges and risks arise at later stages.

Developing a Retrofit Strategy

Do we need a strategy?

If a strategy is 'a planned scheme or cause of action designed to achieve a particular long term goal', then for existing housing stock, the answer is definitively yes. But what is the long term goal? Many housing organisations have set standards that define their ambitions for the housing they provide in detail. The purpose is likely to be something like "providing safe, comfortable, affordable homes in communities that people love".

The implications of a statement or strategy objective such as this is that homes will achieve all current standards in a cost effective way and be free from defects over a set period of time.

Traditionally, landlords have provided services and implemented works to achieve this through a balance of planned and reactive works. However, the continued and increasing financial constraints alongside the emergence of more data about stock performance and the occupants has led to greater opportunities for an effective Strategic Asset Management Strategy (SAMS).

Where does a Retrofit Strategy fit?

The UK has some of Europe's worst performing and least energy efficient homes, and therefore the retrofit of existing homes to improve their energy performance will form a central part of any SAMS.

The problem is that pursuing a retrofit strategy independently of a SAMS is likely to lead to some unintended consequences. In fact, it is probably the case that retrofit, damp and mould growth and building safety strategies should all be subservient to the wider asset management strategy. Programmes of work focusing on these areas should also consider opportunities to undertake works that will affect the other objectives of the wider SAMS.

An uncomfortable reality for some social housing organisations is that certain property types within their stock will cost more to manage and improve than others. This could mean that in order to make the broader strategy cost effective it must include the disposal of some properties to either reinvest or fund the retrofit of those that remain.



STAGE 0 – STRATEGIC DEFINITION continued...

What does an effective Strategic Asset Management Strategy (SAMS) look like?

As can be seen in the graph in figure 1, there is a sweet spot between planned and preventive works, and reactive maintenance works, which achieves the best outcome in the stock for the expenditure committed.

It is in this sweet spot that retrofit programmes of work that clearly form part of a subset of strategic asset management programmes should be undertaken.

In an ideal scenario, organisations should not have purely retrofit or other separate programmes, but programmes of works carried out that are classified as being energy, condition, compliance or carbon-led packages, with the opportunity to provide improvement outcomes under the other categories.

Whole-life carbon

Retrofit programmes currently focus on operational carbon, but there are emerging concerns that they ignore the carbon intensity of capital investment in assets – also known as embodied carbon. An example would be replacing functioning and reasonably performant windows to achieve a very small energy-efficiency benefit, while the embodied carbon cost of manufacturing and installing them outweighs these operational gains. A whole-life carbon approach considers both operational and embodied carbon when deciding on appropriate retrofit measures. With any SAMS needing to consider residents at its heart, there may be circumstances where the improved amenity and perception appears worthwhile from an organisational perspective.

But this is an example of where organisations can be tempted to veer off their strategic pathway to pick up much-needed funding and can distort or lengthen the journey to reach their long term strategic goal by ignoring the importance of embodied carbon, which will be measured in the future.

Finance

There is a general understanding that “patient capital” is waiting to invest, but it is more likely to invest in active building services that can produce meaningful and measurable data, rather than passive thermal measures which cannot. Data about building and services performance is becoming cheaper and more ubiquitous by the day, so any SAMS needs to harness it.

In summary, having reliable data as part of a people-centred, data-driven SAMS should allow packages of work to be pulled “off the shelf” to meet funding requirements or opportunities as they arise.

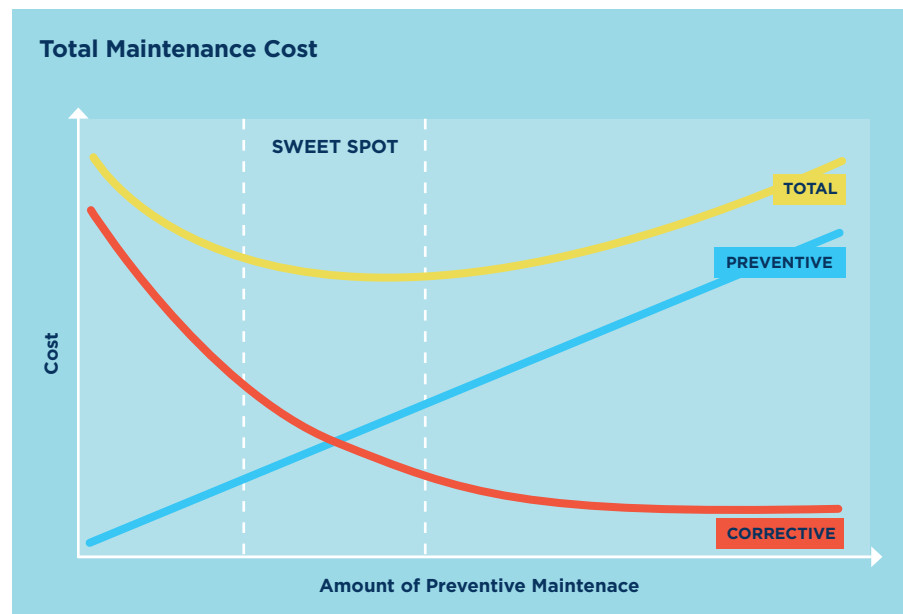


Figure 1



STAGE 0 – STRATEGIC DEFINITION continued...

So what are the key components of a strategic asset management strategy (SAMS)?

An organisation needs a vision and a standard in place to achieve it. There are plenty of other ingredients, such as resident perception and property performance data, but at its core, a SAMS is about achieving the long-term goals for the asset(s).

Property Archetypes

Many organisations will have large numbers of properties, which makes it difficult to consider each at an individual level. The approach is generally to categorise properties into archetypes for consideration, but this leads to a difficult balancing act between too few and too many properties in each. Too few means a detailed analysis is unviable, with conclusions too broad to generalise, while too many means the number of variables become too high to decide on broad actions.

Applying Pareto's 80/20 rule is useful, with 80% of the 'heavy lifting' being done at the archetype level and 20% being done at a property level.

A process for components and building a SAMS

- Develop an organisational standard for properties, people and places.
- Categorise properties into archetypes.
- Agree an energy hierarchy based upon SAP or other energy modelling tools that are acceptable to the organisation and their residents in respect of new technologies, servicing and maintenance.
- Undertake limited energy surveys and modelling of identified archetypes.
- Undertake RAG rating for the archetypes for the interventions identified.
- Agree the other RAG rating or scoring characteristics to be applied for the interventions in archetypes which may include issues, such as:
 - > Building safety
 - > Dampness, mould growth, ventilation and indoor air quality
 - > Resident disruption
 - > Existing condition
 - > Location and stock density
 - > Specific cost factors
 - > Heritage value
 - > Archetype complexity
 - > Repairs record

Probably the most difficult task is to weight these factors, apply them in a model that is actionable and can import property groupings to evaluate whether they should be included in programmes, and calculate the extent those programmes will improve the overall stock to meet the organisation's strategic objective.

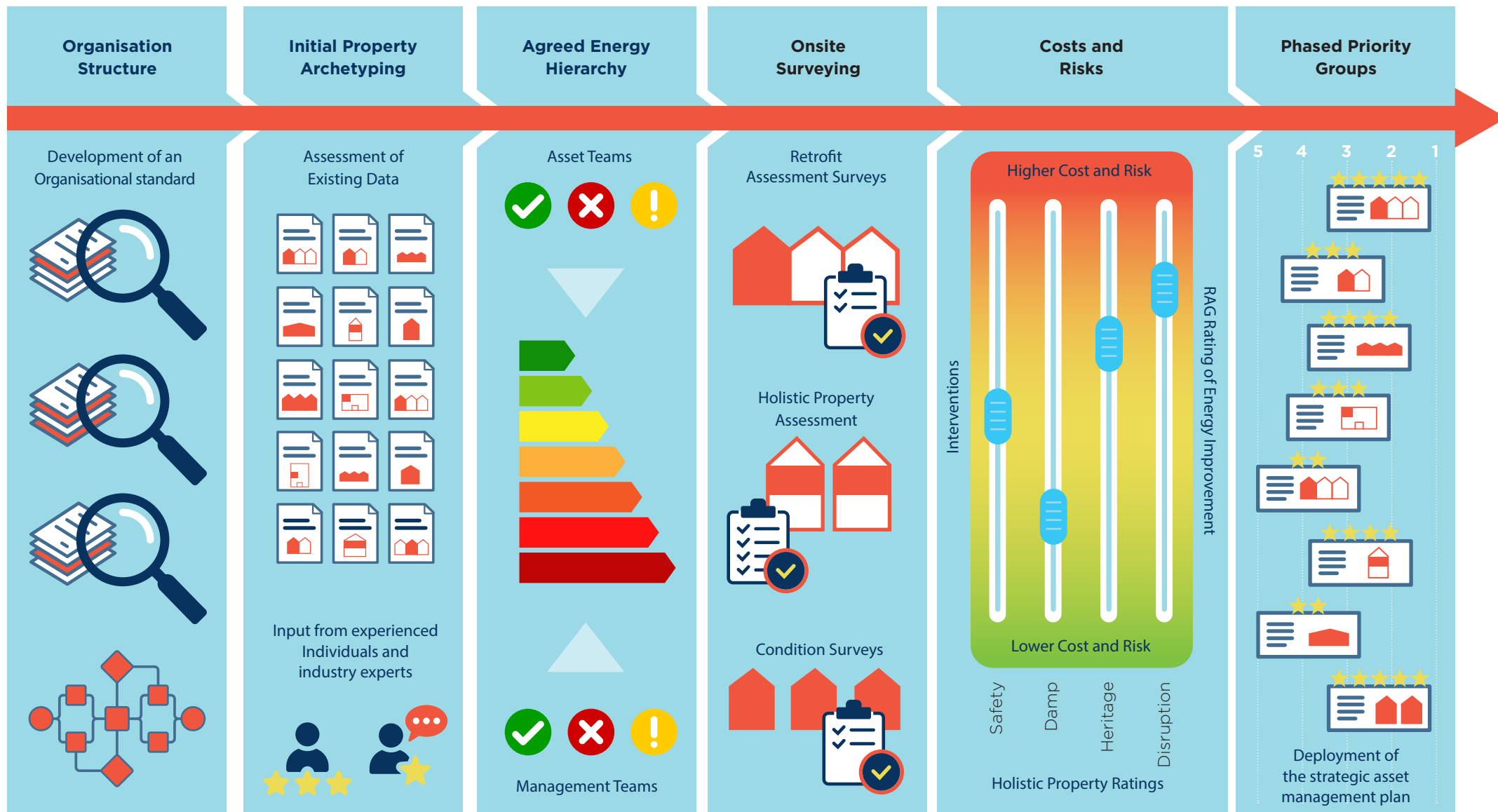
Within such a SAMS, variables should be modelled alongside cost impacts over the period upon which the organisation's strategic objectives are set.

A process map for the creation of a SAMS is included on the following page.



STAGE 0 – STRATEGIC DEFINITION continued...

Retrofit and Strategic Asset Management Strategy Development



STAGE 0 – STRATEGIC DEFINITION continued...

Undertaking stock analysis and verification of existing property inspection

A clear hangover from previous large-scale retrofit projects and an inhibitor to scaling retrofit is the quality of available data from various organisations going through the bidding process. In our experience, there is a churn of staff, system upgrades, regulatory changes and specific areas of prioritisation which often leave data gathering exercises behind. To deliver at scale, plugging this knowledge gap will be crucial.

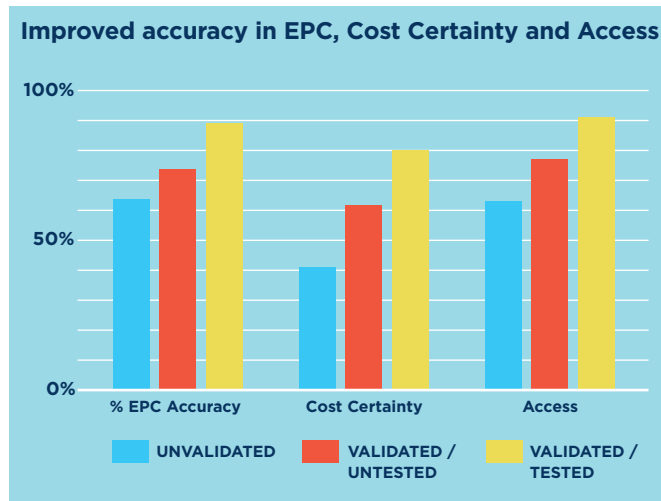
As part of any coherent bid, the data needs to be collated in a manner that ensures the success of a project; this data is the foundation of any project and needs to be an accurate representation of any given property.

Some of the techniques we have seen are as follows:

- Stock condition
- Software analysis – such as those that can be completed through software platforms, such as: Property Tectonics, Keystone and Parity Projects
- Innovation past convention (AI and Property Recognition)

The clear worry emanating from this is project certainty. Without data certainty, costs can fluctuate, installed measures vary too greatly and can change the entire landscape of the project. This is why we have historically advocated validation exercises on especially fringe data, such as that where a software has made a prediction and there is no stock condition or EPC data. This validation enables a two-pronged approach:

1. Test assumed data, confirm and edit
2. Understand properties and enable the start of design and archotyping exercises



The above graphic has been taken from an SHDF Wave 2.1 project with a large social housing provider. The graphic illustrates the improved accuracy in EPC, Cost Certainty and Access through initial assumed unvalidated data, validated but untested data and validated and tested data.

This has a positive, multi-layered effect on the project; where there is tested data in place, this ensures a greater degree of EPC Accuracy. Because the access to properties enables an opportunity to both take residents on the journey from an early stage, and sculpt an engagement strategy from an earlier point in the project, access improves dramatically as a result of early engagement. As the tested access to properties allows a scoping visit rather than a reliance of validated (or unvalidated) EPC data, the archetypal approach to design enables costing for these designs that can be applied to similar strings of archetypal properties. This also creates efficiencies in the programme during the design stage by focusing on the 'topping up' of designs to suit a specific dwelling where archetypal information is already available.

While this does not account for potential supply chain issues on the installer side, this is a large factor in the mitigation of risk, and demonstrates that clear, accurate project set-up from the outset (even at bid stage for SHDF projects) goes a long way to enable delivery at scale.

We believe data could still be improved in the first instance; existing stock condition surveys are typically geared towards component condition and are amenity led. If there is to be reliance on this data for more than just an amenity and component lifecycle, the format of stock condition needs to move away from this to a more holistic review of the property, creating more data points within the property data. It will come as no surprise that many contact points with the property (various inspections; Retrofit Assessments, New EPC Protocols, Damp and Mould Surveys) are becoming more thorough. This needs to reflect all potential types of works rather than individual streams; the singular access and data gathering exercise will clearly be more costly, but the argument is that the amount of data obtained outweighs the cost, while minimising resident disruption.

We have worked with a number of organisations piloting a property check-up programme, which takes a cross-sectional, holistic view of data to provide a snapshot of dwelling health. Since Awaab's law and the ramping up of SHDF programmes, we feel this is a necessity to ensure dwelling health and avoid double-paying for data due to repeat visits for similar functions.



STAGE 0 – STRATEGIC DEFINITION continued...

Development of programme of works

Following creation of the Retrofit Strategy the next logical stage will be to develop workstreams to deliver against the strategy. Most commonly, organisations create short-, medium- and long-term programmes of work – typically spanning up to a 10 year period. The workstreams should be broken down into manageable projects and phases, the scale of which will be reflective of the size of the organisation.

The developed programmes of work should not be contingent upon, and driven by, funding opportunities. This will only lead to organisations delivering projects that do not align with the original strategy, and ultimately resources will be wasted. Instead, funding opportunities should be seen as a ‘good news story’ that supplement planned work. This is difficult of course, particularly given the financial challenges that can impact and constrain retrofit delivery. Funding opportunities can also be a very complex landscape to navigate, not only in obtaining the funding but also in the management and reporting required. It is therefore important to ensure there are individuals who hold knowledge of funding opportunities and the mechanisms that sit behind them. There are organisations and individuals that have the necessary knowledge to create project schemes that can blend different funding streams, which is a complex process, but can maximise delivery of the programme of work.

If it is an organisation’s first programme of work, it is imperative that existing lessons learnt that are well documented across the industry are embedded to avoid any repeat mistakes. However, always remember that what works for one organisation may not work for another. In the same vein, biting off more than you can chew is not only a well-known phrase but something to live by, and it is always recommended that smaller, more manageably sized projects are undertaken before an organisation embarks on large-scale delivery. These projects, typically called ‘pilot schemes’, can utilise and test the success of different procurement and delivery models.

At every stage of delivery, the following question should always be considered: “Would this work at scale?”. This simple but effective question can often come with a “no” as the response, but understanding the reasoning behind that no is vital to unlocking large-scale delivery.

The delivery of the smaller projects will then allow the larger projects to follow. Most organisations are now at the stage where pilot projects have been undertaken and the next, more significant phase of work is now being planned. Where this is the case, lessons learnt workshops with a full dissection must be undertaken.





STAGE 1 – PREPARATION AND BRIEF

The PAS 2035 Roles (Retrofit Coordinator, Assessor and Designer) are appointed

The appointment of the PAS 2035 roles: Retrofit Assessor, Coordinator, and Designer are typically one of the first things to be undertaken on a PAS 2035 compliant retrofit project. It is important to select these individuals based on their technical knowledge and experience of delivering retrofit.

The Retrofit Assessor – it is important to select this organisation and individual based upon their experience, particularly evidenced within the Building Surveying field. The PAS 2035 standard makes reference to the assessment applying the principles of a Royal Institute of Chartered Surveyors (RICS) Level 3 Building Survey. It is worth noting that a Level 3 survey is the most comprehensive survey offered and is typically recommended for older, more complex and large properties. To undertake this survey the individual must be qualified and a member of the RICS. There is, however, a disparity between the training and level of competence required to become a qualified Retrofit Assessor and a RICS Chartered Surveyor; the former requires a Domestic Energy Assessor Course (typically spanning 5 days) and a top up Retrofit Assessor Course (typically spanning 1 day), whereas the latter typically requires completion of an accredited degree, detailed assessment of professional competence with a minimum of 24 months of experience and an assessment interview process.

This training can create a disparity between the expectations of a Retrofit Assessment and the realistic competence of the individual undertaking the retrofit survey, which can lead to defects being missed and construction being misunderstood. This is a significant risk, particularly at the later stages of the project. This competence test should therefore be applied when appointing this organisation and individual.

The Retrofit Coordinator – it is similarly important to select an organisation and individual with sufficient competence and a track record of delivering retrofit projects. The training to become a qualified Retrofit Coordinator is a lengthy process and has led to more competent individuals undertaking this role, but fundamentally the industry has been undertaking similar projects for many years in the form of component replacement schemes. Therefore, selecting an organisation with a detailed understanding of existing buildings and a proven track record of managing works within them will always be of benefit.

Proximity to the project location is also important to consider, as the Retrofit Coordinator must have an active presence at site level to monitor the installations. This was starting to become an issue within the industry, but has been managed through updates to the requirements of PAS 2035 with an obligation to undertake monitoring inspections. Consideration can also be given to appointing a Clerk of Works role to undertake additional inspections and offer an even greater level of quality assurance – which is particularly important on large-scale projects, especially those with complex measures.

The Retrofit Designer – Following discussions with similar companies dealing with retrofit design, there is a general consensus around two distinct issues.

Firstly, there is a feeling that a two-tiered approach is creeping in. As suggested in David Pierpoint's comments above, there is either a distinct lack of any real design information, effectively creating a box-ticking exercise that unnecessarily drains resource due to a lack of coherence or a usable design; or there is a design which covers everything, created for every property, which makes delivery at scale not viable from a cost and programme perspective. See the below on Archotyping and Pattern books as a way to find a middle ground for this issue.

Secondly, the engagement of the designer seems like it happens too late. The PAS standard is rather clear around the stage that designers become involved (on conclusion of Retrofit Assessments), however, designers are often onboarded when key design decisions have been made; such as the choice of EEMs and the sequencing as part of an Improvement Option Evaluation plan. The designer is clearly going to be the most knowledgeable person at the table regarding what works in which building, and there is definitely a missed opportunity with the current utilisation of good designers' services.



STAGE 1 - PREPARATION AND BRIEF Continued...

Intended Outcomes

Defining the Client's intended outcomes is one of the first activities undertaken by the Retrofit Coordinator. The purpose is to create a shared understanding of the objectives of the project; typically these include items such as: improved energy efficiency, improved internal comfort, and reduction of damp and mould. It is important that these outcomes are defined as they will fundamentally form part of a Client briefing document.

At completion of the project, the Retrofit Coordinator will also review the intended outcomes to ensure they have been achieved, and if any haven't, undertake a lessons learnt exercise to identify why and decide how things could be done differently next time.

Undertaking archotyping exercises and studies

As discussed earlier in the toolkit, archotyping is a concept without a formal definition and the interpretation can vary depending on who is asked. For example, a Retrofit Designer would deem an archetype property to be one that a single design package could apply to, which can in turn lead to a vast number of archetypes being generated for seemingly very similar property types. On the other end of the spectrum, an individual providing strategic advice would apply a broader brushstroke and place a wider variety of properties within the same classification. Both approaches are correct, as they assist in the management of what the archetype exercise is needed for.

What is important is to develop an understanding of the property stock, particularly the properties that are going to be included in a retrofit project. This simply isn't the case for many organisations. Undertaking detailed analysis early allows a catalogue to be developed of similar property types, which will enable strategic projects to be derived and delivered.

This process is particularly important where organisations wish to maximise the financial opportunity available through funding and selecting funding sources that are best suited to property types, their characteristics and improvement measures.

Archotyping should be bespoke to each organisation, for example, some will have properties concentrated within a centralised geographic area, meaning property types are similar. Others may have a greater number of properties with differing characteristics. It is common to utilise key characteristics, such as roof type, external wall construction, floor construction, property size and age, to create high level archetypes which can be specified further with development constraints and restrictions, like conservation areas and listed building status.

Typical energy performance characteristics can be determined for each archetype and a hierarchy of improvement measures determined. Energy simulations can be undertaken to determine the archetype performance following improvement, and high level cost exercises can significantly inform planned work.

Data gathering and sample inspections to verify data

Where organisations do not hold property data, it is important that this is gathered. Property data gathering is typically undertaken through stock condition survey programmes. Historically, these surveys have focused on the quantity and condition of building elements to assist in informing basic asset management and future planned work. However, with pressures to improve energy performance, manage building defects, and improve the condition of building elements, it is important that surveys are a holistic assessment and not focused on an isolated part of each property.

For organisations with larger quantities of property data, archetype based surveys can be undertaken to validate the data. If it is found that there is limited data accuracy and certainty, then consideration must be given to a detailed data gathering exercise through on-site assessments.





STAGE 1 - PREPARATION AND BRIEF Continued...

Development of technical compliance documentation

It is important there is a shared understanding between both the installer and client of the materials and products that will be incorporated into the properties – particularly where these installations will be delivered at scale. Therefore, technical compliance documentation should be developed to accurately record this. The technical documentation will typically cover all of the measures that are likely to be installed and the minimum requirements surrounding the installation. This is a technical document and the individual or organisation responsible for developing it should have detailed knowledge of retrofit measures. It is also important to consider that some measures may not form part of existing or regular historic installations,

such as Photovoltaic Panels, however organisations must accept that these will have to form part of their future maintenance responsibility – and the performance requirements should consider this. Using Photovoltaic Panels as an example, requirements can be set to ensure the installed system reduces the required ongoing maintenance to a minimum.

Typically, the technical document will be in the form of a 'performance specification', meaning the minimum parameters are set and the installer is responsible for selected products and materials that meet the criteria. Generally, the more onerous the performance specification, the greater the associated cost.

Request for information procedures can be included within project management processes to enable the installer to confirm their proposals for acceptance by the Client. However, it is important that this protocol is only intended to keep the Client informed and allow for a secondary check of compliance, while responsibility for selecting products remains with the installer.

Client organisations often have internal teams who manage and maintain existing homes and it is important these individuals are consulted as part of the documentation development process. Cost consultants can also be engaged to ensure the future works represent value for money.

Fundamentally, this document will maintain quality, create consistency and assist in delivery at scale.

Development of resident and occupant strategy

A robust resident engagement strategy is essential for a successful retrofit and to enable retrofit 'at scale'. If residents do not permit access to their homes, retrofit improvement works simply won't be installed. Residents must be suitably and properly engaged at key points of the retrofit works, at initial inception and advice, survey and design development, during the works at handover and beyond.

Early engagement and stakeholder mapping, as well as development of a coherent and tailored resident strategy must serve as an early milestone in the retrofit journey. The Client should be encouraged to engage internal, community and specialist stakeholders to make this a reality and not shy away from the additional upfront work, which will only reduce the risk associated with resident drop-out and potential works fatigue later on.

Tools such as resident champions, steering groups, project execution plans, relatable and clear messaging, resident liaison officers, and community events can all help underpin a robust resident strategy. Residents should be encouraged to feel empowered and be a central part of the retrofit process to enable buy-in and not feel like the retrofit is being done to them, but rather for and with them. PAS2035 can help structure key waypoints in the resident strategy.

The project team led by the Retrofit Coordinator are responsible for ensuring all parties are aware of the approved resident strategy, including dedicated staffing and what constitutes a successful 'at scale' retrofit.



STAGE 1 - PREPARATION AND BRIEF Continued...

Financial modelling

One of the key challenges in delivering at scale is the significant cost associated with retrofit and improving our existing building stock's energy performance. Therefore, utilising the outputs of the archetype exercise and building stock information, informed financial modelling can be undertaken.

The financial modelling should be undertaken to align with organisational targets – which will include minimum energy performance positions by certain times. These targets will be included within the retrofit strategy as developed earlier in the process. It is important that the modelling not only takes into consideration the cost associated with the energy improvement measures, but also ancillary costs; for example, those associated with defect rectification and cyclical maintenance of building elements.

Efficient use of the financial resource an organisation holds must be given careful thought and consideration. Alignment of asset management and retrofit must become the norm to enable an organisation to successfully manage their building stock and deliver retrofit measures. The modelling must therefore not only consider retrofit, but all aspects of the asset.

Once this modelling has taken place, schemes can be conceptualised that can be delivered within the financial constraints.

Production of a project execution plan

A project execution plan is a critical document in the delivery of any project, including a retrofit project. It's primary purpose is to provide clear guidelines on how a project is to be executed, controlled and monitored. It creates a structure and a shared understanding for all of the individuals and organisations involved in the project.

A template project execution plan can be developed and then utilised for all future projects.

Any lessons learnt can also be captured and the project execution plan updated to continuously improve the delivery.

Project execution plans will typically include the following items, which will be utilised largely during the delivery stage:

- Project scope and objectives
- Team structure
- Roles and responsibilities
- Timescales and milestones
- Communication protocols
- Performance monitoring
- Risk management protocols
- Quality management protocols
- Procurement strategies
- Contract management requirements
- Change control protocols
- Stakeholder management plans
- Health and safety plans
- Project closeout and handover protocols

Development control requirements

Development control requirements will significantly impact the delivery of retrofit at scale. This applies largely in the form of planning and building control requirements. However, there are other stakeholders which can also affect delivery, such as utility providers.

Planning Requirements

Planning legislation, policy and guidance can significantly restrict retrofit delivery at scale. More and more planning authorities are publishing guidance detailing the likely permission of measures to buildings contained within their borough. These will consider restrictions such as conservation areas and listed status.

Where retrofit is delivered at scale, relationships should be formed with the local planning authority which will assist in the approval process. In large-scale delivery, consideration can also be given to planning performance agreements, which will set out minimum performance requirements between the applicant and local authority, including timescales for key milestones to which both parties must adhere. However, these agreements can often hold significant cost so should only be deployed where absolutely necessary.



STAGE 1 - PREPARATION AND BRIEF Continued...

Included below are typical measures deployed in retrofit delivery and the likely position of the planning authority. It is important to note these are only typical and can vary between each property and local planning authority:

Typical Planning Advice

NO DESIGNATION

External Wall Insulation (EWI)

This is typically deemed permitted development where the final finish matches the existing in terms of colour, texture and overall appearance. A certificate of lawful development can be submitted to confirm the development is legal.

Where an alternative finish is being proposed, planning permission is required, typically in the form of a householder application. The planning authority will consider the planning weight and give consideration to properties with existing features and detailing, such as those common to heritage stock. Greater weight is typically applied to the primary elevation.

Planning authorities are likely to request images of the existing and proposed finishes to establish acceptability and may request a site visit in some cases.

Cavity Wall Insulation (CWI)

This is not considered development and planning permission is not required.

Internal Wall Insulation (IWI)

This is not considered development and planning permission is not required.

Floor Insulation

This is not considered development and planning permission is not required.

External Doors

This is typically deemed permitted development where the proposed doors match or are as similar as possible to the original doors.

External Windows

This is typically deemed permitted development where there is no change in the shape, dimensions, opening type and frame materials. Changes to the glazing type are also typically permitted. A certificate of lawful development can be submitted to confirm the development is legal.

Where an alternative window is being proposed, planning permission is required. The planning authority will give consideration where the building forms part of a terrace or group and will not support replacement windows that spoil the appearance of buildings, particularly those that form a uniform grouping.

Secondary Glazing

This is not considered development and planning permission is not required.

Loft Insulation

This is not considered development and planning permission is not required.

Photovoltaic Panels

This is typically deemed permitted development where the panels do not protrude more than 200mm above the roof slope. A certificate of lawful development can be submitted to confirm the development is legal.

Air Source Heat Pumps

This is typically deemed permitted development if the installation complies with MCS standards and the volume of the installed unit is less than 0.6 cubic metres. Consideration will be given to its proposed location, such as being sited at least 1m from the property boundary. A certificate of lawful development can be submitted to confirm the development is legal.

Ground Source Heat Pumps

This is not considered development and planning permission is not required. Archaeology may need to be considered where the property is located within an archaeological priority area.

Ventilation

This is not considered development and planning permission is not required where there is no external system and external ventilation pipework is minimal and not visible from public viewpoints.

Early engagement with the Local Planning Authority should always be sought to establish their position of the application of energy efficiency measures.



STAGE 1 - PREPARATION AND BRIEF Continued...

Typical Planning Advice

CONSERVATION AREAS

External Wall Insulation (EWI)

Planning authorities are most likely to accept this for the rear elevation that do not form part of a decorative or uniform composition. However, our experience is that this is in rare cases and it is typically not supported. Primary elevations are unlikely to be supported.

Cavity Wall Insulation (CWI)

This is not considered development and planning permission is not required.

Internal Wall Insulation (IWI)

This is not considered development and planning permission is not required.

Floor Insulation

This is not considered development and planning permission is not required.

External Doors

This is typically deemed permitted development where the proposed match or are as similar as possible to the original doors.

External Windows

Planning permission is typically required. New windows should seek to match the original windows or become more in-keeping with the conservation area. Increases in glazing thickness are likely to be supported. The planning authority will give consideration where the building forms part of a terrace or group and will not support replacement windows that spoil the appearance of buildings, particularly those that form a uniform grouping.

Secondary Glazing

This is not considered development and planning permission is not required.

Loft Insulation

This is not considered development and planning permission is not required.

Photovoltaic Panels

Planning permission is required and panels should minimise the effect on the external appearance of the building.

Air Source Heat Pumps

This may be deemed permitted development if the installation complies with MCS standards and the volume of the installed unit is less than 0.6 cubic metres. Consideration will be given to its proposed location, such as being sited at least 1m from the property boundary. A certificate of lawful development can be submitted to confirm the development is legal.

Ground Source Heat Pumps

This is not considered development and planning permission is not required. Archaeology may need to be considered where the property is located within an archaeological priority area.

Ventilation

This is not considered development and planning permission is not required where there is no external system and external ventilation pipework is minimal and not visible from public viewpoints.

Early engagement with the Local Planning Authority should always be sought to establish their position of the application of energy efficiency measures.



STAGE 1 - PREPARATION AND BRIEF Continued...

Typical Planning Advice

LISTED BUILDINGS

External Wall Insulation (EWI)

This is unlikely to be supported due to the impact on the building fabric.

Cavity Wall Insulation (CWI)

This is unlikely to be supported unless it can be demonstrated that the improvement will not increase the risk of damp related issues. Listed building consent will be required.

Internal Wall Insulation (IWI)

This may be supported but consideration needs to be given to the existing fabric and features. Evidence will also be required to demonstrate that the fabric will not be negatively affected. Listed building consent will be required.

Floor Insulation

This is likely to be supported provided the level of the floor will not be affected and where applicable the air flow within the floor void is maintained. Listed building consent will be required.

External Doors

This is unlikely to be supported where there is a loss of historic fabric. Other complementary improvements such as draughtproofing that will not cause harm are more likely to be supported. Listed building consent will be required.

External Windows

Consideration will be given to the existing windows and fabric. In some instances it may be supported to replace existing windows with appropriate double glazed units. The proposed frame thickness, glazing thickness and features will be given significant consideration. Listed building consent will be required.

Secondary Glazing

Secondary glazing is often supported. Appropriate location will be given significant consideration. Listed building consent will be required.

Loft Insulation

Loose forms of loft insulation such as mineral rolls do not require consent.

Photovoltaic Panels

Photovoltaic panels may be acceptable provided they are not visible from the public realm and do not harm the roof structure. Listed building consent will be required.

Air Source Heat Pumps

This is likely to be supported provided the installation does not harm the external appearance, amenity area and visual character of the building. For future servicing, potential harm to the fabric should be given consideration. New radiators and any internal special features should be given consideration. Listed building consent will be required.

Ground Source Heat Pumps

The effect on any historic fabric within the curtilage of the building will be considered. For future servicing, potential harm to the fabric should be given consideration. New radiators and any internal special features should be given consideration. Listed building consent will be required.

Ventilation

The introduction of ventilation must be sensitively introduced and the resulting harm to the existing fabric must be considered. Listed building consent will be required.

FLATS

It should be noted that flatted developments typically do not have the same benefits that are provided under permitted development rights. This also includes properties that have been subdivided to create flats. Therefore, planning permission is often required – for example, a window replacement deemed permitted development for a singular house would require planning permission for flats.

Early engagement with the Local Planning Authority should always be sought to establish their position of the application of energy efficiency measures.



STAGE 1 - PREPARATION AND BRIEF Continued...

Building Control

Building Control play a significant role in retrofit delivery. Their role is primarily concerned with ensuring building work complies with the minimum standards of health and safety in buildings, the conservation of fuel and power, and accessibility. The duty of the Building Control Authority and minimum requirements are set out within the Building Act, which is the primary piece of legislation governing building work.

More and more retrofit work is being covered by government authorised schemes, which enable work to be undertaken without a building control application. These schemes are called competent person schemes and they enable organisations to self-certify their building work. Minimum technical competence is set out to regulate the installers.

When the notifiable work is undertaken, the competent person provides evidence to both the building owner and the Local Authority, demonstrating it complies with the relevant regulations, within 30 days of completing it.

A full list of these schemes are available on the government website: [Competent person scheme](#)

Statutory Authorities

Statutory Authorities may need to be engaged, particularly when delivering certain measures. Overhead electric lines and gas installations are common examples of installations that require a statutory authority to undertake work to them. These can be costly and incur lengthy timescales for undertaking the work.

It is important these installations are identified during the archotyping and stock data analysis so the associated risks can be proactively managed.





STAGE 2 – CONCEPT DESIGN

Dwelling Assessment

The dwelling assessment under PAS 2035, or as many people call it, the 'Retrofit Assessment', is a detailed data gathering exercise at an individual property level. In many projects, the dwelling assessment is the first key milestone, which then triggers the delivery stage. However, this should not be the case; the steps discussed earlier in the toolkit create expediency and efficiency, and mean that the project is not contingent on completing the dwelling assessment.

The dwelling assessment covers a significant quantity of information: the property's condition, an RDSAP assessment, identification of property constraints, an occupation assessment and an assessment of existing ventilation measures. All of this is very important to understand, particularly when energy efficiency measures are being modelled and designed.

The dwelling assessment should be undertaken following the principles of a Royal Institute of Chartered Surveyors (RICS) Level 3 Building Survey. This is, therefore, a detailed assessment and should be undertaken by an individual with skills, knowledge and competence surveying existing homes. The quality of dwelling assessments can vary significantly within the market, so sample assessments should be requested and competency tested when selecting a Retrofit Assessor.

Consideration should also be given to the way in which dwelling assessments are programmed and undertaken. Too often do we see dwelling assessments being undertaken on a first-come, first-served basis. This means that assessments, when compared to the stock as a whole or included within a project, are undertaken almost at random. This reduces the effectiveness of any archotyping strategies that may have been developed. Instead, we would recommend a geographical or archetype based deployment of Dwelling Assessments. This should include early engagement with the residents and occupants in a particular area, which will increase the likelihood of access being provided. Dwelling assessments can then be undertaken more strategically, allowing archetypes or geographical areas to be completed before moving to a new area. This will fundamentally create efficiencies in the design development and delivery stage.

Air Permeability Tests

Air permeability testing, which is also known as an air tightness testing, is a method of assessing the rate of uncontrolled air leakage through a building's fabric. This will include air leakage through walls, floors, roofs, doors and windows. The test is undertaken by pressurising the inside of a dwelling and monitoring how the pressure reduces back to equilibrium. The longer the property holds the pressure, the better the airtightness.

The air leakage plays an important role in building energy performance, with significant air leakage resulting in heat loss, higher energy demand and poorer thermal comfort.

The PAS 2035 standard typically entails undertaking these tests both before and after the works have been delivered. The logic being that the test is undertaken before the works to inform the design and the ventilation strategy, as well as to identify any significant leaks, and afterwards to demonstrate the effectiveness of the installed measures. In some complex installations, air testing may also be deployed during the works to test air tightness layers.

Naturally, at scale the number of air permeability tests will increase and create a significant financial investment. Therefore, it is common for air permeability tests to be undertaken at archetype level for the pre-works assessment, followed by testing to all properties at completion.





STAGE 3 – DEVELOPED DESIGN

Energy Modelling

Energy modelling is a process of taking the baseline (starting position) of the property's energy performance and using software to simulate the improvements.

Energy modelling should be bespoke to each individual property, taking into account its construction and constraints to ensure what is simulated is both feasible and effective. It is not a case of relying upon recommendations made through the Reduced data Standard Assessment Procedure (RdSAP), or similar software.

Therefore, the principles of energy modelling should be agreed at an early stage and following definition of the property archotyping exercise. This will enable a hierarchy of energy efficiency measures to be defined and agreed between the client and the energy modeller.

The hierarchy of measures will then enable efficient and accurate modelling to be undertaken and minimise the likelihood of re-modelling alternative energy efficiency packages. It is common for 'low hanging fruit' to be selected first, such as energy efficient lighting, heating controls and loft insulation, before deploying more complex and costly measures, such as external wall insulation.

It is also important to agree a protocol for the review and agreement of the energy modelling (which is called the 'Improvement Option Evaluation' under PAS 2035). We recommend that maximum timescales are agreed for completing the energy modelling (following receipt of the retrofit assessment information) and discussing the outputs with the relevant stakeholders. These agreed timescales will ensure this critical stage of the project does not hinder or create blockages to achieving delivery.

Production of the Improvement Option Evaluation and Medium Term Plan

The Improvement Option Evaluation is a process of selecting the most suitable energy efficiency measures for the property. These are undertaken through energy modelling and further explained within the previous section of this toolkit.

However, the Medium Term Plan is something that is too often forgotten about and not truly used as intended under PAS 2035. The Medium Term Plan is a document that records future energy efficiency work that will be undertaken at a later stage in the asset's life. This reflects and appreciates the fact that it is unfeasible for many to install all measures at one stage.

Therefore, the Medium Term Plan should form a key component for the future of the property and is intended to set out a clear pathway for future retrofit works. This will fundamentally create alignment between the future asset management and to the organisation's decarbonisation targets. This document should therefore not be forgotten and instead be actively used to plan future work streams.





STAGE 3 – DEVELOPED DESIGN Continued...

Production of Ventilation Strategy

Ventilation is a key consideration when improving energy efficiency, as it must be adequate following the improvement measures.

This is achieved through an adequate exchange of air, ensuring humidity is controlled along with the risk of poor air quality, and unintended consequences such as condensation and dampness managed. These factors will create a healthy environment for the occupants.

An initial ventilation strategy can be undertaken at archetype level, which will set out the principles of the ventilation management. Where required, this can be tailored and made specific to each individual property through a verification process against the dwelling assessment.

The following key elements will form part of the ventilation strategy: Assessment of the existing ventilation (which will be gathered during the dwelling assessment), the approach for upgrading ventilation measures, any processes for monitoring air quality, mitigation of condensation and mould growth, compliance with building regulations (specifically Approved Document F), and how airtightness will be managed.

Archotyping design exercise and identification of property constraints

Concept designs based on archetypes are an efficient and expedient way of producing design documentation for retrofit. Building upon the archotyping analysis and energy modelling that has been undertaken, it is feasible to identify properties with similar construction characteristics that are likely to have similar improvement measures. These similarities allow for concept designs to be produced that apply for more than a single property.

This process needs to be deployed to create efficiencies in both the design programme and associated cost. The concept designs can then be verified against the individual dwelling assessment documentation to identify any areas where bespoke details are required. These are often to manage items such as extensions and installations that did not form part of the original construction.

It is also important that any constraints are identified early within the design process. This means there can be a detailed discussion and solutions identified for any issues that will affect the design process, before significant design works are progressed. The PAS 2035 standard is very clear in requiring the Retrofit Designer to review the dwelling assessment documentation at the beginning of their involvement, therefore this task should be one of their first activities.





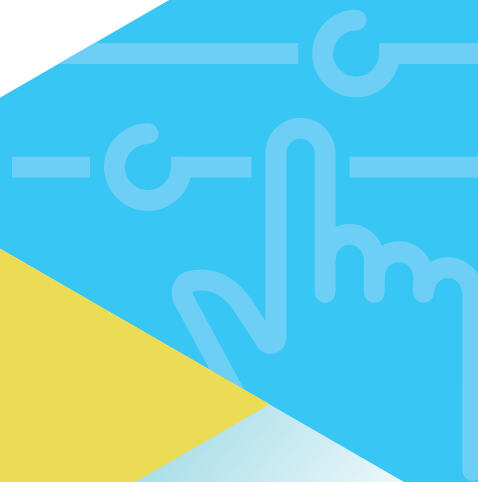
STAGE 4 - TECHNICAL DESIGN

Development of design

Following completion of the archetype-based design, the delivery of the detailed design can then take place. Risk has been mitigated through the earlier stages, which means this processes should be streamlined.

To ensure there is sufficient communication between the design team, regular design meetings should be arranged with a formal structure and delivery strategy. This is no different to design development that has taken place on construction projects historically, and there is no reason why this cannot be deployed in retrofit. This is particularly important when delivering retrofit at scale, as there will be a high volume of design information being produced.

A final design approval protocol should be agreed with the Retrofit Coordinator so the retrofit designs can be submitted, reviewed and approved within an agreed timeframe. The Retrofit Designer should also present examples of their previous design documentation to the Retrofit Coordinator to create an early shared understanding of the designs that will be produced at the end of the process. This will align expectations and allow for any early communication over the content of the design. This is particularly important due to the differing standard and level of quality that currently exists in the retrofit designer market.





STAGE 5 – CONSTRUCTION

PIBI completion

The 'Pre-installation Building Inspection' is a requirement of the PAS 2030 standard and its purpose is to ensure the energy efficiency measure can be installed safely and effectively at the designated location. Typically, this is undertaken by the organisation that will be undertaking the installation. The requirements of PIBI vary depending on the measure that is going to be installed.

Currently, it is favoured by many Clients to employ a single Main Contractor who facilitates the installation of the energy efficiency measures. It is common that a large portion and in some instances all of the works, be subcontracted to individual specialist supply chain members, who will undertake the installation of a single energy efficient measure. Lessons have been learnt on numerous schemes where multiple subcontractors have undertaken separate site inspections to enable each to complete their PIBI.

Projects that contain even a handful of energy efficiency measures can lead to numerous visits, creating resident fatigue and disruption. It is important that these checks are undertaken, as they form part of the quality assurance procedure created by the PAS standard, however there must be a more effective deployment and organisation of these inspections. Therefore, minimising the number of inspections and where feasible, a single inspection should be facilitated by the main contractor to enable all of their supply chain to undertake a joint inspection.

Where an approach based on archetypes and geographical location has been deployed within the project, this will only assist in facilitating the process.





STAGE 5 – CONSTRUCTION Continued...

Quality assurance protocols

There are well-documented examples of where retrofit goes wrong, and this simply must not happen when retrofit is being delivered at scale. The disastrous Preston external wall insulation led retrofit project is well documented and serves as a stark reminder of the inherent risk associated with retrofit. Many of these projects were undertaken before the PAS 2030 and 2035 standards, meaning that the level of control and quality assurance procedures were not a mandated requirement.

The PAS 2035 standard has recently been updated to create even greater transparency on the requirements for the Retrofit Coordinator to visit site and monitor the installations. However, when delivering retrofit at scale, even greater consideration should be given to managing the quality aspects of the project.

The golden thread is a principle of keeping a digital record of crucial building information from the design phase continuing throughout the building's life cycle. This digital record should also be included and form part of the installation phase. It is important that modern technology and platforms are utilised to truly embrace the golden thread – and not just an unorganised catalogue of photographs taken and lost at a later stage.

There are various platforms available and commonly used in new developments, which capture real-time data in an accurate manner. Two prominent examples are Viewpoint's Field View and Autodesk's PlanGrid. These pieces of software fundamentally allow for evidence of compliant installation to be collected and catalogued in a way which is accurate to an exact property and location. For example, imagery can be taken at the key stages of the installation of external wall insulation to evidence, for example, the EWI boards being tightly abutted and mechanical fixings properly distributed. This is particularly important to capture before any work is covered. This information should be made available to the project team as a whole and not retained by a single organisation.

When delivering at scale, the feasibility of a single Retrofit Coordinator being able to visit every property becomes a challenge and additional individuals will need to be deployed. This can be provided through standalone appointments to a 'Clerk of Works' function, which will provide a further level of quality assurance.

Programme Management

Programme management is a critical requirement of any construction project but particularly important for one that includes multiple stages, gateways and hold points. Effective programme management enables the project team to anticipate and mitigate risks, allocate resources effectively and ensure different teams work together. Communication links can also be effectively managed without loss of momentum.

Furthermore, there are onerous reporting requirements stipulated by funding providers which necessitate that organisations hold accurate and up-to-date information on a regular basis. This can be facilitated through accurate programme management and set reporting requirements.



STAGE 6 – HANDOVER AND CLOSEOUT

Handover protocol

Achieving handover is one of the key milestones in any project and should hopefully be a point to celebrate the success of the project. It is, however, imperative the project is brought to a formal and orderly conclusion, ensuring all project deliverables have been successfully achieved and the necessary administrative and contractual closure activities completed.

The handover protocol should be defined in detail through the project execution plan and include the management of the transfer of documentation, process for completing final on-site inspections, resident demonstration and training, and completion of any lodgement activities to the TrustMark data warehouse.

Prior to the formal handover, all testing and commissioning should have been undertaken to demonstrate that the installed measures function as intended, which of course should not be left to the day of the intended handover.

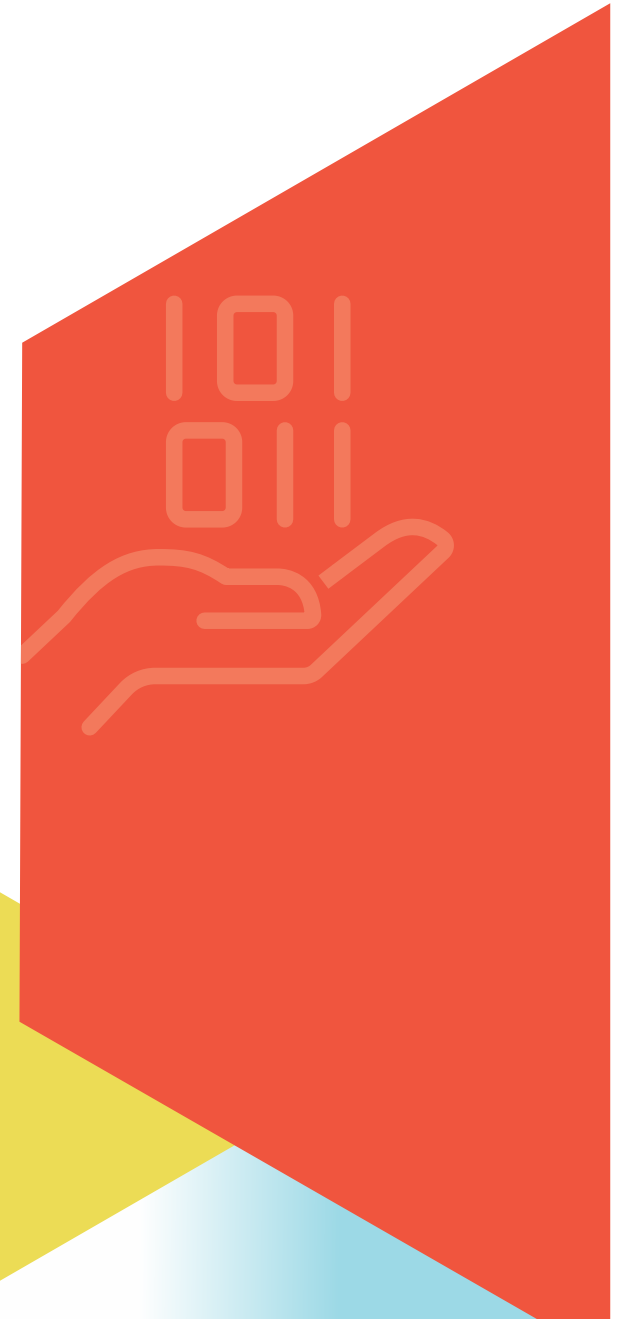
This will also trigger the defects period under a typical construction contract and the monitoring and evaluation period under PAS 2035.

Completion of Lodgement to TrustMark

TrustMark is a government endorsed quality mark for tradespeople and businesses working in home improvement and energy efficiency sectors. During the project, there is a wealth of documentation produced by various parties, and as part of the claim of compliance to PAS 2035, the Retrofit Coordinator is required to upload this documentation to the TrustMark portal.

It is important that this breadth of documentation is effectively managed, and this can be achieved through PAS platforms, discussed later in the toolkit, or alternatively through an effective document management system.

When delivering retrofit at scale, the number of lodgements should not be overlooked and resource should be planned effectively, particularly given the likely peak load of projects all reaching handover at a similar stage.





STAGE 7 - IN-USE

Property data monitoring

Property data monitoring is becoming increasingly available at lower price points and provides a way of continuously collecting, tracking and analysing data. Some organisations may wish to deploy such devices on a large scale across their portfolio to gain information about the way each property is being occupied, allowing them to monitor risks such as the likelihood of damp and mould growth.

The devices typically gather information about energy consumption, temperature, humidity and air quality, regularly capturing data which is then uploaded to a central system.

These devices and data can provide insightful information about the property both before and after the installation of retrofit measures. Where these devices are being deployed it is important that substantial pre-works data is collected to provide a benchmark and comparison for post-works data. Typically, these are installed at least one season before the measures are installed, to create a meaningful dataset.

The archotyping analysis can be used so that fewer devices can be installed, which will then allow for an indication of the portfolio performance as a collective. The success of retrofit can truly be tested through the use of this equipment, as the data does not lie and comparisons can be made against the initial energy modelling.

Lessons learnt and feedback

Continuous improvement is particularly important when undertaking a new concept. The way in which retrofit has been delivered and scaled over recent years has allowed for smaller projects with fewer properties to be delivered with the intention of creating shared learning. However, new challenges will always be faced when moving out of the sandpit and starting the journey of delivering retrofit at scale, along with new lessons learnt identified that reflect the increased complexity.

The purpose of this toolkit is to document, create and publish a multitude of lessons learnt to assist organisations in their own at-scale delivery, however there will always be more to learn. This learning should not be isolated to individuals and must be disseminated to a wider audience. It is therefore important that at key stages of delivery and at conclusion of the scheme, lessons learnt workshops are undertaken. These should be a 'warts and all' review, with meaningful outputs recorded and positive change implemented to assist with future delivery.

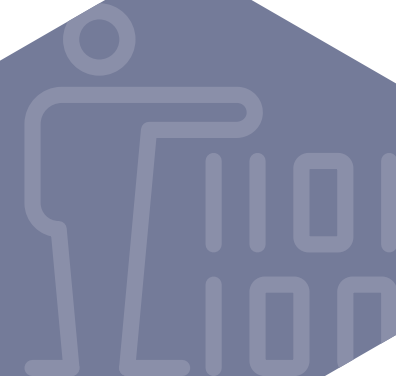
Questions should always be asked of the way in which something is delivered and whether there is a way to improve the process.

PAS 2035 Monitoring and Evaluation

PAS 2035 provides three levels of monitoring and evaluation, and the process aligns to the 'defects period' that is common to construction contracts. It is a way to understand whether the intended outcomes have been realised and whether there have been any unintended consequences arising from the work. This similarly creates a process for continuous improvement for future projects.

Under PAS 2035, there are three levels of monitoring and evaluation: Basic, intermediate and advanced. Basic evaluation is undertaken to every property under a PAS 2035 compliant project. This will typically be in the form of a questionnaire that gathers information from the client and resident.

Where problems have arisen or the outcome does not align with the initial intention of the project, intermediate and advanced evaluation will be undertaken. This will be a bespoke and more detailed review of the project carried out to provide recommendations.



SOFTWARE TO AID DELIVERY

Software has been developed to aid in the delivery of PAS 2035 and 2030 complaint retrofit projects.

The likes of Core Logic, Partity (now combined with Core Logic), and Homelife fundamentally provide a platform to facilitate the undertaking and administration of PAS 2035 and 2030 documentation. Such platforms are optional and not compulsory or a requirement for successful delivery. It is also fair to state that many of these platforms do have their own problems and restrictions, particularly those in earlier stages of development.

We suspect that with time, a market leader will emerge with clear benefits over their competitors. It would also be unreasonable to undertake analysis over the strengths, weaknesses and limitations, as these pieces of software will continue to be developed and improved after the publication of this toolkit.

What is vitally important to consider is that Retrofit and PAS 2035 and 2030 does create a large quantity of documentation, and this must be managed. The resource required to manage the documentation should not be overlooked, particularly given how critical it is throughout the project and to evidence compliance – a requirement to receiving funding. Document control platforms have been in existence to manage construction projects for a long time, with the likes of A-site, Viewpoint and Aconex, to name a few.

A 'Retrofit Administrator' for large-scale projects should be considered. This is not a role referenced in PAS 2035, but aligns to document controller roles that are already in existence. This enables the experts in the field to focus on what they are best at, rather than spending their time managing documentation.

Critically, it is important the documentation does not disappear into the ether – like much of the completion documentation that has been produced over the course of time.



CHALLENGES AND SOLUTIONS ASSOCIATED WITH RETROFIT AT SCALE

Challenges and Solutions associated with Retrofit at Scale

It is often repeated that the number of retrofits we must complete is increasing all the time, whether that's 1.7 homes every minute according to the UK Green Building Council, equating to over 100 homes an hour, or more like 300 homes an hour according to a leading UK contractor. What's for certain is experience on flagship schemes such as SHDF Wave 2.1 shows delivery to be staggered and not achieved at the pace many intended. As an industry, we appear to be failing to meet the challenge of delivering retrofit at scale. The aim of this toolkit is to aid that delivery, with a focus on residential and social housing.

Another frequently expressed truism is not to eat the whole elephant in a single bite. In this section, we break down some of the key challenges to achieving retrofit at scale, and based on our experience and expertise, propose some possible solutions.

CHALLENGES	SOLUTIONS
Procurement and Cost Control Inflation of costs from early schemes such as SHDF Demonstrator through to where we are now. Lack of understanding of scalable procurement models to better control costs.	Procurement and Cost Control Need for more partnership based procurement models, approved industry schedules of rates, oversight of delivery models led by government and industry partners to achieve the scale of delivery required.
Scheme Programming/Organisation Issues associated with scheme delivery, scattergun approach to surveys, inadequate preparation/master programming, design led entirely by retrofit assessments with little or no application of professional discretion, Local Authority Planning constraints/challenges. Questions around visibility of contractor delivery proposals and structures. Are turnkey (and other contractor-led delivery models) actually providing an end-to-end solution?	Scheme Programming/Organisation Need for lead Retrofit Coordinator to have building surveying and project management skills. Need for upskilling. Ability for professional team to apply discretion in design based on Client brief and intended outcomes. Industry code to enshrine fairness, transparency and accountability.
Supply Chain and Economies of Scale Supply chain infancy and lack of accredited professionals/installers. Need for upskilling and economies of scale to be achieved. Bottleneck in current programmes.	Supply Chain and Economies of Scale Mass training scheme and regional structures for either community interest or partnership based delivery models. Training, skills and funding schemes to be revamped as per CLC strategy. Adequate long-term planning, visibility and coordination to avoid bottlenecks.
Design Blockage and Technical Surveys/PIBs Reported issues with the concept in PAS where the Retrofit Assessment enables the Retrofit Design. This isn't the case in practice. Clause 8.2.5 requires the designer to request additional information from the assessor where needed, meaning possible multiple follow-on surveys including technical surveys and PIBs.	Design Blockage and Technical Surveys/PIBs Delivery teams to understand there may be a variety of different measures across properties. Need to build in supply chain capacity across the measures set. Assessors would benefit from having building surveying expertise. Feeds into partnering, regional model of delivery rather than series of bit parts.
Resident Engagement Fatigue Getting residents on side is a challenge, but the fatigue during the survey stage and the delivery of works is a real challenge. Sequencing of measures e.g., installing fans and door undercuts at works commencement can ensure these essential measures are completed for compliance.	Resident Engagement Fatigue Appointment of resident engagement specialist for their input. Finish with elements that residents want. Role for citizen assemblies to drive better understanding of benefits in terms of bill savings and thermal comfort.

FINAL THOUGHTS

Our ambition with this toolkit was to provide a practical guide to delivering retrofit at scale, starting at ground zero with the intention of one day reaching net zero.

A large theme has been changing the way retrofit is currently being delivered into a more streamlined and efficient process – a prerequisite to unlocking delivery at scale.

The existing retrofit standards are largely intended to manage risk and not facilitate retrofit at scale. This needs to be realised so the industry can move from a reactive to a proactive approach.

We've worked with organisations who are leading the way in developing and implementing a retrofit strategy that considers the various stages of a project and its individual stakeholders, and have witnessed firsthand how the approach has significantly aided delivery. It is our hope that this toolkit gives all organisations a blueprint to achieve the same success.

There is a large amount of upfront work and tools required before a retrofit scheme can be successfully delivered, and this is reflected in the "Retrofit Project Manager Core Tasks" section of this toolkit.

In our view, retrofit will become the 'norm' and existing workstreams will combine, leading to a whole-house approach focused not just on retrofit, but on all aspects of building occupation, such as damp and mould risk, overheating, component condition and embedded carbon. A Strategic Asset Management Strategy and protocol is the only way these individual elements can be viewed holistically. Simply delivering programmes of component replacements, reactive maintenance and retrofit measures in isolation serves only to create massive inefficiencies for organisations. With rising costs across the construction industry, these inefficiencies will and already have started to mean intended improvements to properties become unviable, ultimately to the detriment of occupants.

Big data and ever-evolving technologies will enable the analysis of properties at scale and assist in the development of efficient programmes of work. Platforms have emerged and are available to process this data. Many organisations have started to use their existing data sets to model and inform programmes of work, which has led to success, particularly in securing funding and forming initial programmes of work. However, we have seen examples where this data has not yet been tested and inaccuracies within it have created significant hurdles and inefficiencies during delivery, meaning any upfront work has only led to problems.

Careful collection of accurate and useful data, combined with a rigorous validation process, is what is required to inform a Strategic Asset Management Strategy – which will lay the foundations to deliver retrofit at scale.

We hope the guidance within this toolkit will improve the understanding of retrofit among individuals and organisations, helping them avoid the common pitfalls and ultimately enable them to deliver it at scale.

For further information on how Baily Garner can help you with retrofitting your existing homes, contact us.



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