Homes

of today

for tomorrow

Decarbonising Welsh Housing between 2020 and 2050

Stage 4:

retrofit in practice

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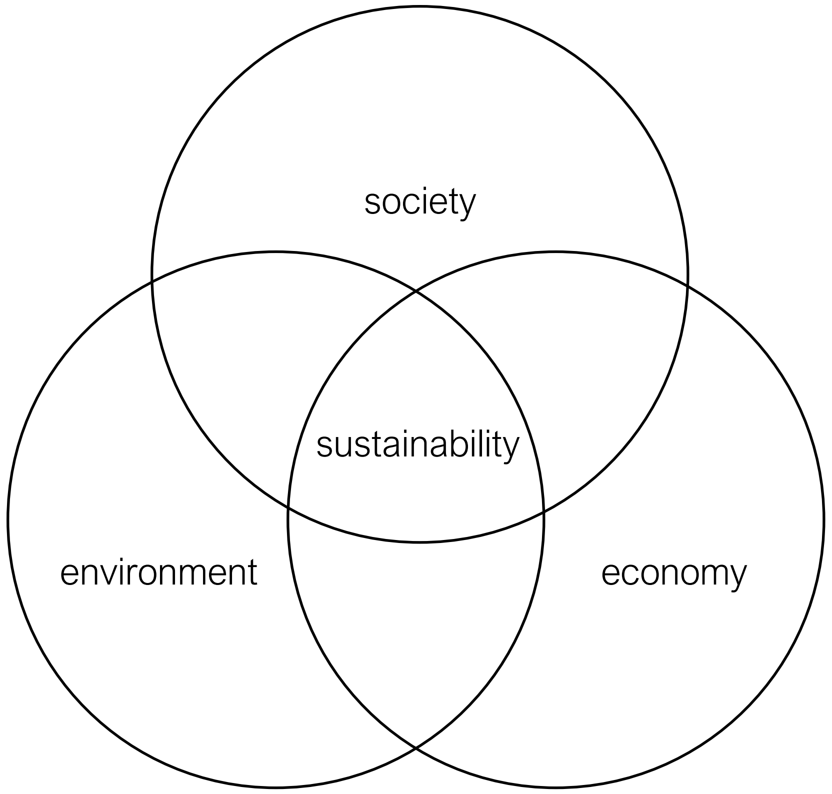
February 2024



The 'three-pillar' definition of sustainability has been variously attributed to the authors of the Brundtland Report, Agenda 21, and the 2002 World Summit on Sustainable Development.

Executive summary

Research by the Welsh School of Architecture under the title *Homes of Today for Tomorrow* has focused on understanding how decarbonisation of the Welsh housing stock should be undertaken:

stage 1	pan Europe review of best retrofit practice
stage 2	modelling decarbonisation of the Welsh housing stock
stage 3	learning from social housing landlords
stage 4	exploring retrofit in practice

Decarbonisation of the existing housing stock presents a huge challenge for current and future generations. There is concern that a highly systematic approach to decarbonisation could diminish the distinctiveness of different homes and places, and miss opportunities to improve quality for occupants and for the wider community.

A systems-led approach to decarbonisation is being promoted by UK government, whereby conventional fossil fuel heating systems are replaced with low carbon (typically electric) heat sources. This is the most affordable approach in terms of capital cost. It is relatively well understood by the industry and replicable at scale, and aligns with the elemental way social housing landlords view their stock. However this approach typically increases fuel bills, with the potential to worsen fuel poverty.

A joint focus on decarbonisation and affordable warmth is promoted by Welsh Government. This requires a fabric-first approach to retrofit and provides a pathway for achieving zero carbon without increasing fuel poverty, but meets only two of the seven Wellbeing of Future Generations Act (WFGA) goals in a meaningful way.

To meet all seven WFGA goals, future retrofit must collectively address decarbonisation, affordable warmth and holistic quality. This requires a step change for all parties involved in the retrofit process, and adoption of both a coherent standard and a flexible approach. The thinking of policy-makers, planners, designers and constructors must extend beyond the dwelling to consider the collective needs and aspirations of the wider community, and there will be lifestyle implications for all of us.

UK zero carbon
focus on decarbonisation.
delivers on **economy**.

Welsh zero carbon
focus on decarbonisation and affordable warmth.
delivers on **economy** and **environment**.

step change needed

future best practice
focus on decarb, affordable warmth and holistic quality.
delivers on **economy**, **environment** and **society**.

The potential improvement of quality and value could be a catalyst for retrofit of homes in the private sector, particularly when this can be achieved within permitted development rights (because of the reduction in cost, timescale and risk). For this to happen, guidance must be provided by the public sector linking retrofit that improves quality of the home with retrofit to decarbonise and improve energy efficiency. Understanding the impact of retrofit on fuel bills could also incentivise the private sector. Presently, energy modelling tends to happen late and does not necessarily inform the retrofit.

The RIBA Plan of Work 2020 is an important document but it confuses homeowners and landlords. Eight sequential work stages do not promote efficient domestic retrofit, which is reliant on as much information as possible being available from the outset. Relatively small details or specialist input which may emerge late in the Plan of Work can completely change the scope of a retrofit, resulting in abortive work - increasing project time, cost and risk of failure. A Plan of Work better suited to domestic retrofit would be more collaborative. It would encourage design and construction professionals to work together, with project aims agreed at the outset. The process would be cyclical rather than linear, and should incorporate clear targets, cost and energy modeling at key stages.

There are a number of roles for governance in creating a better context for retrofit. Centrally provided, freely available guidance that explains retrofit opportunities to homeowners and landlords would inevitably increase the amount and quality of retrofit, particularly in an economic climate where fewer people are moving, and more are seeking to improve the quality and value of their homes. Guidance should outline a legible, streamlined retrofit process and describe both the benefits and the challenges clearly, alongside an explanation of likely costs.

The planning process presents a major source of risk for retrofit projects, particularly if the proposed changes are of sufficient scope to increase property value. Permitted development rights allow some retrofit to take place without planning permission, but the extent of permitted work can be ambiguous. The process of obtaining planning consent is seen as time consuming, expensive and unpredictable. Local Authorities could reduce risk and uncertainty by providing affordable access to expert advice, on a project by project basis, but this will require a considerable increase in resources for planning offices. The constraints imposed by Conservation Area and Listed Building status also need review.

A publicly coordinated energy efficiency consultancy service coordinated could also promote energy efficiency funding programmes, and deliver best practice advice and useful energy modelling at the right point in the retrofit process. This would increase confidence in the value of retrofit, diminishing risk in a notoriously risk-heavy area of construction, and reducing the likelihood of project failure. Central government could make retrofit more attractive and cost-effective by supporting or incentivising collaboration between retrofit designers and constructors.

There is a skills shortage pervading all aspects of the retrofit industry that must be addressed. Our understanding of embodied carbon in particular is very limited. While some tools for measuring and reporting on embodied carbon exist they are not in widespread use, and more work is needed to develop a consistent and coherent methodology, if embodied carbon is to be considered as seriously as operational carbon.

It is not clear that Retrofit Coordinators (as defined by PAS2035, British Standard for retrofit) have the expertise needed to deliver creative, contextual retrofit with a combined focus on decarbonisation, affordable warmth and quality. The skills needed are consistent with the core skills of the Architect, as outlined by professional bodies ARB and RIBA. A mechanical approach to retrofit (as advocated by PAS2035) is more likely to miss opportunities to improve quality and value that should incentivise retrofit in the first place, and less likely to meet the needs of current and future generations.

Homes of today for tomorrow_stage 4: **retrofit in practice**

contents

Welsh School of Architecture (WSA) February 2024

Below: *the secret garden flat is an adaptive retrofit of a terraced property by Nic Howett Architect. The project reconnected a modest flat with its garden space and was named London's best home improvement by the Don't Move Improve! competition in 2023. Photography by Henry Woide.*

section 1: Introduction

The Welsh housing stock is among the oldest and least efficient in Europe. Of the 1.4 million dwellings that existed in 2017 (StatsWales, 2018), one third were built before 1919. In comparison, just 6% were built in the last 30 years. Despite numerous energy efficiency initiatives, almost a quarter of Welsh households experience fuel poverty, (NEA 2017), and housing currently produces 21% of Welsh carbon emissions (BEIS 2018).

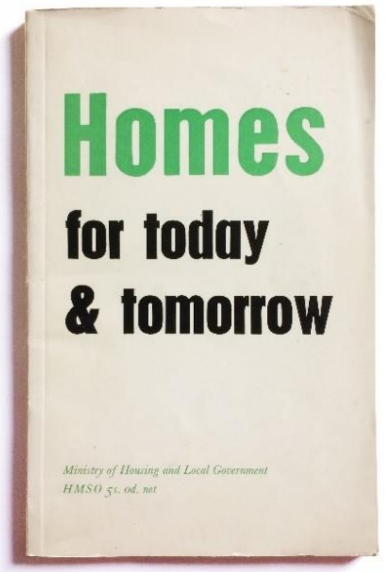
Recent, widespread recognition of the climate emergency has escalated the perceived urgency of decarbonisation, and continues to do so. In 2019, the UK Committee for Climate Change (CCC) stated that Welsh Government should target no less than a 95% reduction in carbon emissions by 2050 (versus 1990 levels, source: CCC, 2019).

The *Homes of Today for Tomorrow* research projects were commissioned by Welsh Government (2017 - 2022) to better understand key challenges likely to affect successful decarbonisation of the Welsh housing stock. Stage 1 provided a broad, pan-Europe review of good, best and emerging retrofit practice. Stage 2 focussed on the Welsh housing stock and established reasonable limits for decarbonisation, along with the link between improvement of dwelling energy efficiency and decarbonisation of energy at source. Stage 3 concentrated on Welsh social housing, as the sector with the clearest incentives for decarbonisation. Recurring house types were analysed, to understand the likely scope and standard of retrofit needed to meet international decarbonisation targets. Both stages unveiled a clear tension between decarbonisation and affordable warmth.

Homes of Today for Tomorrow Stage 4 continues to narrow in focus. A single case study is explored, on the basis that it reflects many of the challenges embedded in retrofit of the Welsh housing stock. Analysis of the potential for retrofit to meet decarbonisation targets and address affordable warmth is combined with an exploration of retrofit that improves quality more generally, in keeping with WFGA. Through this comparison, Stage 4 aims to establish whether the seven WFGA goals (compliance with which is now a legislative requirement for public bodies in Wales) provide an appropriate vehicle to demand retrofit of the Welsh housing stock that:

(1) meets international decarbonisation targets,
(2) avoids pushing low income families into fuel poverty, and
(3) improves the quality of Welsh Housing, such that it is fit for future generations.

Right: Homes for Today and Tomorrow (MHLG, 1961) was published sixty years ago by the Parker Morris Committee, in the context of a fundamental need to improve housing quality. The report recommendations became a mandatory standard for all new towns and social housing which only ended in 1980, when the Conservative government sought to reduce the cost of housing. Today, again, there is a clear need for better quality housing, but a lack of understanding of how meaningful improvement could or should be made.



Project aim and objectives

This research aims to establish whether the goals outlined in the Wellbeing of Future Generations (Wales) Act (WFGA) can be used to drive retrofit of the Welsh housing stock that meets international decarbonisation targets, addresses fuel poverty, and improves the quality of Welsh Housing more generally, such that it is fit for current and future generations.

Objectives:

Outline the implications of WFGA for retrofit of the Welsh housing stock.
Compare different levels of retrofit to understand the scope of retrofit that meets WFGA.
Explore the typical domestic retrofit process, identifying key factors that affect its success.
Develop lessons for retrofit stakeholders including policy makers, clients, designers and constructors.

Research method

For this publication, a case study is used to explore the potential of retrofit to meet decarbonisation targets, while improving the quality of the home more generally. The pre-1919 mid terraced dwelling chosen for the case study has distinct characteristics that make it relevant for the wider Welsh housing stock, in terms of dwelling type, age, physical condition and energy source.

Three retrofit scenarios are described. Each scenario is explained in terms of key aims, scope and specification, and the measurable outcomes that result. The first scenario is a light retrofit with an explicit focus on meeting UK decarbonisation targets - principally through a transition from fossil fuels to low carbon (electric) sources of heat. Constraining capital cost and disruption for occupants are key concerns. The second scenario applies the approach to retrofit advocated by Welsh Government, which requires that decarbonisation is delivered with due consideration for energy costs, so as not to increase fuel poverty. It requires deep retrofit with a fabric first approach alongside a shift to low carbon heat, and probably a renewable energy source. The third scenario treats retrofit for decarbonisation as an opportunity to holistically improve the quality of the home in line with WFGA. This scenario considers organisation of the home, the space standards it meets (including opportunities for expansion), and other improvements that could have wider benefits to quality of life, health or wellbeing.

The impact of each retrofit scenario is measured in terms of energy efficiency (SAP rating and EPC), annual fuel bills, the (embodied) carbon caused by the retrofit, and the impact on operational carbon (against 1990 levels). Analysis of the case study informs a discussion of retrofit options, by establishing what factors to consider when deciding when and how retrofit should take place.

The retrofit case study is then used as vehicle to discuss retrofit in practice. Participating practitioners discussed the case study through their own experience of retrofit, and worked to establish key factors that influence whether retrofit succeeds or fails. The RIBA Plan of Work (2020) provides a structure for recording this discussion, whereby the retrofit is mapped in practice against the Plan of Works, identifying opportunities to improve and inform the retrofit process. This in turn enables a review of the effectiveness and appropriateness of the Plan of Work for domestic retrofit projects.

Conclusions have been drawn from this research in the form of lessons learnt that should have value for key stakeholders involved in retrofit. The lessons learnt are wide-ranging, and have relevance for policy-makers, clients (including homeowners) and developers, as well as designers and constructors of current and future retrofit projects.

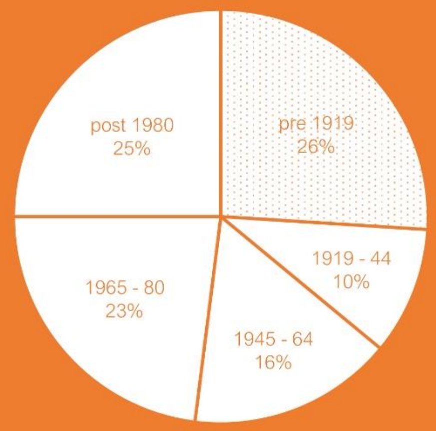


Figure 1: homes by age

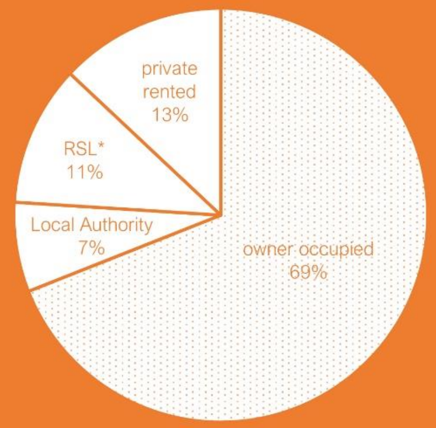


Figure 2: homes by tenure

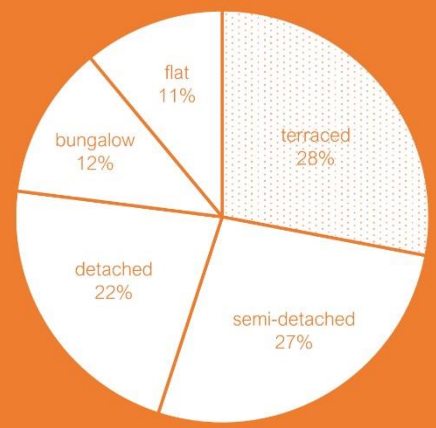


Figure 3: homes by type

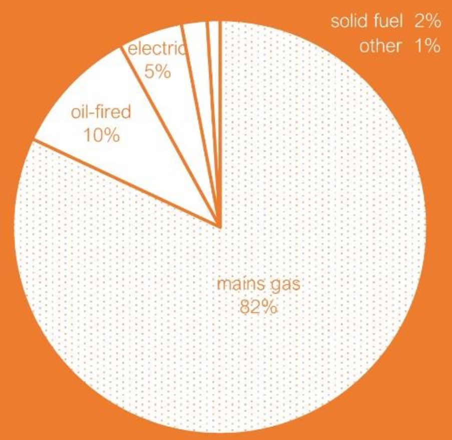


Figure 4: homes by energy source

Four pie charts describe the makeup of the Welsh housing stock as a whole, in terms of four key descriptors – age, tenure, house type and energy source. The case study (below) reflects the most common characteristic for each descriptor (shown hatched on the pie charts) – a pre-1919 mid terraced home in private ownership, heated via mains gas.

The average energy efficiency for dwellings in Wales (calculated using RdSAP) is SAP61, which is the bottom of EPC band D). Pre-1919 dwellings average EPC E (SAP53) and only dwellings constructed post 2000 achieve EPC band C on average (SAP73).

All data is drawn from the Welsh Housing Conditions Survey (WHCS),2017-2018.

section 2:
The Wellbeing of Future Generations (Wales) Act and housing

The Well-being of Future Generations (Wales) Act (2016) requires that public bodies think longer term in their decision-making, working together with people to create a Wales that we all want to live in, now and in the future. Seven goals are enshrined in the Wellbeing of Future Generations Act (wheel, below left) with the combined agenda of “acting today for a better tomorrow.”

Below, the seven WFGA goals are interrogated in terms of implications for the retrofit of housing that is concerned with ‘quality’. The table below identifies that there are key issues to be considered during retrofit, potential benefits to the user, and potential wider benefits. Each of the seven WFGA goals is then translated into a key area of concern or agenda for housing retrofit in the future: carbon, capital, change, health, energy, people and place.

Overleaf, each goal is unpacked to understand implications in more detail. These seven agendas provide a means by which the *quality* of retrofit can be assessed.

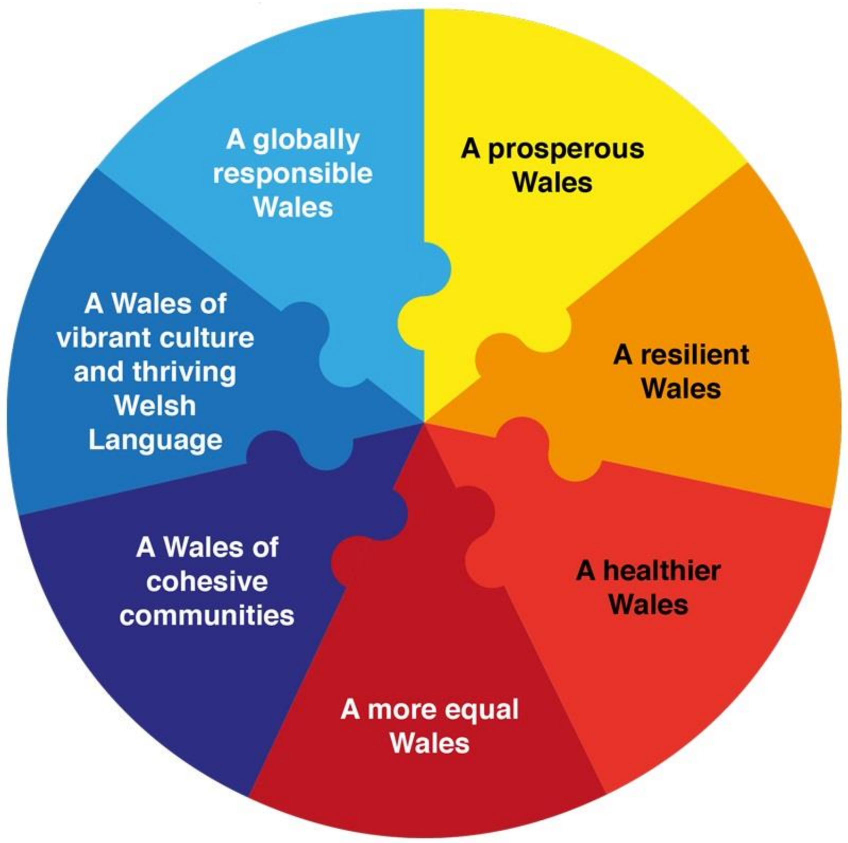


Image and quote source
https://www.futuregenerations.wales/

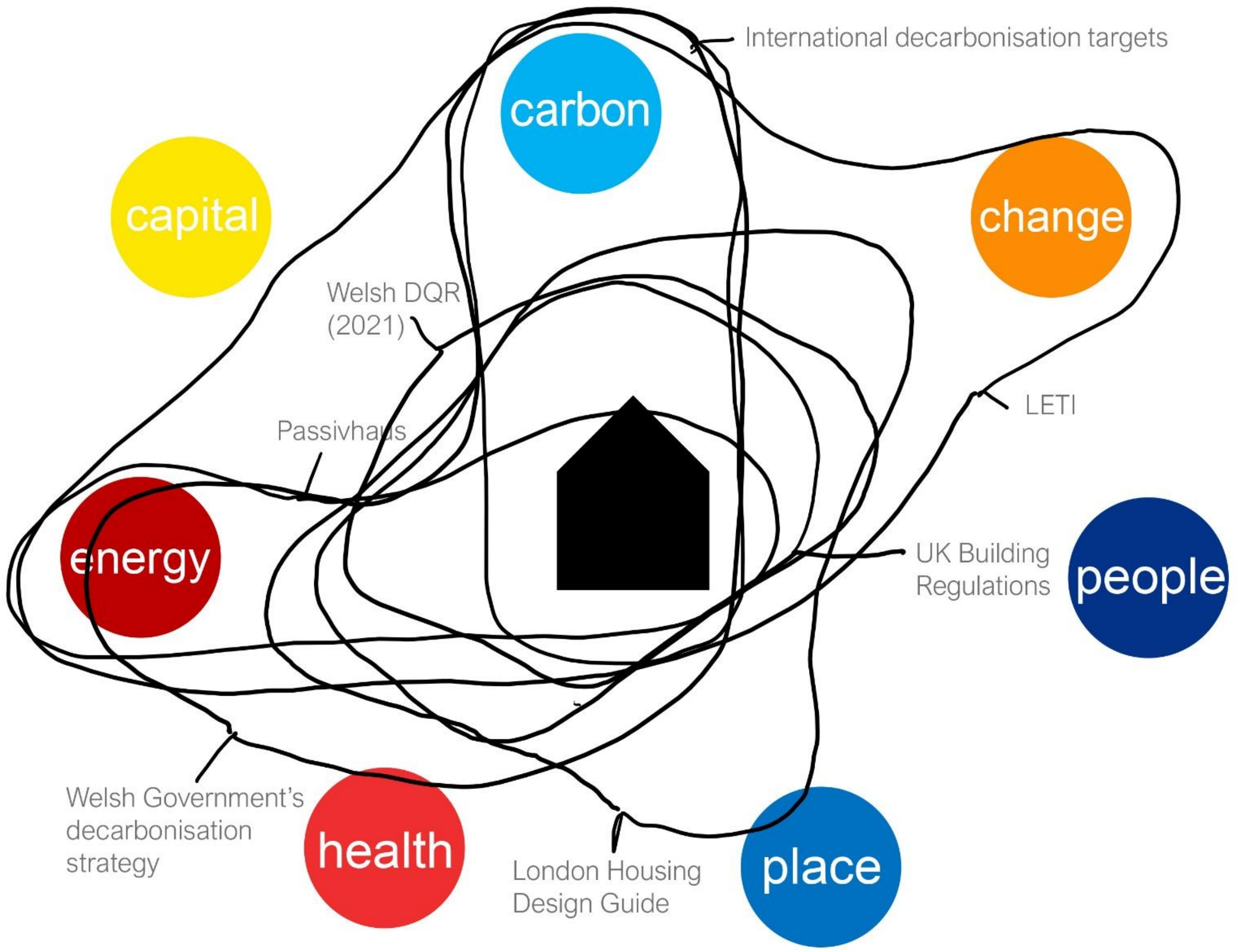
WFGA goal	considerations during retrofit	benefits in use	wider benefits	theme:
A globally reponsible Wales	Specify low embodied carbon, design for low operational CO_2	Reduced CO_2 emissions	Decarbonising Wales, meeting international targets	carbon
A prosperous Wales	Specify local resource use, utilise local skills	Better value retrofit More affordable housing	Stronger local economies, skills and community building	capital
A resilient Wales	Specify for low maintenance, design in ecological diversity	mitigating overheating, flexible and adaptable homes	Reduced pressure on local infrastructure, more capacity	change
A healthier Wales	Specify natural resource use and breathable construction	Healthy internal environment, reduced environmental impact	Healthier communities, with less pressure on the NHS	health
A more equal Wales	Improved fabric performance and more efficient systems	Reducing heating bills Reducing fuel poverty	Affordable warmth for all, Energy positive communities	energy
A Wales of cohesive communities	Design mixed, flexible housing, consult with the community	Meeting housing need with flexible, high quality homes	More varied communities, different procurement pathways	people
A Wales of vibrant culture and…	preserve heritage, design with sensitivity to context	maintaining and enhancing local character	supporting people, commu-nities and distinctive places	place

A number of different sets of regulations and housing standards contribute in different ways, and to different degrees, to the quality of housing in the UK – both in terms of new-build and existing homes. The diagram (below) maps the focus and reach of some of them, as follows:

- International decarbonisation targets
- UK Building Regulations
- LETI (London Energy Transformation Initiative)
- Passivhaus
- London Housing Design Guide
- Welsh DQR (2021)
- Welsh Government's decarbonisation strategy

This mapping exercise identifies that some regulations and housing standards (such as UK Building Regulations) are concerned with many of the WFGA agendas, but are typically not sufficiently onerous for housing to be required to substantially meet WFGA aims. Others (such as Passivhaus) are concerned with just one or two areas of focus. Such standards are less likely to be enforced, but are more likely to result in housing that is in keeping with some of the WFGA aims.

None of the housing standards or regulations commonly adopted in the UK require that housing quality be considered holistically.



Understanding the WFGA goals as a measure of housing quality

Over the following seven pages, each WFGA goal is unpacked in terms of project constraints, project benefits and wider benefits to understand the implications of adopting the WFGA goals in order to ensure better quality housing. Where appropriate, relevant targets or key implications for design and construction are explained. Examples are provided of projects that reflect the focus of some goals. Finally, a key publication is provided for each goal, as a reference / resource for obtaining more detailed guidance and establishing best practice.

carbon capital change health energy people place

WFGA goal: a globally responsible Wales

Housing focus: **carbon**

project constraints:	project benefits:	wider benefits:
specify low embodied carbon, design for low operational carbon	reduced carbon emissions	decarbonising Wales meeting international targets

This goal requires a low carbon upgrade of the existing building fabric. It suggests minimal use of carbon-heavy materials such as cement or concrete, and that priority be given to the use of timber and other CO2 sequestering materials (e.g. wood fibre insulation), along with lightweight foundations, to offset the CO2 that is generated during construction.

The building fabric should be improved to a standard whereby transition to a low carbon heating system is possible without an increase in fuel bills, resulting in a reduction of at least 95% in operational CO2/m^2 compared with 1990 benchmarks.

Left and below: the LETI climate emergency design guides establish appropriate targets for energy efficiency improvements. The newbuild guide was published in 2017, the LETI retrofit guide was published in 2021.

Building element		Retrofit actions	LETI best practice: Constrained retrofit	LETI best practice: Unconstrained retrofit (cool temperate climate)	LETI exemplar: All retrofit types
Walls	Cavity	External, cavity or Internal insulation	0.24 W/m^2.K	0.18 W/m^2.K	0.15 W/m^2.K
	Solid uninsulated	External or Internal insulation	0.32 W/m^2.K	0.18 W/m^2.K	0.15 W/m^2.K
	Timber frame	External or Internal insulation	0.21 W/m^2.K	0.18 W/m^2.K	0.15 W/m^2.K
Roofs	Cold	Insulate	0.12 W/m^2.K	0.12 W/m^2.K	0.12 W/m^2.K
	Warm/flat	Insulate	0.22 W/m^2.K	0.12 W/m^2.K	0.12 W/m^2.K
Floors	Suspended timber	Insulate between joists	0.20 W/m^2.K	0.18 W/m^2.K	0.15 W/m^2.K
	Solid uninsulated	Excavate and insulate below	0.80 W/m^2.K	0.15 W/m^2.K	0.15 W/m^2.K
Windows and doors	Windows	Replace	1.30 W/m^2.K	1.00 W/m^2.K	0.80 W/m^2.K
	Doors	Replace	1.00 W/m^2.K	0.80 W/m^2.K	0.80 W/m^2.K
General envelope	Thermal bridging	Mitigate where possible	0.10 W/m.K	0.10 W/m.K	0.08 W/m.K
	Airtightness	Draught proofing, sealing of chimneys and vents	3.0 ach@50Pa	2.0 ach@50Pa	1.0 ach@50Pa

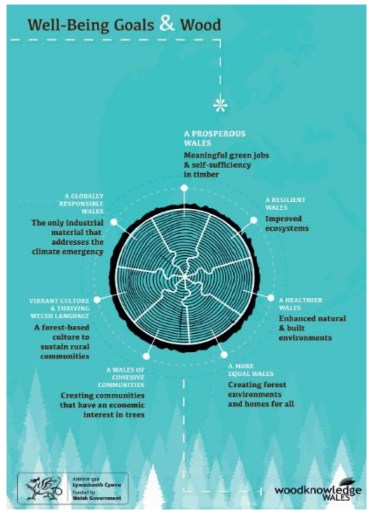
WFGA goal: a prosperous Wales

Housing focus: **capital**

project constraints:	project benefits:	wider benefits:
specify local resource use, utilise local skills	better value retrofit more affordable housing	stronger communities with local skills and resources

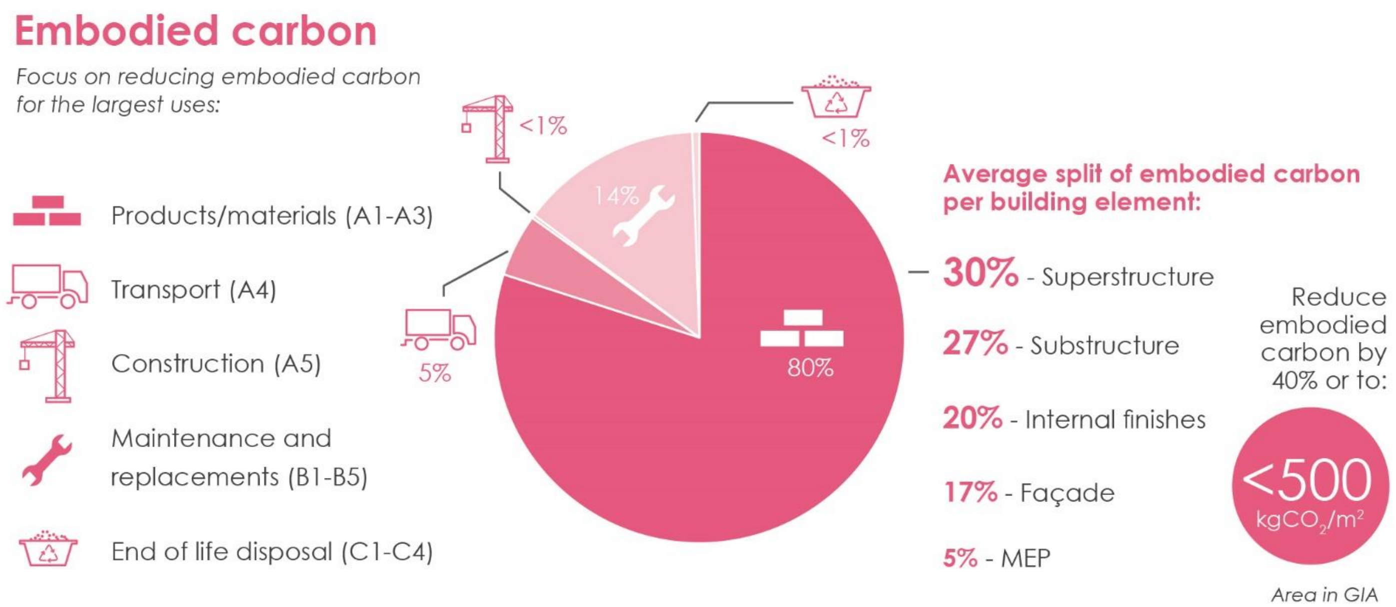
This goal requires that options to utilise locally sourced resources and labour be explored. This may be a little more expensive, but investment will help support local, sustainable economies. Quality may also be higher, and impact on the environment reduced (for example by reducing, or even eliminating, the carbon cost of travel and transportation).

Use of local products and local skills or expertise will make the development easier and more affordable to maintain in the future. By utilising local suppliers, fabricators and constructors, capacity for future work is grown, and connections with the wider community are strengthened.



Left: the *Zero Carbon Homes* report, by Wood Knowledge Wales (2021) makes the case for greater use of local timber in a range of construction-facing applications.

Below: the LETI climate emergency design guides also provide guidance on minimising embodied carbon in construction.



WFGA goal: a resilient Wales

Housing focus: **change**

project constraints:
specify for low maintenance, design in ecological diversity

project benefits:
mitigating overheating, flexible and adaptable homes

wider benefits::
reduced pressure on local infrastructure, more capacity

The dwelling envelope and heating / cooling / renewable energy systems should all be designed, specified and constructed so that they are easy to maintain. Fabric and systems should also mitigate against overheating and more extreme weather, as inevitable consequences of climate change.

Homes should be made sufficiently flexible and adaptable to provide for both the needs of the current user and for future changes in housing need.

Better outdoor spaces are needed – both for people and for ecology. In some cases more space can be created for people and ecology by reducing the dominance of the car. Sustainable urban drainage (SUDS) should be incorporated, providing irrigation and natural features as well as reducing surface water run-off. Opportunities should be explored to increase ecological value and diversity in a connected way. There may also be opportunities for food production on site.

Left: the Wildlife Trusts report *Homes for People and Wildlife* (2018) promotes a synergistic view of people living together with ecology.

Below: the LILAC cohousing scheme in Bramley, Leeds by Agile Homes (formerly White Design) was completed in 2013, and collaboratively designed with residents. It successfully locates cars at the perimeter of the neighbourhood and sustainable drainage sustains a wide range of landscape features, including gardens for food production. The Modcell construction system uses natural materials to sequester high levels of carbon, and dwellings achieve stringent Passivhaus accreditation for very low energy use.

WFGA goal: a healthier Wales

Housing focus: **health**

project constraints:
specify natural resource use, and breathable construction

project benefits:
healthy internal environment, reduced environmental impact

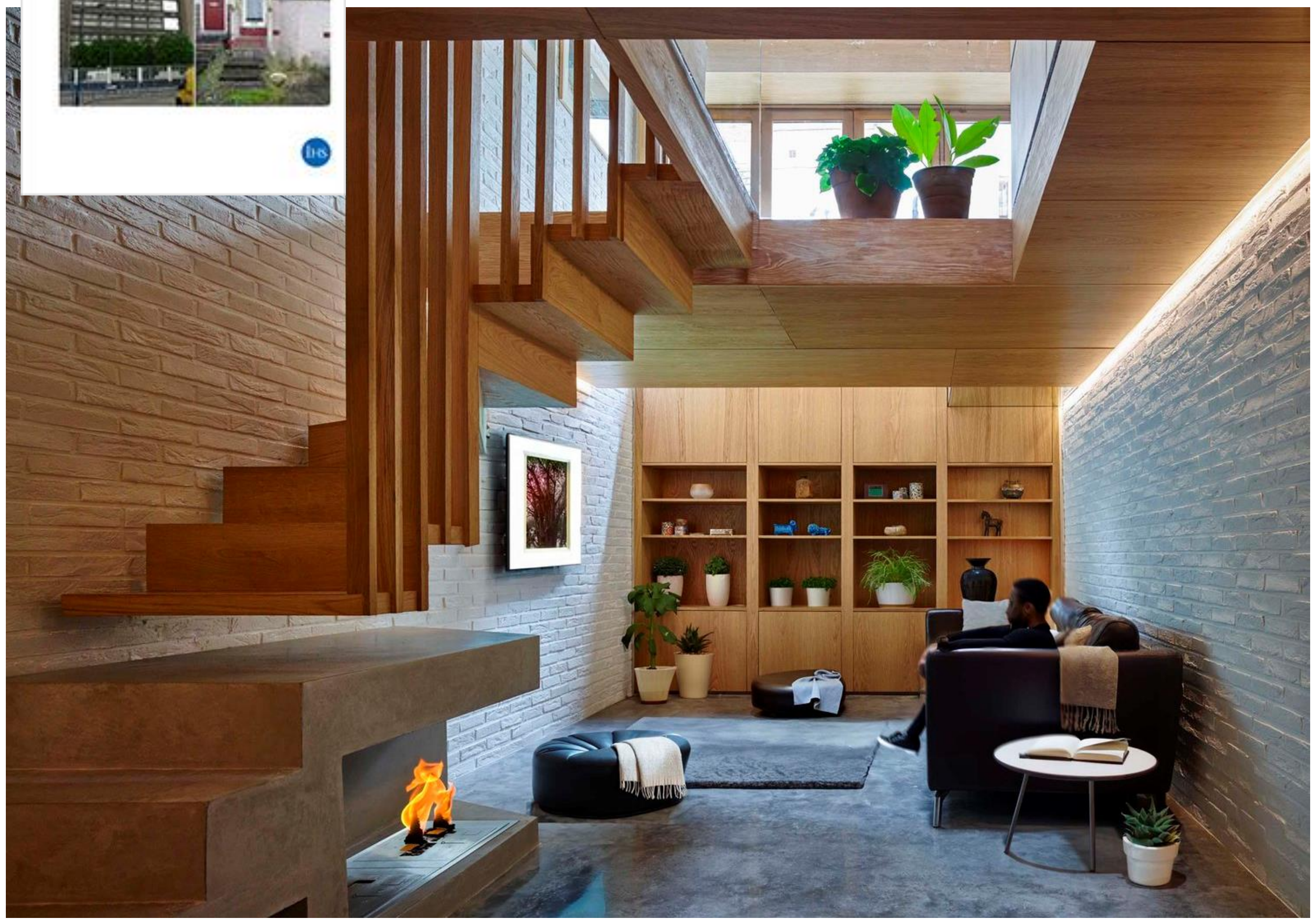
wider benefits:
healthier communities, less pressure on the NHS

The WHO, describe air pollution as the single biggest environmental health risk, killing more people than smoking, road deaths and diabetes combined. Natural resources and breathable construction improve indoor air quality, and reduce potential issues such as moisture build-up and mould growth.

Many aspects of housing design influence how healthy the home environment feels. Natural light offers many benefits, as do tangible connections between inside and outside. Visual and physical access to outdoor spaces can be highly therapeutic, particularly for people with mobility issues. Neighbourhoods can promote heathier lifestyles and lower levels of car use, in the way they are organised and the amenities they provide.

Left: BRE report *The Full Cost of Poor Housing* (2016) attributes £1.4 billion of NHS spending each year to poor housing quality.

Below: the Modern Mews retrofit by Phil Coffey Architects (2022) transformed a dark, dilapidated terrace through the introduction of natural light and ventilation (even reaching the basement, below), views to the outside and healthy low carbon materials.



WFGA goal: a more equal Wales

Housing focus: **energy**

project constraints:
improved fabric performance and more efficient systems

project benefits:
reduced heating bills, less fuel poverty

wider benefits::
affordable warmth for all, energy positive communities

Energy efficiency and decarbonisation are linked, but separate. Some retrofit actions that are critical to decarbonisation (notably adoption of low carbon heat sources) have potential to increase fuel bills for occupants, typically through the transition from gas to electric sources of heat.

UK Building Regulations Part L for retrofit is in need of review. Short term UK energy efficiency targets (eg MEES: EPC 'C' for private rented housing) need to go further. Retrofit must adopt the anticipated long-term decarbonisation targets (currently anticipated as EPC 'A' in conjunction with a low carbon heat source) if it is to contribute to the challenge of making the housing stock fit for future generations.


Homes of today for tomorrow

Decarbonising Welsh Housing between 2020 and 2050

STAGE 2:
Exploring the potential of the Welsh housing stock to meet 2050 decarbonisation targets

Above: *Homes of today for tomorrow - Decarbonising Welsh Housing between 2020 and 2050 Stage 2* (2019) explored the potential of the Welsh housing stock to meet 2050 decarbonisation targets.

Right: themographic imagery reveals the impact of retrofit on energy conservation through fabric heat loss (photograph credit Huw Lane)

WFGA goal: a Wales of cohesive communities

Housing focus: **people**

project constraints:
design varied, flexible housing and consult the community

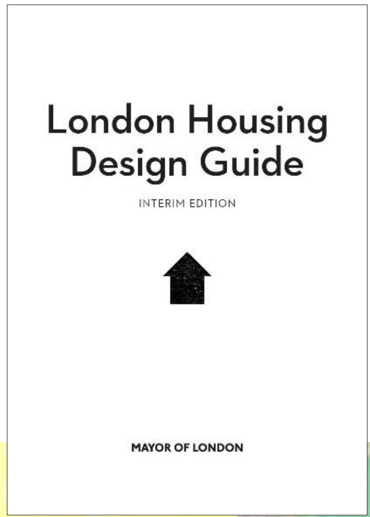
project benefits:
meeting housing need with flexible, high quality homes

wider benefits:
more diverse communities, better procurement pathways

Some of the issues affecting the quality of homes and neighbourhoods do not relate directly to the dwellings, but to the surrounding context, community and *people*. By engaging with communities before, during and after retrofit, harder to treat issues will be uncovered and understood.

Many homes are built to space standards or layouts that are no longer considered appropriate or acceptable. In some neighbourhoods, one type of housing dominates, limiting the range of households that can be supported. In such circumstances, housing must be fundamentally altered to meet current and future expectations.

Flexibility increases the potential to meet changes in housing need. By varying housing type and improving flexibility, a wider range of people can be provided for within a neighbourhood - building a richer, more diverse community. Part of successful community building is provision of shared spaces (both inside and outside) for people to create shared experiences. If possible, such spaces should be opened up to the wider community for a more balanced, more connected network of people.


London Housing Design Guide

INTERIM EDITION

MAYOR OF LONDON

Left: With sections on 'housing for a diverse city', 'from street to front door;, 'dwelling space standards' and 'homes as a place of retreat', the London Housing Design Guide (2010) places people at the centre of housing design.

Below: school children built this 'model' neighbourhood collaboratively to explore the shared amenities that could lead to stronger communities.

WFGA goal: a Wales of vibrant culture and thriving language

Housing focus: **place**

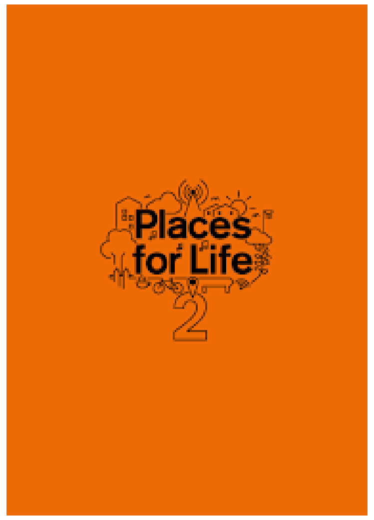
project constraints:
preserve heritage qualities
sensitivity to context

project benefits:
maintaining and enhancing
local character and identity

wider benefits::
supporting communities
with distinctive places

Placemaking lies at the heart of recent changes to national planning policy and has been enthusiastically adopted by the wide range of signatories to the Placemaking Wales Charter, which requires that “the positive, distinctive qualities of existing places are valued and respected. The unique features and opportunities of a location, including heritage, culture, language, built and natural physical attributes, are identified and responded to.” (Design Commission for Wales, 2020)

Retrofit can be used to repair and respect the existing built environment, without erasing or mimicking the past. The addition of distinctive new-build elements can enhance and enrich the existing character of a place. Applied with skill and integrity, an architectural language of retrofit that is informed by both past and future concerns should add to the sense of place, community and culture, not diminish it.



Left: the *Places for Life 2* report (quoted above, published by Design Commission for Wales in 2020) explores how we understand and shape the towns, villages and landscapes in which we live, through the lens of placemaking.

Below: Mount Pleasant Studios (2014). The work of Peter Barber architects exemplifies an approach that is equally rooted in the cultural context of a place as found, and contemporary concerns including the climate emergency, the ongoing housing crisis and a desire to create distinctive, legible and homely places. Photographs copyright Morley von Sternberg.

section 3:
Retrofit case study

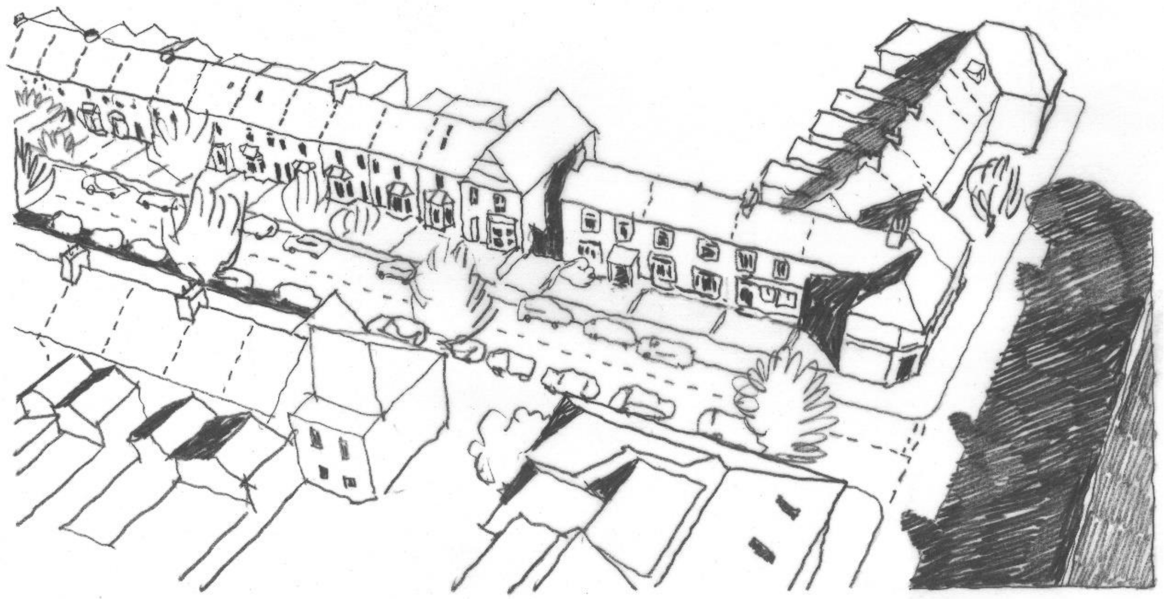
three retrofit scenarios for a pre-1919 mid-terrace dwelling

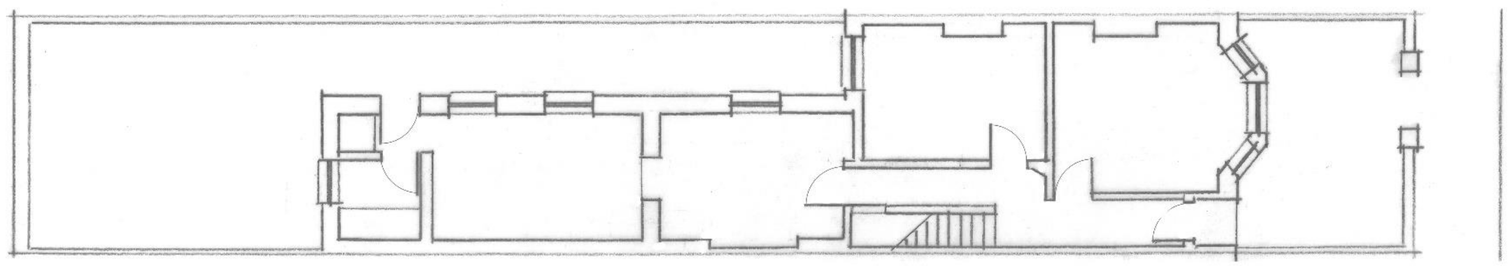
Contributors:
Charlotte Woodfield
Kaiwen Li

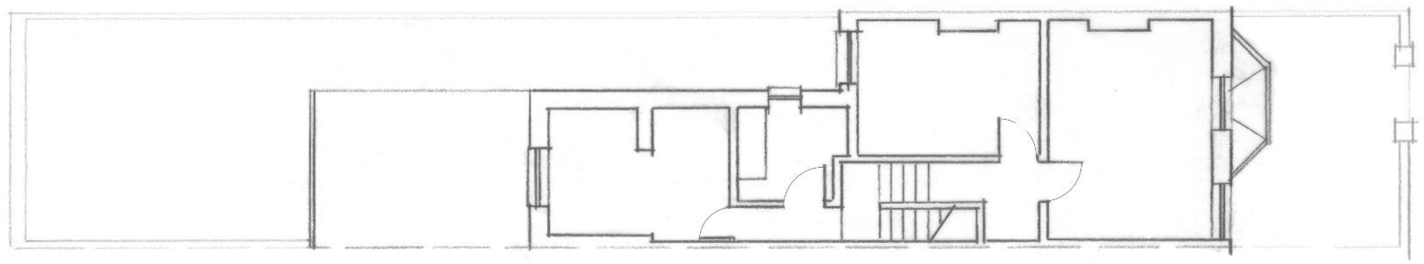
Case study_a typical pre-1919 mid-terrace dwelling
as existing

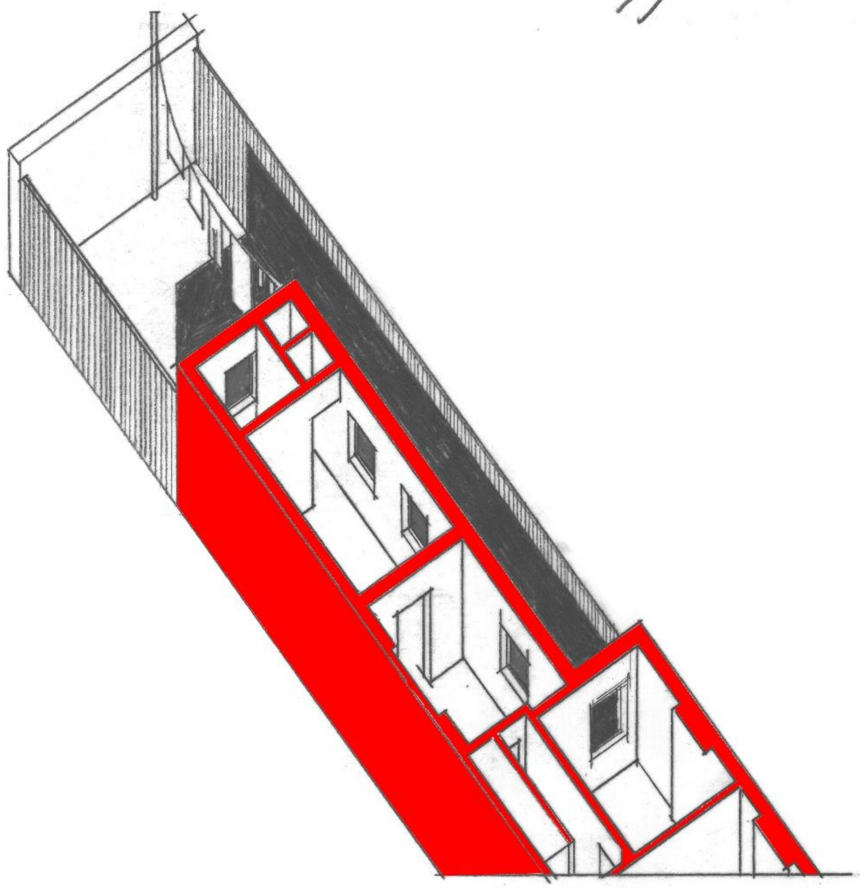
The house is currently occupied by five students who share a modest living room, bathroom and kitchen. Most of the street has been converted into student housing, and the transient nature of the households limits the sense of any community,

The character of street frontages is a constraint, and something to preserve and enhance. The street itself is currently dominated by cars.









The house has not been well-maintained, and achieves only EPC D / SAP64, performing significantly worse than the standard required by current Building Regulations part L.

Internally, some period features remain. The house is made up entirely of small cellular spaces. Some do not comply with good practice standards, and accessibility around the house is limited by numerous changes in level. The long outrigger to the rear makes spaces within very dark, with no direct sunlight and no views out. There is poor acoustic separation of rooms throughout. Roof voids have not been utilised.

Outdoor spaces to both the front and rear of the house are low quality, sterile and are only used for storing waste, recycling and bikes. The rear garden is heavily overshadowed by the existing rear extension, and only the very end of the garden is used, mostly for drying laundry.

existing specification:

- Solid masonry walls to front, uninsulated
- Cavity walls to rear, poorly insulated
- Solid ground floor, uninsulated
- Roof void with 100mm rockwool between joists
- Poor quality double glazing
- Mains gas wet central heating, condensing combi boiler
- Hot water via gas boiler

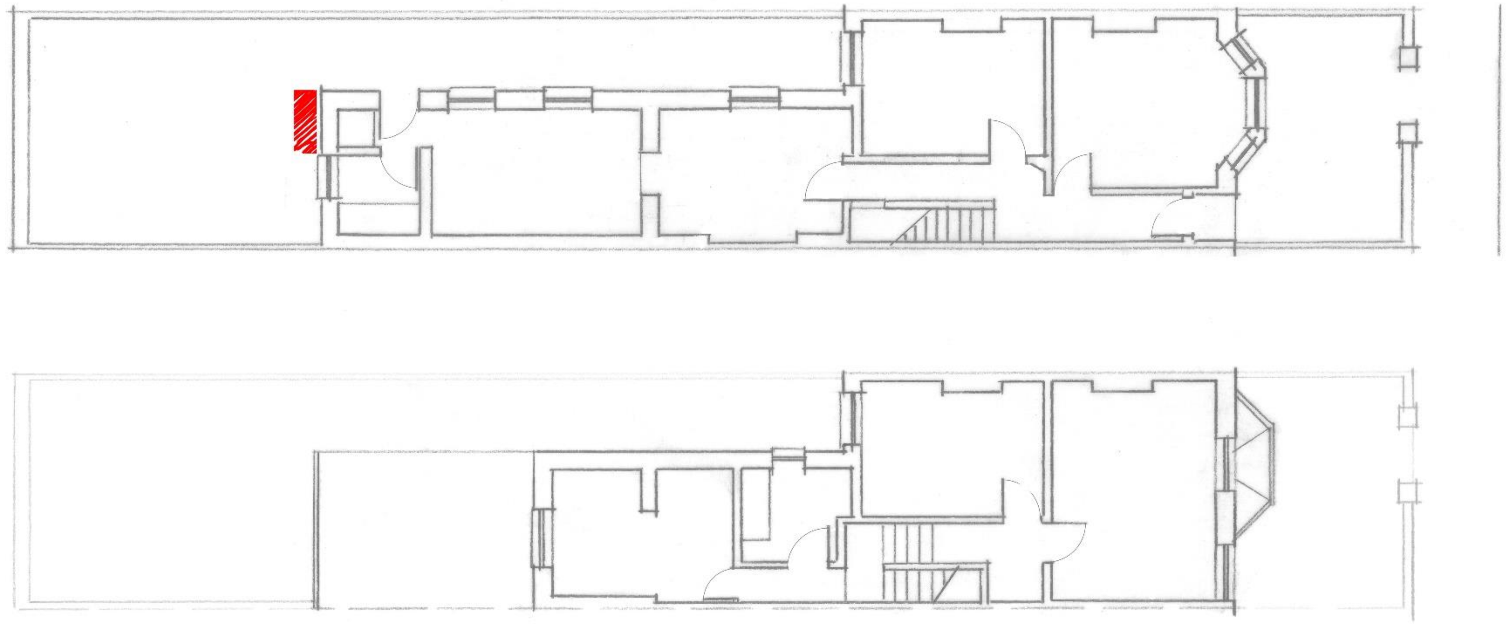
SAP rating 64 EPC band D

Predicted annual fuel bills: £3,218

Embodied carbon, proposed work: nil

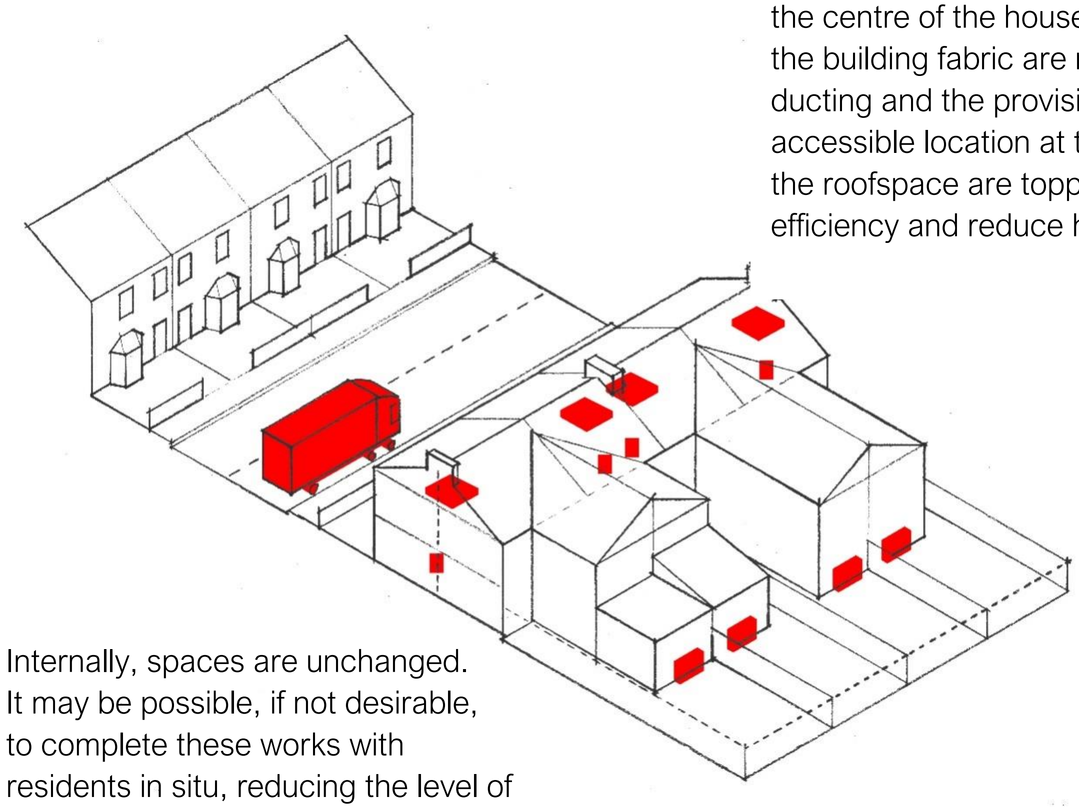
Carbon in use: 34% decarbonised vs.1990

scenario 1: light retrofit, focussed on decarbonisation



Light retrofit is likely to focus on meeting decarbonisation targets as cost-effectively as possible. The primary aim is to replace carbon-heavy energy sources such as natural gas with a cleaner source of heat, such as electricity.

For this case study, the mains gas wet central heating system is replaced with an air source heat pump, controlled via smart meters and controls at the centre of the house. No significant changes to the building fabric are needed other than some ducting and the provision of an ASHP unit in an accessible location at the rear. Insulation levels in the roofspace are topped up to improve energy efficiency and reduce heating load.

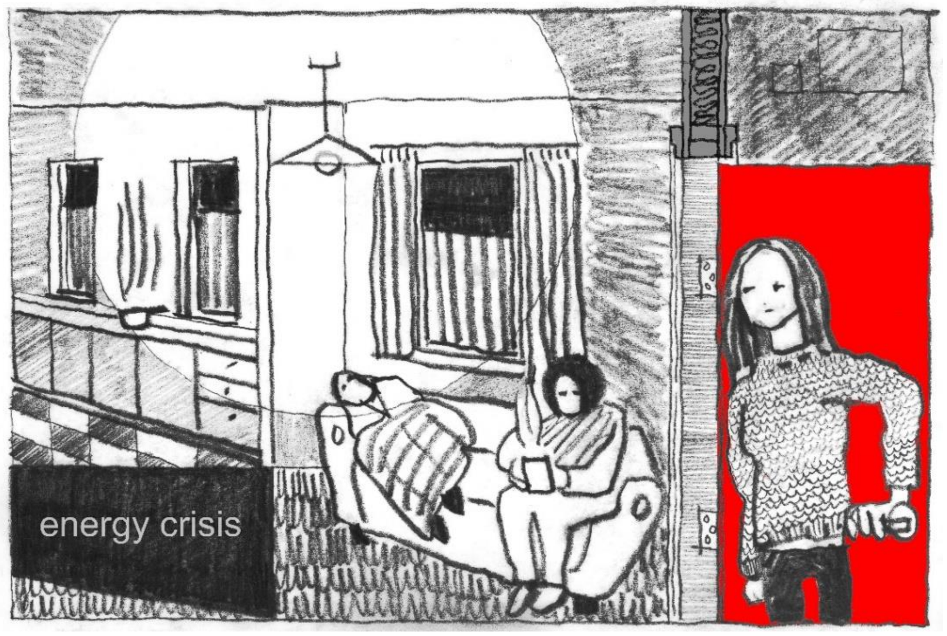


The retrofit can be carried out with standardised components by a single competent contractor, with high levels of repetition and very little messy or unpredictable work. Timescales are relatively short, and the risk of unforeseen consequences is reduced, making costs more controllable.

Internally, spaces are unchanged. It may be possible, if not desirable, to complete these works with residents in situ, reducing the level of disruption that is caused.

By removing gas from the property, standing charges are reduced, and some risks are eliminated. However heating bills will rise considerably because of the difference between the unit costs of electricity and gas.

With increases in the cost of living, the low income student household will struggle to heat their home sufficiently. Low temperatures and an increasingly damp environment will lead to poor air quality and mould growth, potential for future health problems and costs for the NHS.



retrofit specification (grey items unchanged):

- Solid masonry walls to front, uninsulated
- Cavity walls to rear, poorly insulated
- Solid ground floor, uninsulated
- Roof insulation topped up to comply with current Building Regulations
- Poor quality double glazing
- Space heating via air source heat pump with smart controls and MVHR
- Hot water via ASHP

Results without renewables:

SAP rating 54 EPC band D

predicted annual fuel bills: £3,922

Embodied carbon of retrofit: 8524 kgCO2

Carbon in use: 81% decarbonised vs.1990

Results with renewables:

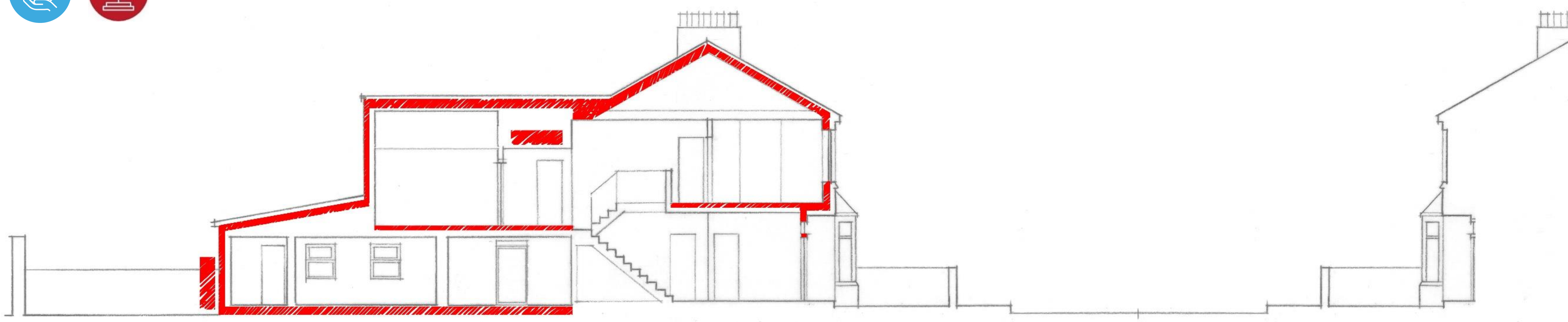
SAP rating 65 EPC band D

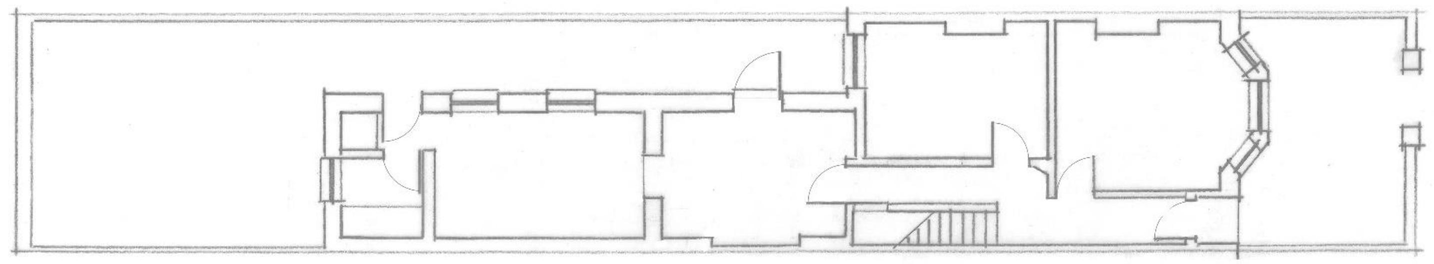
predicted annual fuel bills: £3,026

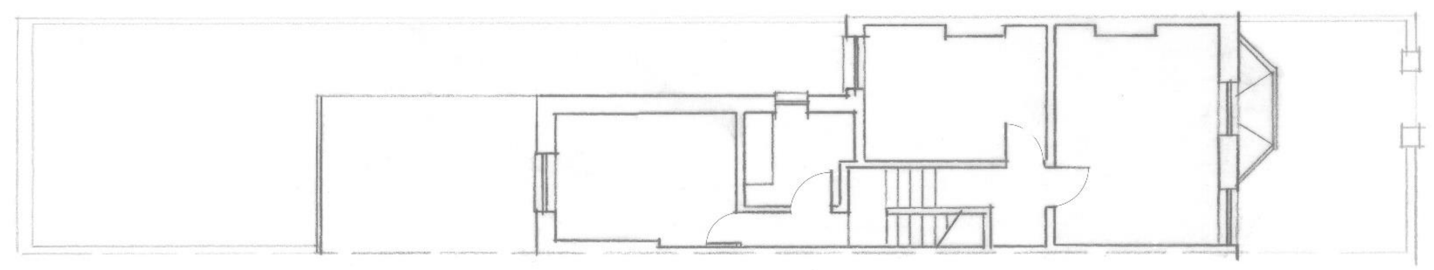
Embodied carbon of retrofit: 18,580 kgCO2

Carbon in use: 86% decarbonised vs.1990

scenario 2: deep retrofit for decarbonisation and affordable warmth







The deep retrofit shown here takes its cues from the existing dwelling. The retrofit is carried out in line with LETI best practice, in a manner that is sympathetic to the local context. The resulting dwelling could continue to be used as an HMO, or could be returned to use as a family home for a household of up to six people.

On the street front, internal lining of the solid walls retains character and avoids complications with the roof line, slightly reducing the size of key spaces. To the rear, external wall insulation improves the thermal performance, watertightness, and appearance of the poorly built extension. Together, these two techniques make the most of existing character and opportunities to improve the house, but considerably increase the range of products, skills and time required to complete the retrofit.

Complete insulation of the roof is necessary to maintain thermal continuity between front and rear. This provides an opportunity to create storage or convert the roof space, and a location for larger new components such as an electric battery. Acoustic insulation between rooms can be improved at the same time.

By insulating the rear ground floor, the changes in level are removed, making the home more accessible, but the headroom of some spaces becomes low as a result. A large windows lends itself to conversion into a new exterior door.

These changes provide better connections to outdoors, and could be a catalyst for improvement of the garden. However, outdoors space remains modest and heavily overshadowed.

Upstairs, the bedroom to the rear of the house can be opened up and externded vertically. This provides accommodation for a bigger family, or a useful work-from-home or studio space.

After the deep retrofit, the house is comfortable to occupy and affordable to heat, to the point where it is equitable with a new-build property. However, key spaces remain small and the centre of the house is still dark and oppressive.

retrofit specification:

- internal Wall Insulation to front, to 0.25W/m^2°C
- external wall insulation to rear, to 0.25W/m^2°C
- partially insulated ground floor, to 0.24W/m^2°C
- in-line roof insulation to achieve 0.13W/m^2°C
- high performance double glazing (1.3W/m^2°C)
- space heating and hot water via air source heat pump
- smart controls and MVHR

Results without renewables:

SAP rating 75 EPC band C

predicted annual fuel bills: £2,258

Embodied carbon: 15,950 kgCO2

Carbon in use: 90% decarb vs.1990

Results with renewables:

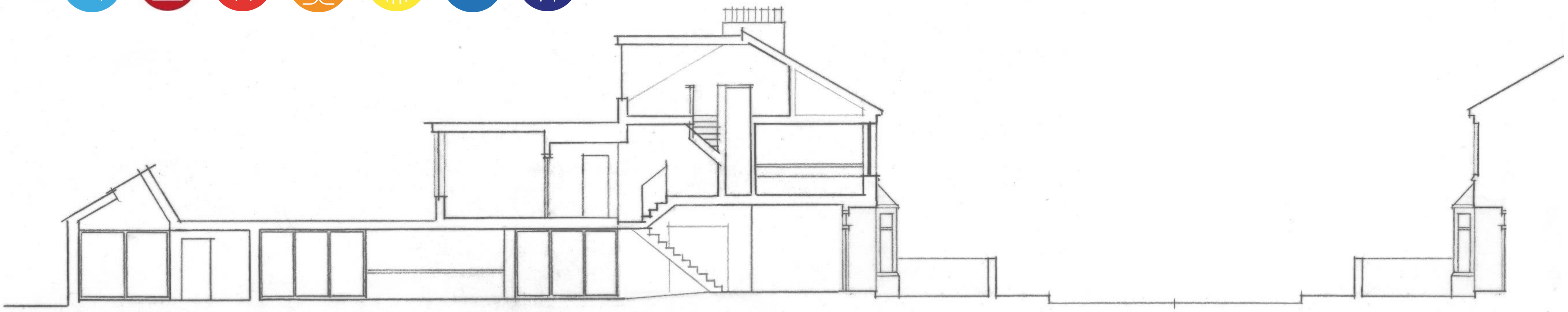
SAP rating 86 EPC band B

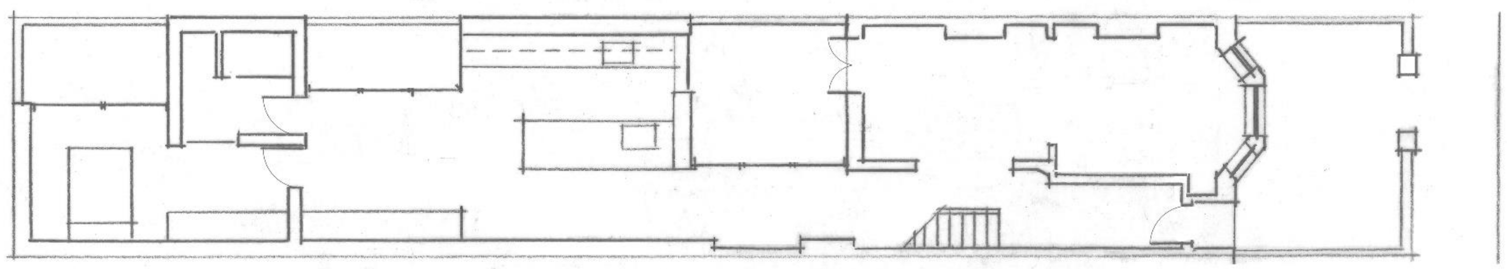
predicted annual fuel bills: £1,362

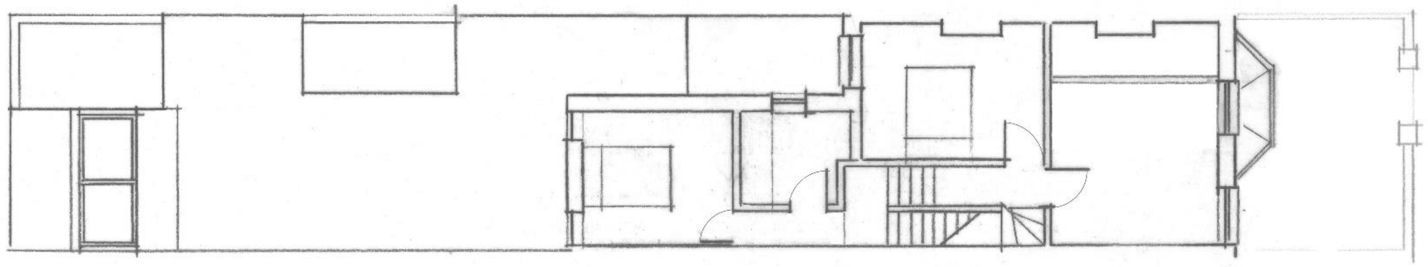
Embodied carbon: 26,000 kgCO2

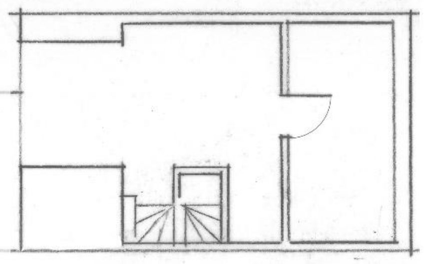
Carbon in use: 94% decarb vs.1990

scenario 3: adaptive retrofit for decarb., affordable warmth and quality homes









retrofit specification

- internal wall Insulation to front, 0.25W/m^2°C
- external wall insulation to rear, 0.25W/m^2°C
- partially insulated ground floor, 0.24W/m^2°C
- in-line roof insulation, 0.13W/m^2°C
- high performance double glazing, 1.3W/m^2°C
- New external wall, floor and roof 0.13W/m^2°C
- heating and hot water via air source heat pump
- smart controls and MVHR

Results without renewables:

SAP rating 78 EPC band C

predicted annual fuel bills: £2,680

Embodied carbon of retrofit: 19,545 kgCO2

Carbon in use: 88% decarbonised vs.1990

Results with renewables:

SAP rating 90 EPC band B

predicted annual fuel bills: £1,336

Embodied carbon of retrofit: 29,600 kgCO2

Carbon in use: 95% decarbonised vs.1990

The adaptive retrofit shown is one of an almost limitless array of options that are possible, even in a relatively constrained situation, if retrofit is approached imaginatively. In this example, the single dwelling is converted into a family home for an extended multi-generational household. Poor quality garden space is transformed into an accessible home for an older couple, who will share kitchen and dining spaces with the family occupying the original house.

The reconfigured 'front' house can accommodate a family of up to six people, with a further two people living at the rear. The privacy of each family is maintained, but key activities such as eating meals bring them together as a household. These changes diversify the types of housing need that the neighbourhood can meet.

The rear extension is reduced so that the house sits in its own shadow. Small garden spaces are located where they will be well lit, and provide key habitable spaces with views, natural light, and convenient connections to outdoors, in particular for the older couple living at the rear. A green roof on the single storey extension provides more space for ecology and attenuates rainwater runoff.

The original house is extended into the roof-space, providing another bedroom or space for working from home. Generosity is created by opening up the ground floor of the dwelling, meaning that key spaces have light and views in two directions. Small changes to wall locations and floor levels increase accessibility throughout. Spatial variety is provided via the creation of a modest void at first floor level, which connects ground and first floor activities.

This adaptive retrofit improves the size, quality and connectedness of spaces, both inside and outside. It increases the capacity of the home, meeting a different sort of housing need, without increasing the need for parking, so that the front garden and the small pocket gardens to the rear can be ecologically diverse. By including renewables, fuel bills are considerably less for the household, and the project meets international decarb. targets.

Going further, if neither household requires a car in this city-centre location, the character of the street can be transformed and it becomes a valuable asset for amenity, ecology and community activity.

Mapping retrofit against the WFGA goals

as existing → landlord options appraisal

- → for sale
- → maintain/repair
- → retrofit / adaptation
- → demolish, newbuild

retrofit / adaptation

Retrofit is constrained by established character and scale of neighbourhood.

Provides an example of holistic improvement for similar situations, but is also bespoke due to the constraints.

retrofit / adaptation → project constraints → project benefits → wider benefits

Light retrofit, focused on decarbonisation

Through retrofit the project can meet international decarbonisation targets. CO_2 emissions reduced by 95% (vs 1990 levels). Any new embodied CO_2 can be offset through careful material choices.

Deep retrofit, for decarbonisation and affordable warmth

Fabric first is essential, to control fuel bills for residents in a low carbon future.

Renewables dramatically reduce fuel bills, making the home affordable to heat and keeping future occupants out of fuel poverty.

Adaptive retrofit, for decarbonisation, affordable warmth and quality homes

project constraints

The large quantity of similar dwellings across Wales means that replicable elements of retrofit can be used to develop local or national supply chains, along with a repeatable low carbon approach.

Small variations between dwellings of a similar type are particularly prevalent (due to dwelling age) and make local skills and resource use particularly important.

project benefits

Retrofit makes use of thermal mass to reduce overheating risk.

Dwelling has improved flexibility, making it more suitable, longer term.

Healthier construction and improved connections to high quality, useful outdoors spaces should improve the physical and mental health of residents, offering a better quality of life, and savings for the NHS.

The nature of the original building is respected and reinforced. New elements are distinctive, while respecting neighbouring properties. The project has a clear character.

wider benefits

By varying the house 'type', capacity of the home is increased. It caters for a different demographic, promoting a more diverse community. Spaces allow for home working and for an inter-generational households.

Changes to the rear of the property mean that the back, as well as the front, now has a character and sense of place.

Zero car use on site and new garden areas increase ecological value, and open up other possibilities for the 'street'. The project could provide valuable amenities for the wider community.

Light (systems led) retrofit only meets one WFGA goal (*a globally responsible Wales*). Typically it will increase fuel bills for occupants, with the potential to worsen fuel poverty.

Deep retrofit with a joint focus on decarbonisation and affordable warmth, as promoted by Welsh Government, requires that retrofit provides a pathway for zero carbon without increasing fuel poverty. However, it still meets only two of the seven WFGA goals in a meaningful way (*a globally responsible Wales* and *a more equal Wales*).

To meet all seven WFGA goals, retrofit must jointly address decarbonisation, affordable warmth and holistic quality. This requires creative thinking, and adoption of both a coherent retrofit standard and a flexible approach. The thinking of policy-makers, planners, landlords, designers and constructors must extend beyond the dwelling to consider the collective needs and aspirations of the wider community.

section 4:
Retrofit in practice and the RIBA Plan of Work

For this section of research, four practitioners contributed to a review of the retrofit process in practice. Each practitioner drew from their own experiences working in various roles on different retrofit projects over the course of their career.

Discussion began with the case study (described in section 3), and focussed on the RIBA Plan of Work 2020 (shown below) as a vehicle for describing and analysing the 'typical' retrofit process.

The participants collectively discussed and agreed on the particular challenges and opportunities that are commonplace in retrofit projects, and used the RIBA work stages to locate them along a retrofit timeline. Through discussion, they also identified opportunities to improve the retrofit process, in particular by streamlining the process and avoiding duplication of tasks, by minimising abortive work and risk, and through the provision of appropriate support and best practice, often project-specific guidance at key milestones.

Right: a linear process is central to the RIBA Plan of Work 2020, which defines development in terms of eight sequential stages. The description of each stage identifies key outcomes and core tasks, along with the information exchanged between stakeholders.

Over the following pages, retrofit in practice is described using the RIBA work stages. Each stage of retrofit is analysed in terms of the anticipated outcome (with reference to the supporting RIBA overview), the key stakeholders involved, and their associated tasks (in grey).

Challenges that often impact negatively on retrofit are shown in red, at the point in the timeline where they typically occur.

Opportunities to improve or inform retrofit are shown in orange, indicating the stakeholder affected.

Lessons learnt are shown in black. These findings, derived from the discussion of retrofit in practice, are described in more detail in section 5 - conclusions.

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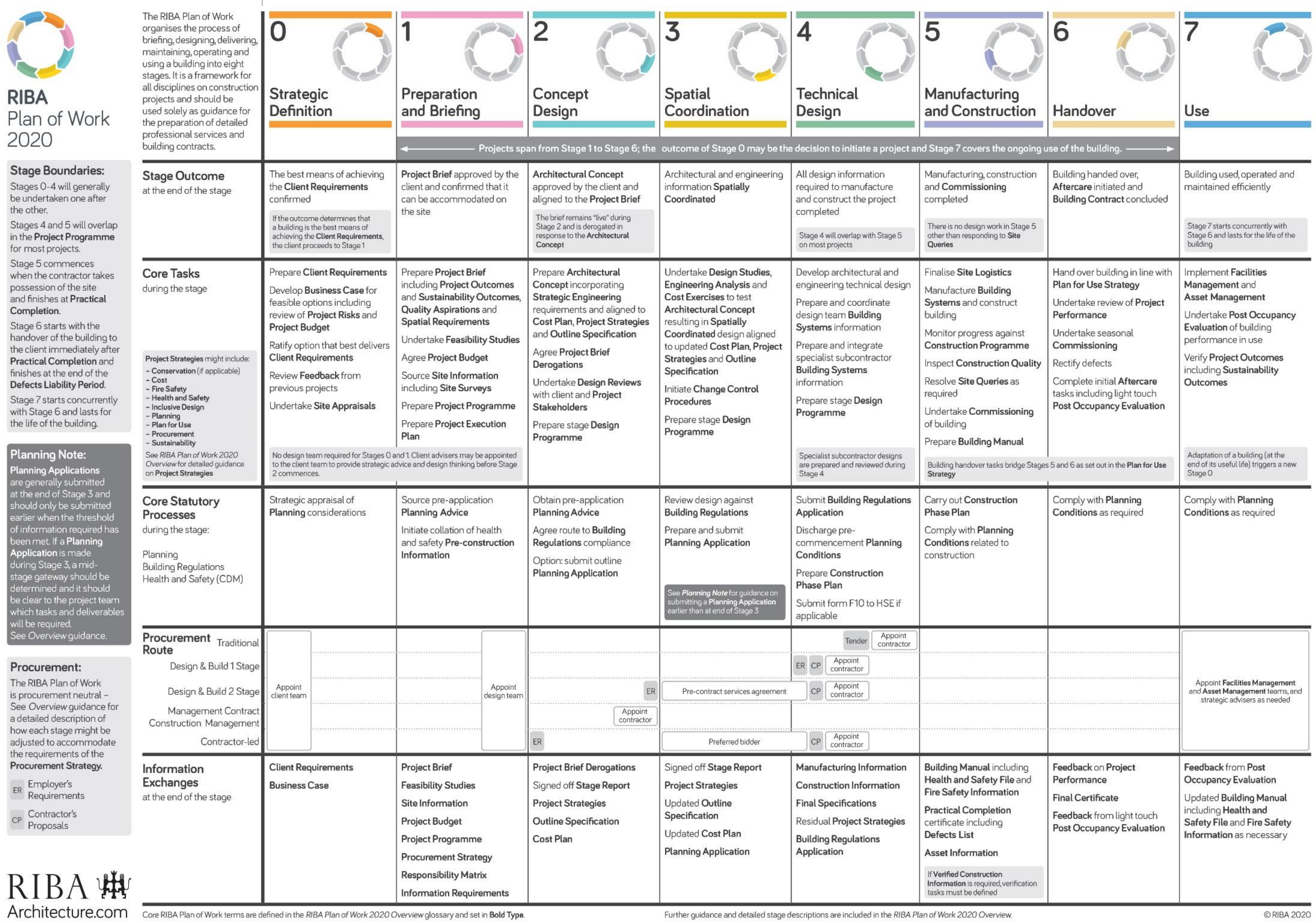

RIBA Plan of Work 2020

The RIBA Plan of Work organises the process of briefing, designing, delivering, maintaining, operating and using a building into eight stages. It is a framework for all disciplines on construction projects and should be used solely as guidance for the preparation of detailed professional services and building contracts.

Stage Boundaries:
Stages 0-4 will generally be undertaken one after the other.
Stages 4 and 5 will overlap in the **Project Programme** for most projects.
Stage 5 commences when the contractor takes possession of the site and finishes at **Practical Completion**.
Stage 6 starts with the handover of the building to the client immediately after **Practical Completion** and finishes at the end of the **Defects Liability Period**.
Stage 7 starts concurrently with Stage 6 and lasts for the life of the building.

Planning Note:
Planning Applications are generally submitted at the end of Stage 3 and should only be submitted earlier when the threshold of information required has been met. If a **Planning Application** is made during Stage 3, a mid-stage gateway should be determined and it should be clear to the project team which tasks and deliverables will be required.
See *Overview* guidance.

Procurement:
The RIBA Plan of Work is procurement neutral – See *Overview* guidance for a detailed description of how each stage might be adjusted to accommodate the requirements of the **Procurement Strategy**.
ER Employer's Requirements
CP Contractor's Proposals

Projects span from Stage 1 to Stage 6; the outcome of Stage 0 may be the decision to initiate a project and Stage 7 covers the ongoing use of the building.

	0 Strategic Definition	1 Preparation and Briefing	2 Concept Design	3 Spatial Coordination	4 Technical Design	5 Manufacturing and Construction	6 Handover	7 Use
Stage Outcome at the end of the stage	The best means of achieving the **Client Requirements** confirmed If the outcome determines that a building is the best means of achieving the **Client Requirements**, the client proceeds to Stage 1	**Project Brief** approved by the client and confirmed that it can be accommodated on the site	**Architectural Concept** approved by the client and aligned to the **Project Brief** The brief remains "live" during Stage 2 and is derogated in response to the **Architectural Concept**	Architectural and engineering information **Spatially Coordinated**	All design information required to manufacture and construct the project completed Stage 4 will overlap with Stage 5 on most projects	Manufacturing, construction and **Commissioning** completed There is no design work in Stage 5 other than responding to **Site Queries**	Building handed over, **Aftercare** initiated and **Building Contract** concluded	Building used, operated and maintained efficiently Stage 7 starts concurrently with Stage 6 and lasts for the life of the building
Core Tasks during the stage **Project Strategies** might include: – **Conservation** (if applicable) – **Cost** – **Fire Safety** – **Health and Safety** – **Inclusive Design** – **Planning** – **Plan for Use** – **Procurement** – **Sustainability** See *RIBA Plan of Work 2020 Overview* for detailed guidance on **Project Strategies**	Prepare **Client Requirements** Develop **Business Case** for feasible options including review of **Project Risks** and **Project Budget** Ratify option that best delivers **Client Requirements** Review **Feedback** from previous projects Undertake **Site Appraisals** No design team required for Stages 0 and 1. Client advisers may be appointed to the client team to provide strategic advice and design thinking before Stage 2 commences.	Prepare **Project Brief** including **Project Outcomes** and **Sustainability Outcomes**, **Quality Aspirations** and **Spatial Requirements** Undertake **Feasibility Studies** Agree **Project Budget** Source **Site Information** including **Site Surveys** Prepare **Project Programme** Prepare **Project Execution Plan**	Prepare **Architectural Concept** incorporating **Strategic Engineering** requirements and aligned to **Cost Plan**, **Project Strategies** and **Outline Specification** Agree **Project Brief Derogations** Undertake **Design Reviews** with client and **Project Stakeholders** Prepare stage **Design Programme**	Undertake **Design Studies**, **Engineering Analysis** and **Cost Exercises** to test **Architectural Concept** resulting in **Spatially Coordinated** design aligned to updated **Cost Plan**, **Project Strategies** and **Outline Specification** Initiate **Change Control Procedures** Prepare stage **Design Programme**	Develop architectural and engineering technical design Prepare and coordinate design team **Building Systems** information Prepare and integrate specialist subcontractor **Building Systems** information Prepare stage **Design Programme** Specialist subcontractor designs are prepared and reviewed during Stage 4	Finalise **Site Logistics** Manufacture **Building Systems** and construct building Monitor progress against **Construction Programme** Inspect **Construction Quality** Resolve **Site Queries** as required Undertake **Commissioning** of building Prepare **Building Manual** Building handover tasks bridge Stages 5 and 6 as set out in the **Plan for Use Strategy**	Hand over building in line with **Plan for Use Strategy** Undertake review of **Project Performance** Undertake seasonal **Commissioning** Rectify defects Complete initial **Aftercare** tasks including light touch **Post Occupancy Evaluation**	Implement **Facilities Management** and **Asset Management** Undertake **Post Occupancy Evaluation** of building performance in use Verify **Project Outcomes** including **Sustainability Outcomes** Adaptation of a building (at the end of its useful life) triggers a new Stage 0
Core Statutory Processes during the stage: Planning Building Regulations Health and Safety (CDM)	Strategic appraisal of **Planning** considerations	Source pre-application **Planning Advice** Initiate collation of health and safety **Pre-construction Information**	Obtain pre-application **Planning Advice** Agree route to **Building Regulations** compliance Option: submit outline **Planning Application**	Review design against **Building Regulations** Prepare and submit **Planning Application** See ***Planning Note*** for guidance on submitting a **Planning Application** earlier than at end of Stage 3	Submit **Building Regulations Application** Discharge pre-commencement **Planning Conditions** Prepare **Construction Phase Plan** Submit form F10 to HSE if applicable	Carry out **Construction Phase Plan** Comply with **Planning Conditions** related to construction	Comply with **Planning Conditions** as required	Comply with **Planning Conditions** as required
Procurement Route: Traditional / Design & Build 1 Stage / Design & Build 2 Stage / Management Contract Construction Management / Contractor-led	Appoint client team	Appoint design team	Design & Build 2 Stage: ER Management Contract Construction Management: Appoint contractor Contractor-led: ER	Design & Build 2 Stage: Pre-contract services agreement Contractor-led: Preferred bidder	Traditional: Tender, Appoint contractor Design & Build 1 Stage: ER, CP, Appoint contractor Design & Build 2 Stage: CP, Appoint contractor Contractor-led: CP, Appoint contractor			Appoint **Facilities Management** and **Asset Management** teams, and strategic advisers as needed
Information Exchanges at the end of the stage	**Client Requirements** **Business Case**	**Project Brief** **Feasibility Studies** **Site Information** **Project Budget** **Project Programme** **Procurement Strategy** **Responsibility Matrix** **Information Requirements**	**Project Brief Derogations** Signed off **Stage Report** **Project Strategies** **Outline Specification** **Cost Plan**	Signed off **Stage Report** **Project Strategies** Updated **Outline Specification** Updated **Cost Plan** **Planning Application**	**Manufacturing Information** **Construction Information** **Final Specifications** Residual **Project Strategies** **Building Regulations Application**	**Building Manual** including **Health and Safety File** and **Fire Safety Information** **Practical Completion** certificate including **Defects List** **Asset Information** If **Verified Construction Information** is required, verification tasks must be defined	**Feedback** on **Project Performance** **Final Certificate** **Feedback** from light touch **Post Occupancy Evaluation**	**Feedback** from **Post Occupancy Evaluation** Updated **Building Manual** including **Health and Safety File** and **Fire Safety Information** as necessary

RIBA Architecture.com

Core RIBA Plan of Work terms are defined in the *RIBA Plan of Work 2020 Overview* glossary and set in **Bold Type**.

Further guidance and detailed stage descriptions are included in the *RIBA Plan of Work 2020 Overview*.

RIBA work stages **0 - 1**	Project definition, preparation, briefing
outcome	Priorities are outlined. Key limitations are investigated. A Project Brief is produced by the client

key tasks

- Identify priorities and commitments
- Collect data: EPC, site survey, invasive building survey, utilities searches, planning constraints
- Draft brief
- Identify funding, budget and financial constraints

RIBA work stage **2**	Concept design
outcome	Key limitations are understood. A feasible concept is developed, aligned with the Project Brief and approved by the client.

key tasks

- Obtain advice on energy, agree brief and targets
- Develop concept proposal
- Draft cost plan / business case
- Seek pre-app planning consultation, if required.

Timeline, including key tasks and roles									Notes:
	Guidance should be available for clients that clearly outlines the retrofit process, roles and challenges. Links should explain relevant standards and targets.	Finding consultants with relevant expertise can be difficult. Government should subsidise consultants with expertise to build capacity + confidence.		some retrofit can be conducted within permitted development rights, simplifying the retrofit process, but… Permitted development rights often constrain retrofit options. Conservation area or listed building status may limit retrofit options further. Easements and boundaries add further risk to retrofit. Risk and uncertainty could be reduced by making utilities data available and reliable.	Government should make expert energy advice available and affordable. session#1	Affordable finance must be available. Grants would promote retrofit. Stamp duty could be adjusted for energy efficiency. Retrofit should be zero rated for tax.		Planning advice has become hard to reach + tends to be generic. Planning offices must be resourced better, so that advice is available + up to date, relevant for retrofit and responsive rather than generic.	
Client	Project inception, research by client	Client appoints lead designer		Client develops outline brief + budget	Agree targets	Draft cost plan / business case			…to RIBA stage 3
Architect / designer		Designer undertakes feasibility study		Collate constraints imposed by building context and policy	Develop concept design		Submit for pre-app consultation	Obtain feedback on pre-app	
Surveyor			desk-based surveys	in situ surveys					could be designer or contractor
Energy consultant					Early energy advice to inform strategic design				could be designer if they have appropriate training
CDM		CDM responsibilities explained to client							often the designer
Cost consultant				support with budget		support, cost plan			less likely to be involved in smaller projects
Planning / Conservation officers								Contact at pre-app is typically limited to email exchanges	
Highways officer								consultee	only on large projects affecting highways
SBD								consultee	only when creating new social housing

RIBA work stage **3**	Coordination of information
outcome	Key information describing the proposed retrofit is coordinated. Key applications are submitted for approval.

key tasks

- Develop the concept and advice obtained into a proposal.
- Consult with people who will be affected.
- Review Building Regulations compliance.
- Submit Planning, Listed Building Consent and SABs applications, as required.

RIBA work stage **4**	Detailed design
outcome	All information required to carry out the retrofit project is produced and distributed. Tenders are returned.

key tasks

- Obtain Planning and SABs approvals, as required.
- Obtain detailed advice on key aspects of the works, including energy and performance.
- Submit Building Regulations application.
- Produce and distribute tender package.

Timeline, including key tasks and roles		Designer should seek to improve quality by thinking holistically about retrofit potential.	Government should make expert energy advice available and affordable. session#2	Planning refusals add cost and time, and the risk deters applicants. Guidance should be available from planning officers to encourage retrofit. Advice should improve proposals, avoid wasting time and cost, and streamline the approvals process.		Government should make expert energy advice available and affordable. session#3	Designer should seek to improve quality by discussing detailing, materials construction. Embodied carbon and resource use should be part of a wider discussion.		Notes:
Client									…to RIBA stage 5
Architect / designer				submit for Planning, LBC and SABs approval if required.	obtain Planning, LBC and SABs approval if required.	Detailed design development	Produce tender documentation	Discharge pre-commencement planning conditions	
Engineer			Advice, input on SABs (if needed)				advice, Building Regs (SUDS, if needed)		
Energy consultant			energy advice to inform proposal, EPC			detailed energy advice: buildability and specification			could be designer if they have appropriate training
Contractor		advice					advice		Contractor may be involved pre-tender in an advisory capacity
Cost consultant			support with pre-planning costing				Pre-tender cost estimate. May run tender administration.		Particularly valuable to have cost input pre-tender
Party wall surveyor						Serve party wall notices	Any party wall issues to be resolved prior to commencement		
Planning / Conservation officers				Contact is typically limited to email exchanges	Planning officer to condition approval.			Discharge pre-commencement planning conditions	
Highways officer / SBD		advice	consultee			advice		Discharge any pre-commencement conditions	only on large projects / new social housing
Building control officer		advice				advice		Review of Building Regs application	Local Authority or suitable alternative
Ecologist			Advice, input on SABs (if needed)			advice	Support with tender documentation		only on large projects affecting ecology

RIBA work stage 5	Construction
outcome	Construction works undertaken and any commissioning completed.

key tasks

- Appoint a contractor
- Review and finalise scope of works.
- Commence works on site, beginning with any enabling work.
- Periodic inspections by Building Control.
- Discharge of any relevant planning or LBC conditions.

RIBA work stages 6-7	Handover and use
outcome	Contract concluded. Building handed over with aftercare such that the building can be used, operated and maintained effectively.

key tasks

- Complete works on site to client satisfaction.
- Comply with pre-occupation conditions.
- Building Regulations signoff.
- Provision and review of building manual.
- Post completion review and lessons learnt.

Timeline, including key tasks and roles	High tender returns may break budgets,. Costs will be driven up by a shortage of skilled contractors and labour, and by use of non standard materials and techniques.	Designer should seek to ensure quality through their continual involvement in works	Work to be done by all parties to minimise the performance gap and meet the specification.	Unknowns and unanticipated issues will inevitably add to cost and time, and threaten the success of the project . A material benefit of reducing the cost of retrofit (e.g. zero rated VAT) is a bigger contingency fund to make projects more resilient to risk.		Incomplete information at handover leads to poor operation and mistakes in future use. Manual must be clear about constraints on future use and adaptation, product lifespan, correct maintenance and servicing regimes and procedures.	Government should make expert energy advice available and affordable. session#4	Lack of available expertise for future servicing maintenance and repairs.	Notes:
Client	Work starts on site					Handover		Ongoing use, future repair, maintenance and improvement	Project concluded.
Architect / designer	Briefing new parties, toolbox talks					signoff, manual	Lessons learnt		May conduct contract administration
CDM	Ongoing monitoring, construction stage CDM plan					signoff, manual			
Energy consultant							Post completion energy consultation. Feed learning back.		could be designer if they have appropriate training
Contractor						Handover	Lessons learnt		
Cost consultant									May conduct contract administration
Planning / Conservation officers					Discharge pre-occupation planning conditions				
Highways officer / SBD					Discharge any pre-commencement conditions				only on large projects / new social housing
Building control officer		Periodic site visits			Building Regulations signoff				Local Authority or suitable alternative

Reasons to retrofit: decarbonisation and affordable warmth

Recent changes to the cost of energy have dramatically increased fuel bills for everyone, and are likely to push many more households into fuel poverty. Holistic retrofit of all homes should be a priority, not just those rated EPC D to G. However cost, complexity and uncertainty all discourage retrofit, particularly of older homes and more complicated situations. Homeowners and landlords need to be made aware of the reasons to retrofit (see figure below) and incentivised to do so.

Standing charges are now considerable, and represent an increasingly significant proportion of energy costs (particularly for more efficient homes). The financial benefits of moving to a single fuel source for heat incentivise decarbonistion. However, light retrofit for decarbonisation (replacing conventional fossil fuel heating systems with low carbon - typically electric – sources of heat) is likely to increase fuel bills and consequently fuel poverty.

Deep (fabric first) retrofit without renewables can decarbonise without increasing fuel costs for the bill payer. However the sequence of works must be planned carefully, or the transition to electric heat will still be seen to increase fuel bills. Deep retrofit with renewables can dramatically reduce fuel bills, keeping households out of fuel poverty as energy costs rise.

Renewables combined with storage (typically PV with batteries) further reduces fuel bills. Such retrofit can potentially bring equity by bridging the performance gap between newly built and retrofitted homes. Storage also reduces pressure on energy infrastructure, which will be increasingly important as the scale of decarbonisation increases.

All seven WFGA goals will not be met by retrofit that focuses exclusively on improving energy efficiency, reducing fuel bills and decarbonising, but providing affordable warmth can be prioritised.

landlord options appraisal

- **for sale** → Most straightforward option for landlord. Generates ££ for another project. Passes the problem to someone else. Makes a positive outcome less likely to happen.
- **maintain / repair** → Business as usual, minimises impact, costs are known. Delays resolution of the problem for 10-15 years. No real benefits for users or wider community. Costs more long term.
- **deep retrofit** → Complex situation may require expertise. Costs more short term. May improve character / sense of place. Provides learning for similar situations. On-site decant unlikely to be an option.
- **adaptive re-use** → Requires specialist input. Costs more short term. Opportunity to change character / sense of place / demographic. Provides a blueprint for improvement of similar situations. On-site decant unlikely to be an option.
- **retrofit with newbuild** → Allows for increases in density / changes in use. Newbuild element may improve value for money. Opportunity to improve character / sense of place / community. On-site decant may be an option.
- **demolish, newbuild** → Opens up other development options. Reduces risk (and potentially cost) for contractor and landlord. Wastes the carbon, history, resources in existing buildings. On-site decant is not an option.

Reasons to retrofit: going further and compliance with WFGA

Some homes and neighbourhoods are compromised by issues that will not be addressed by a retrofit designed solely to improve energy efficiency, reduce fuel bills and decarbonise. The directive to decarbonise can (if not managed carefully) override other, sometimes more important, concerns. Retrofit that goes beyond improving performance may fundamentally improve the quality and value of the home, whether that quality be spatial, functional, cultural, economic or experiential.

Retrofit can simultaneously decarbonise, increase quality and improve performance (reducing fuel bills). Some of this work can be done within Permitted Development rights. Permitted development rights present opportunities to incentivise retrofit, enabling homeowners to carry out retrofit that increases the quality and value of their home, while also meeting international targets. Work needs to be done linking these opportunities.

However retrofit options are constrained for many homes (typically by the planning system), limiting opportunities to improve quality and value. The conservation of historic character or period features is a common constraint, limiting retrofit options for many street frontages. In contrast 'backs' tend to be less constrained, so long as they are not visible from the public realm. As a result, some flexibility of approaches is needed, even for retrofit of an individual dwelling. In more constrained situations, recognising and realising opportunities to improve quality requires more specialist input.

As the operation of homes is decarbonised, more attention will be paid to embodied carbon (typically 10-15% of lifetime carbon). Retrofit provides the possibility of much lower carbon intensity decarbonisation than demolition with newbuild. Lower carbon intensity retrofit requires coordination and a skilled supply chain. Retrofit should be used to build the resources, skills and supply chain needed for successful decarbonisation, at a local level.

The need to decant residents is a real constraint. Retrofit that goes beyond repair, maintenance and simple replacement usually requires decant. This should be considered when developing retrofit strategies, for example by coupling retrofit with newbuild.

Housing providers will have difficulty comparing the relative merits of different retrofit options, as there are many complex factors and implications to consider (see options appraisal, below left). Tools must be developed to help both homeowners and landlords make better decisions. Support must be provided so that harder to treat properties are improved, not neglected and offloaded or left vacant. Improving the quality of our homes, and tapping into opportunities to make changes that improve their usefulness and long term value, is an important part of successfully decarbonising the housing stock as a whole.

Left: appraisal of the development options typically available to social housing landlords, along with headline benefits (in black) and disadvantages (in red).

The potential improvement of quality and value could be a catalyst for retrofit of homes in the private sector, particularly when this can be achieved within permitted development rights (see previous section). For this to happen, retrofit that improves quality of the home needs to be linked to retrofit to decarbonise and improve energy efficiency, with useful guidance on implementation and cost, and clear explanations of the benefits that can be achieved.

Understanding energy performance is an essential part of the retrofit process, in particular the impact of retrofit on fuel bills. Presently, energy modelling tends to happen late in the retrofit process, and not in a way that informs the work being carried out. Clear understanding of impact on fuel bills could incentivise more retrofit in the private sector.

The RIBA Plan of Work 2020 is described as “the definitive model for the design and construction process” (RIBA, 2021). It is used almost universally throughout UK industry to map the business of commissioning, designing, procuring and delivering built works, and its eight distinct work stages form the basis for the appointment of many consultants including architects. The Plan provides a linear template for the design and construction process. It necessarily breaks down the complex and lengthy process of undertaking multi-million pound construction projects into more manageable workstages. It anticipates that early strategic work undertaken by a small focused team in a strategic way leads to an increasingly extensive team of specialists along with an incremental increase in the level of detail and information provided.

This incremental, linear model does not promote efficient or robust domestic retrofit, which is reliant on as much information as possible being available from the outset. Relatively small details or specialist input which may emerge late in the process promoted by the RIBA Plan of Work can completely change the scope of a retrofit, resulting in abortive work, increasing project time and cost, along with the potential for project failure.

A Plan of Work better suited to domestic retrofit would be more collaborative from the outset. It would encourage design and construction professionals to work together to understand the client’s needs and agree project aims at the outset. They would then collaboratively explore opportunities to improve quality, obtaining the information needed to make key retrofit decisions with confidence. The process would be cyclical rather than linear in nature, and should incorporate clear targets, cost and energy modeling at key stages along the way.

There are a number of roles for governance in creating a more suitable context for successful retrofit. Centrally provided, freely available guidance that explains retrofit opportunities to homeowners and landlords would inevitably increase the amount and quality of retrofit, particularly in an economic climate where fewer people are moving home, and more are seeking to improve the quality and value of their property. It is important that such advice comes from a public body without commercial bias. The guidance should outline a legible, streamlined retrofit process and describe both the benefits and the challenges clearly so that retrofit is undertaken from an informed position.

Government-led coordination of an energy efficiency consultancy service for retrofit could, if aligned with the promotion of funding for energy efficiency measures, pump-prime and de-risk retrofit. Such a service could deliver best practice advice through access to exemplar case studies and useful, project-specific guidance (including energy modelling) at the right points in the retrofit process. This would increase confidence in the value of retrofit, diminishing risk in a notoriously risk-heavy area of construction, and reducing the likelihood of project failure.

The planning process presents a major source of risk for many retrofit projects, particularly if retrofit is to increase the property value. Permitted development rights enable some works, but the extent of permitted work can be ambiguous. Currently it is difficult, often impossible, for homeowners or designers to access meaningful advice on planning matters, partly because every retrofit is different and, as identified, truly successful retrofit requires an approach that is both creative and contextual.

Local Authorities could considerably reduce risk and uncertainty in retrofit by providing affordable access to advice, on a project by project basis. However this would require a considerable increase in the resourcing of Local Authority planning departments. It would also benefit from closer collaboration between Planning, Building Control and other consultees of the planning process.

Our understanding of embodied carbon is in its infancy. While some tools for measuring and reporting on embodied carbon exist they are not in widespread use, and more work is needed to develop a consistent and coherent methodology if embodied carbon is to be considered as seriously as operational carbon.

Central government, Local Authorities or professional accreditation bodies could make retrofit more attractive and cost-effective by supporting or incentivising collaboration between retrofit designers and constructors. If design and construction services were offered in a joined up way, either through a one-stop-shop or a partnering approach, there would be less abortive work, shorter retrofit programmes, and better decision making right through the process.

When it comes to the implementation of low carbon retrofit, there is a skills shortage pervading all aspects of the industry that must be addressed. Training and product development and testing are needed now, if there is to be capacity to deliver retrofit at the scale needed in the near future.

The British Standard for Retrofitting Dwellings (PAS2035) outlines how retrofit projects should be managed and delivered. It provides a specification that any publicly funded retrofit should comply with, and outlines the Retrofit Coordinator role as “a specialist project manager, taking overall responsibility for overseeing the assessment of dwellings, the identification, specification, inspection and evaluation of energy efficiency measures for installation at a given dwelling as a single project, and their subsequent monitoring and evaluation.” (PAS2035, 2019)

With specialist support, for example in energy modelling, it may be the case that Retrofit Coordinators as described by PAS2035 are capable of managing a retrofit focused explicity on achieving decarbonisation and maintaining affordable warmth. However it is not clear that Retrofit Coordinators have the expertise needed to deliver creative, contextual retrofit - retrofit with a combined focus on decarbonisation, affordable warmth and the provision of quality homes. The skills needed to do so are consistent with the core skills of the Architect, as outlined by the professional bodies ARB and RIBA.

A mechanical approach to retrofit (as advocated by PAS2035) is more likely to miss the opportunities to improve quality and value that should incentivise retrofit in the first place, and less likely to result in retrofit that meets the needs of current and future generations.

Careful retrofit of a terraced house by Wilkins and Witham (2019) reorganized internal spaces to improve operation of the home. The adaptation employs sustainable, breathable materials, natural light and new views to improve quality and create a healthy home.

section 6:
References

(in order of appearance)

The secret garden flat by Nic Howett Architect (2023) Photography by Henry Woide https://nla.london/news/dont-move-improve-2023-winners-announced

Homes for Today and Tomorrow (MHLG, 1961) https://archive.org/details/op1266209-1001/page/n27/mode/2up

Welsh Housing Conditions Survey (WHCS) 2017-18 (2018) https://www.gov.wales/welsh-housing-conditions-survey

The Wellbeing of Future Generations (Wales) Act https://www.futuregenerations.wales/

London Energy Transformation Initiative (LETI) *Climate Emergency Design Guide* (2017) https://www.leti.uk/cedg

London Energy Transformation Initiative (LETI) *Climate Emergency Retrofit Guide* (2021) https://www.leti.uk/retrofit

the *Zero Carbon Homes* report, Wood Knowledge Wales (2021) https://woodknowledge.wales/zero-carbon-homes/

The Wildlife Trust, *Homes for People and Wildlife* (2018) https://www.wildlifetrusts.org/sites/default/files/2018-05/homes_for_people_and_wildlife_lr_-_spreads.pdf

LILAC cohousing scheme in Bramley, Leeds by Agile Homes (formerly White Design, 2013) https://www.lilac.coop/ https://agile.property

BRE, *The Full Cost of Poor Housing* (2016) https://bregroup.com/buzz/the-full-cost-of-poor-housing/

Modern Mews retrofit, London by Phil Coffey Architects (2016) https://www.coffeyarchitects.com/modern-mews

Homes of Today for Tomorrow Stages 1-4 https://orca.cardiff.ac.uk/id/eprint/115442/

London Housing Design Guide https://www.london.gov.uk/sites/default/files/interim_london_housing_design_guide.pdf

Design Commission for Wales, *Places for Life 2* (2020) https://dcfw.org/wp-content/uploads/2021/01/Small-Places-For-Life-2-Digital-4MB.pdf

Mount Pleasant Studios sheltered housing for homeless people, Camden, London by Peter Barber Architects (2014) http://www.peterbarberarchitects.com/mount-pleasant photographs copyright Morley von Sternberg

RIBA *Plan of Work 2020* and overview (2021) https://www.architecture.com/knowledge-and-resources/resources-landing-page/riba-plan-of-work

PAS2035: Retrofitting dwellings for improved energy efficiency – Specification and guidance (2023) https://retrofitacademy.org/wp-content/uploads/2023/10/PAS2035_2023.pdf

Retrofit of a terraced house by Wilkins and Witham (2019) photos courtesy of the designer.