SOLID WALL INSULATION
Unlocking Demand and Driving Up Standards

A report to the Green Construction Board and Government
by the Chief Construction Adviser
Peter Hansford FREng

November 2015

HM Government
Chief Construction Adviser

Cover: External insulation to social housing block

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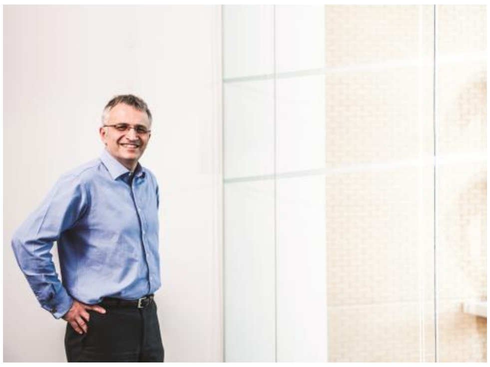
Foreword

By Mike Putnam, Co-Chair of the Green Construction Board



The UK has a legally binding commitment to reduce carbon emissions from 1990 levels by a massive 80% by 2050. Accordingly, the Construction 2025 strategy has set the ambition of achieving a 50% reduction in emissions across the built environment by 2025.

We need to find a myriad of ways to meet these targets. Given that there are around 26 million existing homes in the United Kingdom and over eight million of these with solid walls, adopting solid wall insulation as a solution for much of our existing housing stock makes good business sense.

The Green Construction Board commissioned Peter Hansford to carry out this review. Its purpose is to leverage the latent possibilities in the construction industry to unlock innovation and increase demand for solid wall insulation.

I urge industry and Government to study the recommendations made by Peter Hansford and to grasp the huge business opportunities inherent in them. Measures such as ‘taking a co-ordinated and holistic approach to solid wall homes’ and ‘accreditation of assessors and qualified installers’, when implemented, will reap sustainable ways of achieving a greener environment.

Lastly, I wish to thank Peter Hansford and all of those who contributed to this report.

Mike Putnam
Chair, Green Construction Board
November 2015

Applying wet trades

Executive summary

There are around 26 million existing homes in the United Kingdom and over eight million of these have solid walls. Solid Wall Insulation (SWI) is an important measure available to be deployed for improving energy efficiency and reducing greenhouse gas emissions with these properties.

Benefits derived from treating properties with SWI, in addition to the carbon reduction benefits, include:

- improving comfort, health and wellbeing;
- supporting fuel security by reducing overall energy demand;
- addressing fuel poverty;
- improving fabric and reducing maintenance costs;
- regenerating neighbourhoods; and
- contributing to GDP and tax revenues.

The economic case for the energy efficiency of the UK housing stock is also strong.

However, current demand for SWI is depressed for a variety of policy and technical reasons. At the same time, SWI has developed somewhat of a poor reputation due to numerous examples of inadequate installation and poor workmanship. If SWI is to be promoted as an effective retrofit solution, these areas need to be addressed with urgency.

The Green Construction Board is therefore keen to see increased demand for SWI and better standards of design and installation, so as to significantly reduce carbon across the domestic sector of the built environment.

Government policy impacting SWI has often lacked consistency, which appears to have resulted in a degree of confusion and misunderstanding, particularly by homeowners. Similarly, the stop-start nature of policies and funding streams has resulted in a shortage of industry investment in this area.

With so many property archetypes existing, there is no single solution that would apply to all properties. This adds to the confusion by householders of what is the correct solution for their individual properties.

External insulation to social housing block (before and after)

To make matters worse, the building physics for some types of property is not widely nor perhaps fully understood. This has resulted in many instances of an incorrect solution having been applied, which in some cases has caused damp, mould or poor air quality. Little wonder then, the reluctance of homeowners to spend money retrofitting their properties if the outcome cannot be assured.

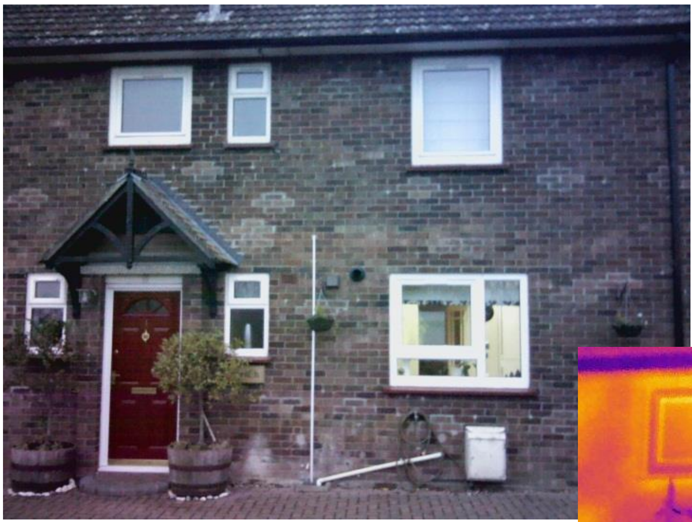
To overcome these problems, a higher level of expertise is needed in assessing the correct solution for a particular property and in ensuring that it is installed properly.

The top 12 domestic property archetypes in the UK account for approximately 15.5 million homes. They represent around 60% of the total UK housing stock and 57% of its greenhouse gas emissions. Of these 15.5 million homes, around 3.5 million (some 23%) are suitable for SWI. SWI therefore has the potential to benefit a significant number of homes and play a key role in reducing greenhouse gas emissions from the UK domestic housing stock.

From this group of 3.5 million homes suitable for SWI, 75% are owner occupied (2.6 million); 10% are owned by Local Authorities or Housing Associations (340,000); and 15% are private rented (550,000). Nearly 1.2 million of these homes (34%) are categorised as containing ‘vulnerable households’.

This report offers recommendations to address the issues above, and proposes:

- Taking a co-ordinated and holistic approach to insulating solid wall homes;
- Policy measures which Government may wish to consider;
- Focusing research on areas that are not fully understood;
- Review and revision of standards and measures for statutory compliance;
- More robust accreditation of assessors and qualified installers;
- Development of guidance for assessors, designers, supervisors and customers, in language appropriate to themselves;
- The role of a Retrofit Co-ordinator;
- An awareness campaign with a simple message, so as to increase uptake;
- The creation of a Retrofit Hub as a technical centre of excellence; and
- Leadership arrangements for making these recommendations happen.



Thermal images showing heat loss

This is my independent report to the Green Construction Board and Government. I look forward to seeing their responses to my recommendations. However, I am aware that work is already underway in Government to address some of the issues that I have raised in this report. And I believe that industry can take early action to play its part in addressing others, without necessarily waiting for Government's response.

I look forward to seeing an increase in the use of SWI as an effective retrofit solution, and to a dramatic improvement in the way in which it is installed and its quality assured.

External insulation to a rear elevation

External insulation in progress to high-rise block

1. Introduction and purpose

This report is addressed to the Green Construction Board and to Government.

It covers:

- what more might be done to unlock demand for Solid Wall Insulation (SWI) in domestic properties;
- how to improve its affordability; and
- how to increase its attractiveness as a solution.

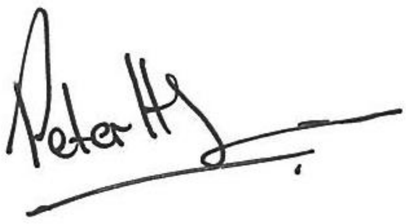
In Section 2, I describe my understanding of the background to this review. I set out my findings in Section 3, based on written and oral evidence that I have received. And I summarise my recommendations in Section 4.

Finally in Section 5, I outline my suggested next steps for taking my recommendations forward.

Annex A includes a table of property archetypes and ownership categories that have formed the basis for my analysis.

Annexes B and C list those parties and individuals who have contributed to this review by submission of written and oral evidence respectively. Finally, in Annex D, I acknowledge assistance that I received during the course of this review.

I am grateful for the guidance and support provided to me by members of the steering group and the secretariat. That being said, I take full responsibility for the expressions of opinion, stated findings and recommendations contained in this report.



Peter Hansford BSc MBA HonLLD FREng FICE FAPM

Government Chief Construction Adviser
November 2015

Air tightness testing

2. Background to review

Of the circa. 26 million homes in the United Kingdom, some eight million have solid walls and consequently, if insulated, will need solid wall insulation (SWI). Most of these are homes built before 1919, together with many of the 'system built' homes built between the 1920s and 1970s. Little SWI was undertaken in the UK prior to 2008. This is in contrast to continental Europe where some SWI installations are now over 50 years old.

Improvement to the insulation levels within homes in the UK has focused on the lower cost measures of cavity wall insulation and loft insulation. This has resulted in, by April 2012, 13 million homes having had cavity wall insulation installed and 14.8 million homes having had loft insulation greater than 125mm thick installed. By this date only 132,000 solid wall homes had been insulated – less than 2% of all solid wall homes – and most of these were in the social housing sector.

Marking a rapid expansion of capacity and activity, 77,000 solid wall homes were insulated between April 2012 and July 2013, driven by the Government's Energy Company Obligation (ECO) policy. Since the Government's announcement in Autumn 2013 to reduce the level of ECO funding support, installation of SWI has reduced.

As part of the Coalition Government's industrial strategy, *Construction 2025*[1] – issued in July 2013 in partnership with industry – the Green Construction Board (GCB) was tasked with the development of market and technology based plans to secure the jobs and growth opportunities from driving carbon out of the built environment. In late 2014, in considering its forward programme for the next two years, the GCB was keen to address the domestic retrofit sector in recognition of the 25% of carbon emissions resulting from that sector.[2] It identified SWI as a particular technology warranting further and urgent consideration.

At its meeting on 11 February 2015, the GCB commissioned me, as Chief Construction Adviser, to carry out a review of SWI. I was tasked with considering what more might be done to unlock demand for SWI, improve its affordability and increase its attractiveness as a solution.

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[1] *www.gov.uk/government/uploads/system/uploads/attachment_data/file/210099/bis-13-955-construction-2025-industrial-strategy.pdf*

[2] *www.gov.uk/government/uploads/system/uploads/attachment_data/file/295968/20140327_2013_UK_Greenhouse_Gas_Emissions_Provisional_Figures.pdf*

There is a direct linkage to the Major Projects Authority's annual review of policy effectiveness, in this case the Department of Energy and Climate Change (DECC)'s Household Energy Efficiency Policy. Additionally, there have been numerous reports that have addressed the effectiveness of Government policy on domestic energy efficiency, including the work of the Valuation and Demand work-stream of the GCB.

GCB members Rob Lambe (Willmott Dixon) and Lynne Sullivan (SustainableByDesign) supported me as a steering group to the review. Jane Manning of the Department of Business, Innovation and Skills (BIS) provided secretariat services.

My review has received strong support from DECC, the Department for Communities and Local Government (DCLG) and BIS. Throughout the review, my team and I have liaised closely with officials from DECC and DCLG, but we have remained independent from the direction and policy of these departments.

I issued a Call for Evidence on 16 March 2015, with an invitation for written evidence to be submitted by 24 April 2015. I subsequently extended this to 1 May 2015. The content of the written evidence varied from general papers to customised submissions. A list of the contributors of written evidence is included in Annex B to this report. Following close consideration by the steering group, I invited a number of parties to meet me and/or my team to provide oral evidence. A list of those parties providing oral evidence is included in Annex C to this report.

Following formulation of my draft findings and recommendations, I invited a cross-section of industry players to join me in a round table discussion meeting on 23 September 2015. I used this to validate my findings and to secure support of my recommendations from key industry stakeholders, before publishing this report.

On 23 July 2015, DECC announced that the Government had commissioned an independent review led by Dr Peter Bonfield OBE FREng to look at standards, consumer protection and enforcement of energy efficient schemes and ensure that the system properly supports and protects consumers. I have met with Peter Bonfield to ensure that our respective reviews are complementary.

CASE STUDY – SOLID WALL INSULATION – Llandysul, West Wales

Overview:

The Beeches Estate in Llandysul, West Wales, consists of 105 properties; a third of these are privately owned and the remainder are owned by Tai Ceredigion and Cantref Housing Association. The estate comprises a mix of 2-bed bungalows and 3-bed semi-detached homes which are off the gas grid and of hard-to-treat wall construction.

As part of the Welsh Government's ARBED (meaning 'Save') initiative, procured through an open tender, Willmott Dixon Energy Services worked in partnership with Ceredigion County Council on a programme of energy efficiency measures which included external wall insulation (EWI), loft insulation, draught proofing, boiler upgrades, central heating controls and associated enabling works.

Project and technical description:

A detailed technical assessment was completed on each property before any work started to identify the most appropriate energy efficiency measures, inform the detailed design and identify the enabling works. Quality and attention to detail were critical. The area is known for its cold, wet and windy weather and it was suspected that the cavity wall insulation in some of the properties had already failed.

The EWI system designer, Solix, identified the appropriate standard details for each property. They developed bespoke details and produced drawing packs which ensured the installation contractor knew exactly what to do.

The source of the cavity wall failure was traced to leaking concrete gutters so these were replaced. Measures, including extending roof lines, were taken to ensure good weather-tightness. Continuity of insulation was ensured with the potential thermal bridges and thermal bypasses addressed. The site management team, supported by the system designer, ensured that the installation was of a high quality.

Following an unannounced site visit **Colin King**, one of the UK's foremost experts on refurbishment and Director of BRE, said: *"A well thought-through scheme, with the careful selection of correct products and a level of quality control on site I have rarely encountered."*

The Beeches, a typical 3-bed semi-detached property before the works

The Beeches, a typical 3-bed semi-detached property after the works

Comments made by the local community:

Emma C said: *"My house was always cold even if my heating was on full it still had a really bad chill. Even my young children have noticed a difference, they can wear pyjamas after bath time."*

Nammo said: *"Heating-wise we spent a lot of money on coal. We couldn't have the fire out at all even in the summer months because it was very cold in the evening but now we don't have to have the fire on at all."*

Typical Improvements:
EPC before works E48, after D61
Lifetime carbon saving – 50t CO_2
Annual fuel saving - £220

CASE STUDY – SOLID WALL INSULATION – London Borough of Havering

Overview:

On behalf of the London Borough of Havering Willmott Dixon Energy Services have been improving the energy efficiency of their non-traditional housing stock. The contract was procured via Places for People's Green Services Hub.

The scheme consisted of over 300 non-traditional construction homes including: Unity, Wates, Cornish type 1 & 2, Orlit, Stent, Scottwood and Wimpey No Fines. Measures included: external wall insulation (EWI), high performance windows and doors (bringing elements of the planned maintenance schedule forward), flat roof and mansard roof insulation, external repairs, roofing repairs, central heating upgrades and asbestos removal.

Project and technical description:

External wall insulation is a common technique for improving home energy efficiency. However its application can present problems if detailing is overlooked, particularly in non-traditional homes. Willmott Dixon carried out a structural survey on an initial 10% of homes to determine if structural repairs would be necessary as part of the works. Each archetype underwent a detailed technical assessment to determine the appropriate system and identify the most appropriate way to ensure performance.

Industry standard approaches would have left many thermal bridges and thermal bypasses unmitigated. The system supplier, Weber, addressed the majority of these with bespoke approaches including thermal bridge behind the fascia up to the wall plate and the lower section of the tiled gable on the Wates; around the pressed steel window reveals on the BISF; below the starter track on all properties; and between the ground floor EWI and the mansard on the Cornish 1. Thermal bypasses requiring treatment included: the cavity on the Orlits and behind the framed insulations solution on the Cornish type 2. Since a proportion of older double glazed windows did not have trickle vents these windows were changed as part of the works to ensure good indoor air quality.

The system designer developed detailed drawing packs for each archetype so that the installation contractor knew exactly what was intended. The site management team ensured that the installation was of a high quality. Details and lessons learned were included in Willmott Dixon's EWI book, so that best practice could be shared across all of its sites.

A BISF type system-built home from the 40s externally insulated alongside its neighbour

An Orlit type system-built home after external wall and roof insulation

Mary K, pensioner, described what the scheme meant to her: *"When a woman has a facelift, she looks good, she feels good, that's how I feel with this house. It looks good and the glowing inside is the energy I am saving."*

Colin King, one of the UK's foremost experts on refurbishment and Director of BRE said: *"Unfortunately, at the moment, the evidence of bad practice far outweighs the evidence of good practice. What we need to do as an industry is up the game. In Havering, there is good quality control and robust checking."*

Typical Improvements:
EPC before work D61, after work C71
Lifetime carbon savings - 30t CO_2
Annual fuel saving - £270

3. Findings

I have grouped my findings into six themes: policy & general; approach; technical; expertise; capacity; and knowledge & awareness.

Policy and general

3.1 A significant finding of this review is a clear endorsement from all parties that I have spoken to that SWI is a key area to be addressed. It has a strong carbon reduction case; in addition SWI can deliver the following identified benefits:

Comfort, health and wellbeing

- improved resident comfort;
- resultant health benefits;
- reduced or eliminated condensation and mould, which lead to respiratory problems;
- reduced number of winter deaths and hospital admissions;

Supporting fuel security

- reduced energy demand;

Addressing fuel poverty

- reduced utility bills;
- resultant reduced risk of fuel poverty and number of vulnerable households;
- for rented properties, resultant reduced risk of rent arrears;

Fabric and maintenance

- improved fabric condition;
- lower maintenance costs;
- reduced call outs from issues related to cold homes;

Neighbourhood and regeneration

- improvement to streetscape and estate regeneration, provided design is effectively considered;
- increased property desirability;

Contribution to GDP and tax revenues

- increased ease of letting;
- increased asset value;
- increase in VAT revenue from insulation activities;
- increase in employment in insulation and associated trades.

3.2 In addition, the economic case for investment in the energy efficiency of the UK housing stock is strong.[3 4]

3.3 I have found a strong demand for consistency of Government policy and incentives. Lack of long-term consistency in the past has apparently resulted in confusion and misunderstanding. Moreover, the perceived stop-start nature of many policies has resulted in reluctance by many in the industry to invest in manufacturing capacity and skills development.

3.4 Seasonal misalignment in funding-windows has similarly caused problems. By this I mean the availability of funding has, on occasion, driven the installation of external cladding during inclement seasons, rather than at a more conducive time of year from a weather viewpoint. This pressure would be alleviated by the creation of longer-term funding availability-windows or policy drivers.

3.5 I have explored the restrictions experienced by social landlords on their ability to adjust rents to allow an acceptable return on investment for the retrofitting of solid wall insulation, whilst still reducing total outgoings of the tenant. I have found that this is normally not possible due to the rent cap formula in England. I note that this is not the same in Wales, where there is a different rent formula.

3.6 Similarly, I have explored the extent of incentives available to private landlords and owner-occupiers.

3.7 I have also noted the influence that Planning authorities have in encouraging the right solution for the right property and ensuring that a proportionate planning response is applied. I note that Permitted Development Rights have a role to play in this area and found that inconsistent application across the UK has caused delay to retrofit schemes and frustration to landlords and homeowners.

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[3] *Building the Future: The economic and fiscal impacts of making homes energy efficient: Verco/Cambridge Econometrics: October 2014.*

[4] *The Customer is always right: Putting consumers back at the heart of UK energy policy: Policy Exchange.*

Approach

3.8 The importance of a 'whole-house', rather than a piece-meal approach, is clear. That is not to say that all properties have to be subjected to a whole-house retrofit solution as a single exercise. Rather, the point is that properties should be assessed on a whole-house basis and the retrofit measures should be planned over the medium-term in a manner that does not later preclude the addition of further measures. For example, solid wall insulation measures should take cognisance of the possible need to install ventilation equipment, and the separate need to replace doors and windows (possibly at a later date).

3.9 'One size does not fit all' when it comes to SWI solutions. My finding is that there is a need for a typological approach, which considers property archetypes and categories of ownership. This should also take into account special circumstances such as historic and listed buildings and properties more exposed to weather extremes (such as coastal properties). Further, the issues and risks surrounding internal wall insulation and external wall insulation are quite different and therefore need to be considered separately. I have included an initial analysis of property archetypes and ownership categories in Annex A of this report.

3.10 As with the segmentation of SWI solutions, guidance should be targeted at different audiences – assessors, designers, installers and customers – rather than targeted at a universal audience, many of whom would find parts of that guidance irrelevant or at an inappropriate level of technical detail.

Technical

3.11 Some technical areas are not yet widely (or even fully) understood for certain property archetypes, notably those relating to moisture control. Building physics research should be targeted on the less-understood situations and archetypes. SWI solutions in these circumstances should only be carried out where and when acceptable solutions have been determined, and be undertaken with great care and following a detailed assessment of the appropriate technical solution.

3.12 It is clear to me that correct specification, detailing and proper installation is paramount. I have been shown many examples of poor detailing and of inadequate installation. This area needs attention, but it is perfectly soluble. For many archetypes, this could be through a robust assessment framework with pattern book solutions and appropriate training. For other archetypes and in more challenging situations, quite considerable work is required to establish robust approaches suitable for mainstream installation delivery.

3.13 The framework below is offered as a suggestion to assist the proper focusing of research effort, and to provide a common language, for external wall insulation (EWI). A similar categorisation approach might be developed for internal wall insulation (IWI).

Category	Description	Examples
1	Relatively straightforward minimum standards *Construction types that are less sensitive to the type of EWI system but still need a focus on correct detailing, ventilation, etc*	Concrete build homes / blocks (including system built) which are not on the designated defective list, simple building form, good building condition, no heritage value, set back from road/pavement, with ground levels below floor levels. Such as Wimpey No Fines and concrete ring-beam tower blocks
2	More complex standards and some additional research/work may be required to inform EWI standards *Homes that need careful system selection, detailing, ventilation, repair removal and replacement of utilities, pipes, etc*	Brick homes in low exposure positions with no or modest heritage value Steel frame system built homes, such as BISF Designated defective system built homes Timber framed homes
3	Significant research required before minimum standards could be written; homes that may not be suitable for EWI *Those homes where the risks are substantial and the evidence base of correct approaches and likely outcomes is weak*	Homes in higher exposure positions Homes with medium and high heritage value Homes where there is a significant level of damp in the walls

3.14 Proper ‘design’ is frequently absent entirely. This leads me to question where design responsibility should sit.

3.15 I am of the view that a Retrofit Co-ordinator (or competent person, or responsible designer) role is necessary to take responsibility for ensuring that a correctly designed and executed solution is delivered.

3.16 As a direct result of some of the above, unless properly addressed, there is an unacceptable risk of unintended consequences, which might include damp, mould, poor air quality and poor building performance. Depending on the extent of the problems, this may cause health issues for occupants together with the possible failure to achieve the predicted improvement in thermal performance required to deliver lower energy bills and reduced greenhouse gas emissions. At the extreme, for some property archetypes, structural damage could be incurred.

3.17 I am of the view that some standards are insufficiently detailed in respect of SWI and may not be fully fit for purpose and consequently require revision. This may include aspects of the Building Regulations, BS 5250, the RdSAP tool and PAS 2030. I recognise that this process will, in some cases, take a considerable time; however, others can be undertaken much more quickly. Nevertheless, in my opinion, the review of all of these standards should commence without delay.

3.18 I note that industry tends to adopt quality standards rapidly when these are made a condition of accepting grant funding or are prescribed as terms of a contract. Such a mechanism offers a rapid means of improving the performance of a large proportion of the industry and thereby of raising generally accepted industry practice.

3.19 The Building Regulations do not specifically address a national retrofit strategy or programme. For example, for most property types, incentivising additional measures by means of consequential improvements has been rejected. Similarly, the current requirement for improvement in ‘U value’ requirements for retained thermal wall elements is seldom applicable to buildings less than 30 years old. Guidance in Appendix A of the Building Regulations on renovation targets could usefully be expanded.

Expertise

3.20 The standards and incentives for assessment need addressing, in order to drive up the quality of output. This might include the introduction of a high-level audit of assessors, coupled with appropriate sanctions for inadequacies that are identified in audit. It might also point to the establishment of a register of competent assessors.

3.21 Quality control arrangements should be addressed, possibly including the introduction of regulation and sanctions. This would encompass a review of the appropriateness of independent inspection vs. self-certification. One suggestion worthy of consideration is that of on-line notification/registration of readiness for inspection, with random unannounced inspections and high sanctions imposed for poor workmanship identified.

Capacity

3.22 My finding from this review is that there is unlikely to be a significant constraint in manufacturing capacity. Manufacturers are prepared to invest and flex their capacity to match demand, provided they have sufficient confidence in a future pipeline of demand for their products. This is another driver for consistent and long-term policy.

3.23 There does appear to be a general lack of knowledge and skills in tradespersons, an insufficient availability of multi-skilled (or poly-competent) tradespersons and a clear need for skills integration. Again this is soluble; flexible training courses and flexible apprenticeships are available and could be adopted widely, especially if a long-term market were to reward those with a combination of skills.

3.24 In addition, there is a need for the development of site management and professional skills in the area of domestic retrofit. Whilst retrofit co-ordinator training is available, its take-up is low. These skills will be needed more widely to support an expanded retrofit programme.

Knowledge and awareness

3.25 There is a lack of performance data available from properties that have been retrofitted with SWI. Performance data is vital for informing the correct technical solutions and driving industry to deliver systems and products that provide the best performance for householders, rather than simply focusing on the performance achieved in laboratory tests. Performance data is also important for raising consumer awareness of the benefits of proper insulation.[5]

3.26 One suggestion worthy of consideration is that of giving advantage to those manufacturers that collect (perhaps via the internet-of-things) and make widely available to customers in-use performance data, over those manufacturers that simply publish laboratory results. By this means manufacturers and installers who can demonstrate actual performance will benefit, and conversely those who cannot so demonstrate will not. This might be achieved through accommodating system, or product family-specific in-use factors within performance calculations.

3.27 There is a general lack of awareness by private homeowners of the need for SWI, the solutions available and the costs and benefits. Consumers may lack confidence in solutions being offered to them. A help-line might be beneficial and schemes such as Home Performance Labelling might be very beneficial in this regard. As a feedback loop smart meters, with appropriate algorithms for adjusting for occupancy and weather with displays installed inside the house, could provide demonstrable evidence of the benefits realised.

3.28 During the review, I heard some demand for the creation of a Retrofit Hub, as a centre of technical excellence and expertise. My observation is that there is much good work already being carried out in this area and consequently a hub, if created, could co-ordinate that which is already happening. This end could be achieved by giving recognition and support to the work already being carried out and by creating a more effective retrofit network. The Building Control fraternity should

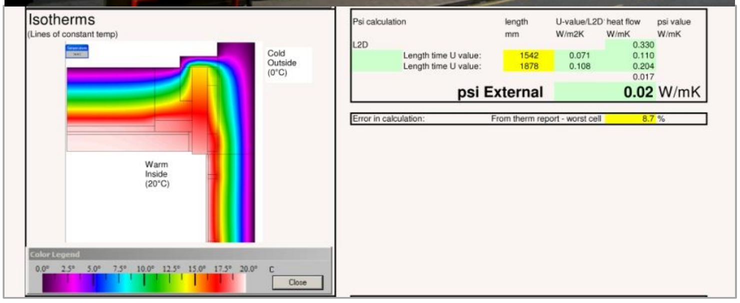
[5] *The Energy Technologies Institute is running a retrofit pilot in a range of common house archetypes, to achieve a 30% or 50% reduction in heat loss using an holistic approach rather than focusing on a single retrofit measure. Another key aspect of the pilot is an attempt to use a 4-person poly-competent team to minimise delays on site, with targets for the 30% reduced heat loss retrofit of two weeks duration and a £10k budget. The houses will be tackled sequentially, with detailed monitoring so as to maximise learning.*

be involved in this network. However, the breadth of support for such a hub as yet remains unclear to me.

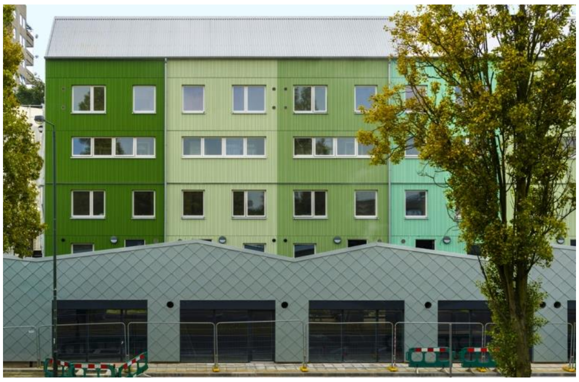
3.29 I have also heard a suggestion for a focal point to be identified (an individual or party) within industry or Government to drive forward Government's response to the recommendations of this review.

CASE STUDY – SOLID WALL INSULATION – Parkview, Thamesmead

Parkview Hub, Thamesmead, comprising 18 flats and underused garages is owned and managed by Gallions Housing Association (now Peabody) who, following extensive consultation with residents, commissioned its retrofit and selected it to be part of a demonstration project in the European-funded E2 Rebuild research network. Applying fabric first techniques, space heating energy reductions of 80% less than existing are anticipated, and following completion of the works in 2015, a 2-year monitoring period and the fit-out of the ground floor commercial/community uses is underway.



Parkview, along with multiple similar blocks on Thamesmead, was constructed in 1972 of precast and insitu solid concrete. Whilst the precast facade panels partially encapsulated less than an inch of insulation the predominant envelope was solid insitu concrete with inherent thermal bridges, and was categorised as 'hard to treat' thermally.



The Parkview retrofit was designed to be delivered with residents in occupation, to the Passivhaus Enerphit standard to achieve an upper limit space heating demand of 25kWh/m2 (to enable residents to heat their homes for around £3 per week), and the project was procured via a Design-and-Build contract with SustainableByDesign as contractor's architects. Design input included thermal modelling of critical junctions to remedy cold bridging condensation problems, iterative energy modelling during the construction period as a specification change control mechanism, and detailed design information tailored to factory production. Contract value was £3m, and more detailed project information and project team membership can be found at

The construction consists of factory-made pre-glazed timber storey-height SIP panels, with high performance factory-finished timber board cladding, craned in to overclad the existing facades and a metal-clad roof with landlords' PV roof array. Internal alterations to inhabited flats were designed to be limited to 'breaking through' and making good around the existing window and door openings, and integrating new heat recovery ventilation units. U-values of overcladding units are typically in the range 0.10 to 0.15W/m2K.

CASE STUDY – SOLID WALL INSULATION – New Court, Trinity College, Cambridge

Typology and Construction:

- College Accommodation - originally planned in two-room sets but variously remodelled over time. Replanned – closer to original pattern - to provide 133 study bedrooms (1/3 ensuite, 2/3 with shared facilities) with 4 fully-accessible rooms, teaching rooms, fellows' sets and tutorial offices.
- Original construction 1820s solid brick walls either fair-face or with a variety of facings - ketton stone, roman render.
- Retrofit works include thermal upgrade with internal wall insulation - 60mm vapour-permeable wood-fibre, double-glazing to existing, refurbished window frames, MVHR, underfloor heating with GSHP borehole heat source.

Tenure Type: Private College accommodation and offices
Location: New Court, Trinity College, Cambridge

Programme	Project Commenced	-	January 2010
	Listed Building Consent	-	January 2013
	Site Start	-	March 2014
Completion	Phase 1	-	August 2015
	Phase 2	-	January 2016

Brief: College brief required provision of accommodation to contemporary standards, enhancement of historic character and fabric quality, and 88% reduction to carbon emissions. **Assessment Method:** Extensive character and policy analysis, building physics monitoring and calibrated WUFI modelling to develop mould risk parameters and acceptable solutions

Client: Master, Fellows and Scholars of Trinity College

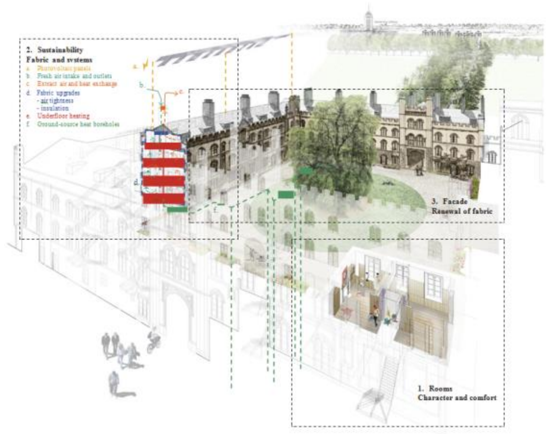
Project Team:

5th Studio - Architects
Max Fordham LLP - M+E Engineers
Max Fordham LLP - Building Physics Modelling
CAR - Structural Engineers
Bidwells - Project Management
Richard Utting Associates - Cost Consultants
Beacon - Planning and heritage consultants
Archimetrics - Building fabric monitoring
SDC - Main Contractors Munro - Building Services
AVV - Render
Coulsons - Fitted furniture and linings
NBT - Insulation - building physics advice
Bill Bordass - building physics advice
GCU - Material property analysis

Project Description:

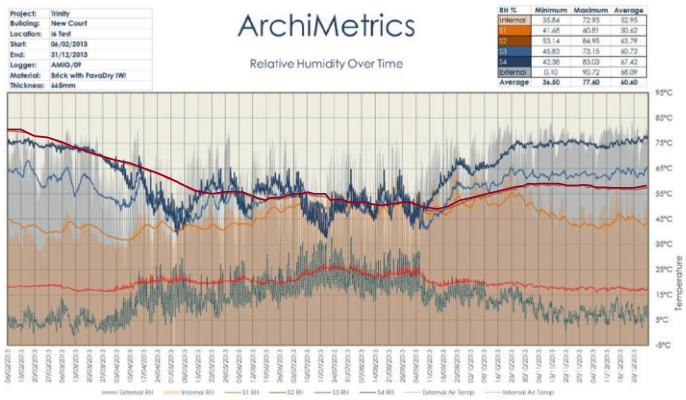
Indicative Floor Area:	5,340m2
Cost:	Total contract cost: c.£20m.
Cost/m2:	£3,745
Construction Period:	21 months
Design Output:	7 years building and interior condition monitoring and space heating monitoring

Typical energy usage:
Annual space heating - Currently: c.857,000 kWh
Predicted: c.124,000 kWh



Overview of components of project

View of completed study bedroom



1-year monitoring results from sample insulation installation

Technical Measures:

U-value improvement:	0.675 to 0.25w/m2 typical
Airtightness:	from 19 to 3m3@50Pa

Lessons learned:
While 'theoretically' addressing occupancy-generated moisture, vapour impermeable insulation solutions proved to create dangerous conditions in terms of external moisture, especially solar-driven vapour, pressure. The delivery of these standards to historic buildings of this quality and significance requires abnormal levels of site supervision and quality management.

Innovations:
Internal wall insulation to Grade 1 Listed Building, sealed double-glazing within existing window frames. MVHR distribution ductwork using historic chimney flues.

4. Recommendations

Developed from the themes in the Findings section of this report, I set out my 10 recommendations below.

Recommendation 1: Holistic approach

Government and industry to adopt a co-ordinated and holistic approach to SWI, considering both policy and market based measures. Both Government and industry have their roles to play in unlocking demand and driving up standards for SWI, and these need to be co-ordinated.

Specifically, Government and industry should work jointly to address the failures in the SWI market and develop a detailed plan of action to address the shortcomings in the areas of: technical; knowledge and skills; quality; policy; and consumer demand.

Recommendation 2: Consideration to policy

Government to give consideration to the appropriateness and effectiveness of its policies relating to SWI in view of evidence received through this review, giving due regard to the following:

(a) driving down costs through consistency and longevity of policy;
(b) encouraging a whole-house approach, thereby avoiding piece-meal retrofit solutions;
(c) prioritising work programmes based on an archetype/ownership matrix, so as to progress more quickly the 'low risk' and 'high benefit' property categories;
(d) giving cognisance to installation time-windows;
(e) incentivising private owners (possibly through the use of Stamp Duty, VAT benefits, or other similar measures);
(f) incentivising social landlords, perhaps by allowing an adjustment to rent based on energy performance;
(g) mandating or encouraging capture of performance data (possibly through further development of smart metering);
(h) addressing quality control arrangements;
(i) ensuring the proper protection of consumers.

Recommendation 3: Research

Focus research effort on categories of property archetype (including historic buildings) in a timely way, so as to solve problems based on priorities informed by archetype and ownership categories.

Recommendation 4: Standards and compliance

Review and revise as necessary standards and statutory requirements, establishing a clear minimum quality standard for SWI assessment, design and installation that can be readily referenced. The review to include:

(a) BS 5250;
(b) PAS 2030 and other quality control, verification and accountability requirements;
(c) Assessment standards;
(d) Building Regulations;
(e) Statutory Planning requirements;
(f) Enforcement arrangements.

Recommendation 5: Accreditation

Pursue accreditation/regulation and inspection of assessors and qualified installers, with meaningful sanctions for under-performance.

Recommendation 6: Guidance

Develop guidance aimed at different audiences – assessors, designers, installers, site supervisors, Building Control and customers (including clients, landlords and occupiers).[6] Guidance should include design requirements for diverse property archetypes and circumstances.

[6] *It is recognised that development of guidance is currently in progress by DECC and DCLG.*

Recommendation 7: Retrofit Co-ordinator

Retrofit co-ordinators to be appointed for all SWI projects, with clearly defined responsibilities – internal and external reporting lines to be related to the complexity and size of the scheme.

Recommendation 8: Awareness campaign

Launch an awareness campaign to increase uptake of retrofit solutions, including SWI, using a clear, simple message (e.g. "Less use; less spend; less waste"). This should comprise independent consumer information that is perceived to be trustworthy.

Recommendation 9: Retrofit Hub

Encourage industry to establish and run a Retrofit Hub as a technical centre of excellence, to facilitate the sharing of knowledge and guidance between clients, industry and consumers, and to provide a forum for engagement with a national retrofit programme.

Recommendation 10: Leadership

Establish a leadership forum with key stakeholders across industry and Government to oversee and drive forward Government's response to the recommendations of this review, with effective linkage to the Green Construction Board and/or the Construction Leadership Council.

This new leadership forum is encouraged to establish a detailed implementation plan by the end of 2016.

External SWI installation

5. Next steps

I anticipate that there will be a Government response to this report over the next few months.

I further anticipate that during 2016 DECC will determine its future home energy efficiency policy, in the light of both this report (my Recommendation 2) and the Bonfield Review.

Meanwhile, I am aware that DCLG is continuing its review of relevant standards and statutory compliance (see my Recommendation 4).

However, without waiting for the Government response, I strongly advise industry to take the actions arising from this report that it can proceed with on its own. This includes developing guidance (my Recommendation 6) and establishing a Retrofit Hub (my Recommendation 9).

Finally (in line with my Recommendation 10) I urge a new leadership forum to develop, by the end of 2016, an Implementation Plan for Solid Wall Insulation. This should set out the types and numbers of properties to be treated, year on year, so as to contribute to the targeted 50% reduction in greenhouse gas emissions across the built environment by 2025.

Internal solid wall insulation

Annex A:
Archetypes and ownership categories

Archetypes	Total Number	Suitable for SWI	Prop'n of CO_2 (note 3)	Ownership Categories Approx. Nos. Suitable for SWI			Vulnerable Households Approx. Nos. Vulnerable & Suitable for SWI		
				Owner Occupied	LA/HA	Private Rented	Owner Occupied	LA/HA	Private Rented
Pre-1919: Terrace & Semi	2,920,000	2,410,000	13%	1,800,000	150,000	460,000	520,000	40,000	140,000
1919-1944: Semi	1,920,000	670,000	8%	550,000	80,000	50,000	140,000	20,000	130,000
1945-1964: Semi	2,040,000	200,000	8%	140,000	40,000	10,000	50,000	20,000	40,000
1965-1980: Terrace, Semi, Detached, Bungalow & Low-Rise Flat	4,890,000	180,000	17%	100,000	60,000	20,000	30,000	30,000	10,000
Post-1980: Semi, Detached & Low-Rise Flat	3,680,000	70,000	11%	50,000	10,000	10,000	10,000	5,000	3,000
TOTALS	**15,450,000**	**3,530,000** (23%)	**57%**	**2,640,000** (75%)	**340,000** (9.5%)	**550,000** (15.5%)	**750,000** (63%)	**115,000** (10%)	**323,000** (27%)
							Approx. Total No. of Vulnerable Households suitable for SWI		**1,190,000**

Notes

1. Data based on the top 12 property archetypes in the UK (by archetype frequency) as set out in '*Stock archetypes in the UK', BRE, 2011.* This excludes mansion blocks and high-rise buildings.

2. Table covers 15.5 million of the overall 26 million domestic properties in the UK (i.e. 59%).

3. Proportion of CO_2 emissions tabulated is the proportion of CO_2 emissions from the entire stock of UK domestic property (not just the top 12 property archetypes).

4. All numbers have been rounded.

5. Vulnerable Household is a household in receipt of at least one of the principal means tested or disability related benefits.

Annex B:
Written evidence received

The parties and individuals listed below provided written evidence to the review.

AECB	Fran Bradshaw and Andrew Simmons
Benx/Sers Group	Alan Robb
Black Country Housing Group	Richard Baines
BRE	Colin King
British Board of Agrément (BBA)	Jon Denyer
British Gas	Urszula Thorpe
BSI	Clare Price
Centre of Refurbishment Excellence (CoRE Fellowship)	David Pierpoint and Paul Ruyssevelt
Chartered Institute of Builders (CIOB)	David Barnes
CITB	Richard Bayliss
Construction Products Association	Peter Caplehorn and Jane Thornback
Department of Energy and Climate Change (DECC)	Elizabeth Milsom
Andy Frew (individual)	Andy Frew
Institute of Historic Building Conservation (IHBC)	James Caird

The Insulated Render and Cladding Association (INCA)	Katie Nurcombe
Innovate UK	Rick Holland
Lucideon	Geoff Edgell
Mineral Wool Insulation Manufacturers Association (MIMA)	Sarah Kostense-Winterton
Modern Masonry Alliance	Mike Leonard
National Insulation Association (NIA)	Neil Marshall
National Energy Foundation (NEF)	Kerry Mashford
National Planning & Conservation Historic England	David Pickles
Parity Projects	Russell Smith
Royal Institute of British Architects (RIBA)	Emilia Plotka
Royal Institution of Chartered Surveyors (RICS)	Alan Cripps
Rockwool	Nick Ralph
Saint-Gobain	Jade Lewis and Mark Weaver
Scottish Government	Alisdair Macleod
South Kesteven	Duncan Lucas
Spex, Brian (individual)	Brian Spex
Sustainable Energy Association (SEA)	Fraser Wallace

Sustainable Homes	John Stapleton
Sustainable Traditional Buildings Alliance	Neil May
Trinity College Cambridge	Oliver Smith (5th Studio Architects)
UK Green Building Council (UKGBC)	Richard Twinn
University of Sheffield	Danielle Tingley
Westminster City Council	Irene Fernow
Willmott Dixon	David Adams

Annex C:
Oral evidence taken

The parties and individuals listed below provided oral evidence to the review.

Association for the Conservation of Energy	Andrew Warren
Benx and Spears	Alan Robb
Black Country Housing Group	Richard Baines
BRE	Colin King
British Board of Agrément (BBA)	Jon Denyer
Centre of Refurbishment Excellence (CoRE Fellowship)	David Pierpoint, Peter Rickaby and Paul Ruyssevelt
Committee on Climate Change	Indra Thilainathan and Ute Collier
Institute of Historic Building Conservation (IHBC)	David McDonald, Sara Crofts, Ann Cook and Alex Bulford
The Insulated Render and Cladding Association (INCA	Pádraig Barry and James Mead
Innovate UK	Rick Holland
Leeds College of Building	Ian Billyard
Mineral Wool Insulation Manufacturers Association (MIMA)	Sarah Kostense-Winterton
National Energy Foundation (NEF)	Gabby Mallett and Kerry Mashford
National Insulation Association (NIA)	Neil Marshall, David Lawrence, Mark Weaver, Gary Burdy and Nick Ralph

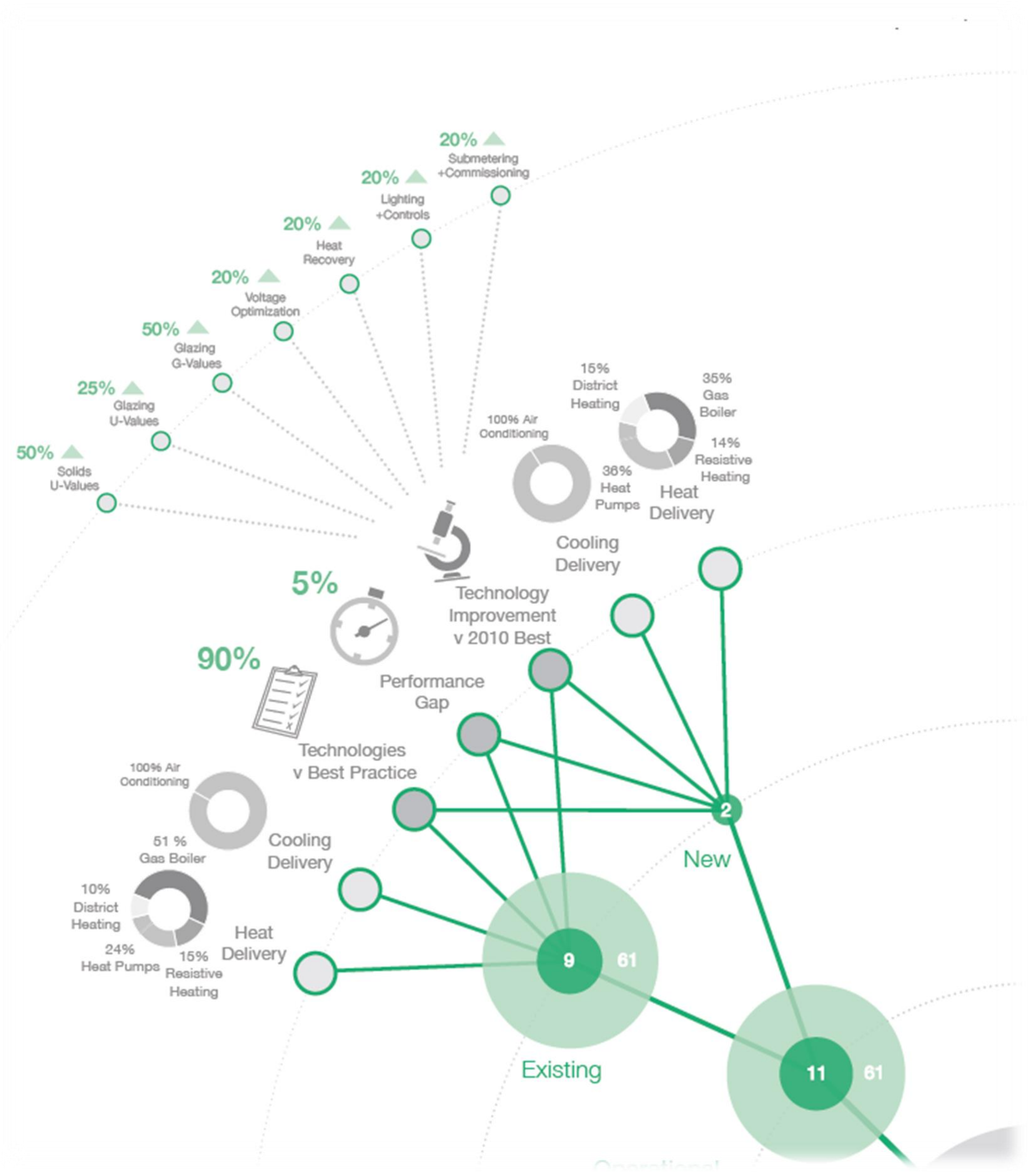
Saint-Gobain	Jade Lewis and Mark Weaver
Sustainable Traditional Building Alliance	Neil May
Trinity College Cambridge	Oliver Smith (5th Studio Architects)
UK Green Building Council (UKGBC)	Richard Twinn
Willmott Dixon	David Adams

Annex D:
Acknowledgements

I wish to thank all the parties and individuals who have provided written and oral evidence to this review, and particularly for their assistance, openness and co-operation.

I also wish to thank the London Borough of Havering, the Peabody Trust, SustainableByDesign and Willmott Dixon for allowing me to visit properties and regeneration schemes in Havering and Thamesmead. In addition, I wish thank the Junior Bursar and the Chair of the Building Committee of Trinity College Cambridge for permitting me to visit their refurbishment project at New Court.

Finally, I wish to thank Lynne Sullivan (SustainableByDesign), Rob Lambe and David Adams (Willmott Dixon) and Jane Manning (BIS) for their assistance with the drafting and editing of this report.



20%
Submetering
+Commissioning
20%
Lighting
+Controls
20%
Heat
Recovery
20%
Voltage
Optimization
50%
Glazing
G-Values
25%
Glazing
U-Values
50%
Solids
U-Values
15%
District
Heating
35%
Gas
Boiler
14%
Resistive
Heating
36%
Heat
Pumps
Heat
Delivery
100% Air
Conditioning
Cooling
Delivery
Technology
Improvement
v 2010 Best
5%
Performance
Gap
90%
Technologies
v Best Practice
100% Air
Conditioning
Cooling
Delivery
51 %
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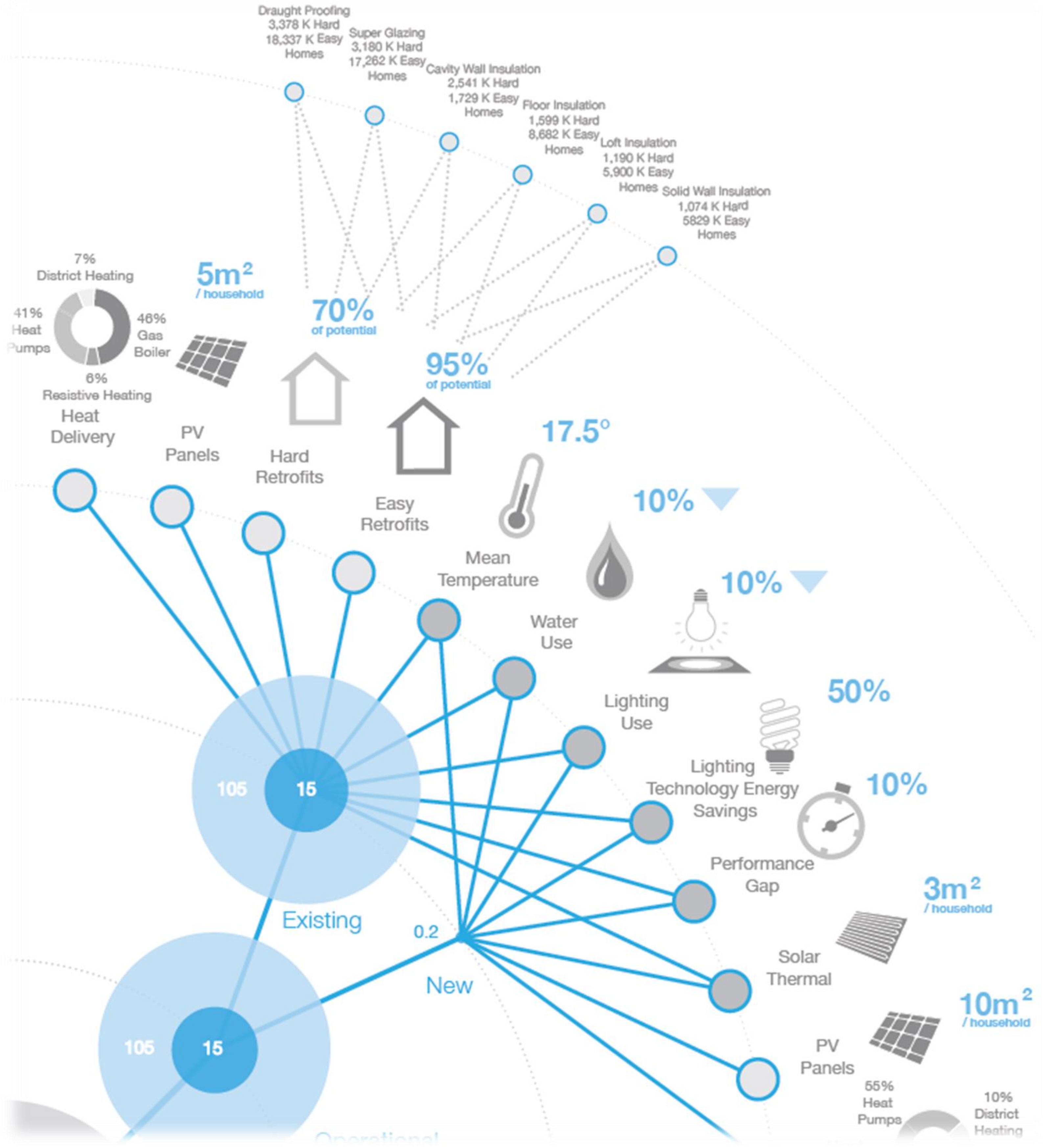
Existing
11
61


Draught Proofing
3,378 K Hard
18,337 K Easy
Homes
Super Glazing
3,180 K Hard
17,262 K Easy
Homes
Cavity Wall Insulation
2,541 K Hard
1,729 K Easy
Homes
Floor Insulation
1,599 K Hard
8,682 K Easy
Homes
Loft Insulation
1,190 K Hard
5,900 K Easy
Homes
Solid Wall Insulation
1,074 K Hard
5829 K Easy
Homes
7%
District Heating
41%
Heat
Pumps
46%
Gas
Boiler
6%
Resistive Heating
5m²
/ household
70%
of potential
95%
of potential
Heat
Delivery
PV
Panels
Hard
Retrofits
Easy
Retrofits
17.5°
Mean
Temperature
10%
Water
Use
10%
Lighting
Use
50%
Lighting
Technology Energy
Savings
10%
Performance
Gap
3m²
/ household
Solar
Thermal
10m²
/ household
PV
Panels
55%
Heat
Pumps
10%
District
Heating
105
15
Existing
0.2
New
105
15

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