

Written evidence submitted by Knauf Insulation

Context

Knauf Insulation is the largest UK supplier of insulation into the New Build housing sector and part of the wider €11bn Knauf Group.

We have limited our response to the two questions we believe are crucial to unlocking a good outcome in terms of achieving net zero in the UK's housing stock.

How effective is the EPC rating at measuring energy efficiency? Are there any alternative methodologies that could be used?

- Whether in new build homes or energy efficiency retrofit, the EPC is built on a theoretical desk top calculation. Almost nothing is 'measured' on-site. An assessor may visit a home and check which materials are present in terms of wall or loft insulation, type of brick work etc. But the performance of those materials to resist heat loss are not measured.
- The vagaries of install quality, material condition, brickwork and rainwater goods condition are not taken into account. Two homes with equivalent Energy Performance Certificate ratings could have wildly different running costs even if occupied in the same way and exposed to the same weather.
- This variance has been identified by multiple sources and given a many names from 'real performance', 'in-use performance', or the 'performance gap' between design promise and reality.

"Developers do not have to...test the properties 'as built' performance. The house purchaser has no way of knowing...whether the property operates to that energy efficiency standard in reality."

Energy Efficiency Inquiry Report 2019, BEIS Select Committee

"None of the [Future Homes Standard] proposals will be effective unlessby the time the Future Homes Standard is introduced, it can be done on an 'in-use' energy performance basis."

Committee on Climate Change, Letter to Rt. Hon. Robert Jenrick MP, Feb 2020

- Whether the issue at hand is energy efficient retrofit or new build homes, the buyer has no way of knowing they have got the performance promised in the Energy Performance Certificate. In economics the buyer cannot ascertain the quality of the product they are buying while the seller has no mechanism to differentiate a high quality product from a low quality one.
- In terms of retrofit, the buyer is required to buy loft insulation with no evidence it delivers against expectation. The buyer of a new home buys it on the presumption the roof, wall and floor insulation have been installed well and their home will be low cost to run with no nasty surprises in terms of mould, cold spots or condensation issues resulting from poor quality installation.

- Nobel prize winning economist George Akerlof¹ identified this ‘information asymmetry’ between buyer and seller arguing it would lead to the erosion of trust in a market which would drive an ever higher proportion of low quality products - or ‘lemons’ to use Akerlof’s phrase – onto the market.
- While the issue under investigation is home efficiency and its impact on bills and CO2 emissions, the bigger issue is poor underlying fabric efficiency is inevitably a symptom of an underlying quality issue. Leading new home insurer, NHBC, identified wall insulation issues as one of its top 5 general build quality issues in its 2018 Construction Quality Review².
- The previous Government set up the Each Home Counts review³ in an attempt to address similar quality issues linked to the installation of energy efficiency measures in existing homes.
- Akerlof offered solutions where his ‘Market for Lemons’ emerged from robust warranties and regulation to technologies designed to identify a high quality product from a lemon.
- Government and industry have tried a host of interventions in terms of warranty requirements, Ombudsman schemes, Standard creation (including Publicly Available Specification – PAS’s – in PAS2030 and PAS2035).
- Yet there is little evidence these attempts have resolved the ‘Market for Lemons’ dilemma allowing a buyer to know the quality of the product they are buying and seller to verify that quality. Indeed, if we look at the Persimmon review⁴ more evidence has come to light that issues haven’t yet been resolved.
- We believe technology can resolve the ‘performance gap’ in both energy efficiency retrofit and new build homes allowing buyers to know they have got the performance they have paid for. And we believe we have already demonstrated this works through a series of social housing tenders in Belgium and UK case studies.

If we want energy efficiency homes, why subsidise insulation and not its impact when installed?

- The key technical challenge to resolve is to develop a scalable route to establish the ability of the home fabric (the walls, windows, doors, roof, floor) to resist heat loss. In terms of retrofit that means establishing the improvement before and after the installation of efficiency measures while in new build that means comparing performance against the design expectation and equivalent buildings.

¹ "The Market for Lemons: Quality Uncertainty and the Market Mechanism" George Akerlof 1970

² <https://www.nhbc.co.uk/binaries/content/assets/nhbc/tech-extra/2018/technical-extra-23.pdf>

³ <https://www.gov.uk/government/publications/each-home-counts-review-of-consumer-advice-protection-standards-and-enforcement-for-energy-efficiency-and-renewable-energy>

⁴ Findings of the Independent Review”, Stephanie Barwise QC, 2019

- After 5 years R&D we have launched a new company – Knauf Energy Solutions (KES) – offering a Smart Retrofit and Smart Build service, currently to social housing providers. The service comprises two components;
 - Measurement – deploying a series of small, discrete sensor boxes supported by cloud based machine learning. These combine to measure the innate home efficiency over a period of 12 weeks. This measurement can take place before and after retrofit or ‘post-completion in new build’.
 - Quality control – the measurement approach is backed up by a quality control service. In retrofit, a ‘whole house’ specification is developed and the install quality controlled. We are developing a series of digital quality control tools to support that process such as on-site photographs of key install details and product tracking. A similar support service is available to new build developers.
- Launched 6 months ago in Belgium, the Smart Retrofit offer celebrated its 2 large tender win with a social housing provider with a current pipeline of €7.1m pipeline of work to retrofit 100s of homes. The crucial, and world-first, difference to these tenders is that the winner of both tenders was required to prove in each and every home the level of fabric efficiency improvement. A 3rd tender was published last week on a similar basis.
- While our technology is part of a UK Government innovation trial - SMETER⁵ - the challenge of launching a similar Smart Retrofit service in the UK as that in Belgium is the overarching dominance of the EPC (and supporting SAP software) in shaping policy.
- Multiple policies only value the theoretical efficiency improvement of homes by the addition of loft, cavity wall or solid wall insulation say. This improvement is then logged as an improvement to the Energy Performance Certificate of that home and tracked against policy targets....whether it has been installed well or not.
- The latest decision to spend £2bn to subsidise insulation, amongst other measures, is a case in point. The policy will conduct a desk based exercise where home eligibility is likely government by current EPC rating and success will be decided by the theoretical improvement to that rating.
- To my question ‘will we be able to claim a voucher if we demonstrate the actual improvement to home fabric’ rather than just demonstrate loft insulation has been improved? The answer from an official was.... there wouldn’t likely be time and neither would there be vouchers available for the measurement itself.
- As the UK’s largest insulation manufacturer we have asked the UK Government to establish a ‘real performance’ market to bring through technologies that offer assured outcomes for house holders and social housing providers rather than subsidise the installation of insulation.

⁵ <https://www.gov.uk/guidance/smart-meter-enabled-thermal-efficiency-ratings-smeter-innovation-programme>

We would argue the time is right to stop subsidising insulation and either subsidise, or regulate, its demonstrated impact when installed?

- The service described above resolves Akerlof's key dilemma of 'Information Asymmetry' in his 'Market for Lemons' work. The customer can buy an assured outcome rather than insulation that may, or may not, deliver a warm, low-cost to run and low carbon home.
- A high level description of our technology was published at the following [link](#)
- The 3 social housing tenders in Belgium have procured, or are procuring, this proven outcome rather than a theoretical one. Two providers have so far demonstrating they are willing to pay a premium of €3,500 per home for that extra level of assurance.
- To clarify, within the tender they also require their version of the EPC theoretical improvement to be calculated for national policy reasons. But they will be the first ever to contract with a provider in the knowledge they have got the improvement they have paid for.
- From a supply chain perspective, the Smart Retrofit offer moves risk away from the home owner and on to the supply chain. While the measurement technology allows Knauf Energy solution to manage that risk by ensuring the completed work is delivering against expectations. Where underperformance is measured, it can be rectified without leaving an unknown liability waiting to come back and haunt us later on.

"From day one, Knauf brought a level of quality control we haven't previously experienced in other retrofit projects. They set out a clear list of steps that needed to be taken to prepare the homes for retrofit, supported the quality control of those works while also designing and overseeing the insulation install works.

The measurement service is the first time we have been offered any certainty that our homes have actually been improved."


Asset owner in our UK retrofit case study

- The price point for the service described above is likely an early stage market price with many fixed costs having to be spread across a small number of homes retrofitted in Belgium. If a competitive market for 'proven home efficiency' can be established those costs will inevitably, and rapidly, reduce....but only if the market values that proven efficiency at scale.
- While government governs that market, through its EPC (and SAP) based policy development whether it is through Building Regulations in New Build or subsidy mechanisms in retrofit, these innovation will not come through. And we will be stuck with the Market for Lemons.

- The EPC is made of several components. One of which is an estimate of a home's fabric efficiency. Policy must learn to allow real measurement of this element of a home to 'slot in' and displace the theoretical figure where that measurement has taken place. Such a 'dynamic' EPC has already been mooted by BEIS.
- Until this happens policy will always be dependent on delivering efficiency in theory only. If we are to believe that 'Every Home Counts' as per the review title, then only by measuring every home and demonstrating value for money can you claim that 'mission statement'.
- If we continue to underpin the EPC only by theoretical calculations then we will be saying to the buyers of retrofit 'some of you will have a good outcome and get a warm, comfortable home, others an average one and some a poor one. However, as Government we will get our uptick improvement to the EPC whatever the quality of product you get'.
- That is not a sustainable position where people's homes are at stake. New real performance measurement technologies are coming to market, it should be incumbent on Government to set out how they will be incorporated into the Energy Performance Certificate.

UK Case Studies

- While we are considering launching a UK equivalent commercial offering to our Belgian Smart Retrofit offer, we have already conducted two 'housing estate level' pilots for proof of concept. These include a 28 home 'retrofit' of a 50yr old estate in Manchester and the improvement of 12 'nearly-new' homes in Salford.
- For context, we barely improved the Energy Performance Certificate rating of any home in either of the two case studies set out below, yet we improved the **actual** efficiency dramatically. We achieved this by quality controlling the install and measuring the actual fabric improvement.

Overview of the Manchester project

- We delivered retrofit measures to 31 homes with 28 households agreeing to the monitoring
- The homes were 1970s construction and already insulated in walls and loft
- However, the occupants had complained about high bills and on inspection the urea formaldehyde insulation in the walls was failing and the loft insulation was in a poor state
- So, the estate was already insulated but tenants were not getting significant benefit from that insulation.
- The homes were electrically heated, with occupants paying a high pre-payment tariff while many had high levels of heating system operation and high thermostat settings
- This resulted in electricity bills of over £3000 pa for some and under-heating for others
- The retrofit measures installed were applied as a 'whole house' approach with a 'maximum improvement within reasonable cost' approach.
- These measures were;
 - cavity insulation extraction, cavity cleaning and insulation re-application,
 - party wall insulation,
 - replacement loft system insulation including draught proofing in the loft,

- enabling or correction works to de-risk future issues such as fixing the guttering

The following results were established using Knauf Energy Solutions' measurement technology which establishes the real performance of each home;

- **31% average improvement** in home fabric efficiency
- Average energy saving of 2,071 kWh per yr or £411 based on standard occupancy (tenants on pre-paid electricity meter at 19.85p per kWh)
- Higher users on the estate would see a saving of **£660**, and lowest user a saving of c **£228**
- While slightly comparing apples and pears, BEIS recently published analysis of estimated energy bill reduction driven by its large scale retrofit programmes. The National Energy Efficiency Dataset results suggests an average 11% reduction in energy use from installing loft and cavity insulation when compared with an equivalent property that was not insulated in a scheme.
- Our approach saw a c3x multiple improvement on that average while actually comparing a poorly insulated – but still insulated home – vs an improved home. The 'worst' performer was still improved by 20%.
- We believe this improvement is a strong indication of the huge benefit gained when the project aim is about 'measured improvement' at a house level rather than the project or scheme aim being 'install an insulation measure' with no measurement of the outcome.
- The improvement equates to estimated bill savings in the project across the 28 homes driven by the retrofits of just short **of c£10,000 pa**...a huge saving
- As these homes were electrically heated, we were also able to analyze the impact on peak power demand reduction driven solely by fabric energy efficiency improvement.
- Results showed a cumulative 10kw peak power demand reduction across 10 of the sample homes - a 29% reduction - driven solely by the fabric improvement.

Overview of the Salford project

- Very briefly, we ran another case study which improved the efficiency of 12 nearly new homes by on average 17% by simply rectifying the insulation in the loft and improving the wall efficiency. The improvement in the larger semi-detached homes was as much as 28%. Had we quality controlled these homes from the beginning, we would likely have seen greater improvement.
- In the process, we addressed multiple quality issues that may have had costly detrimental impacts on the structural integrity of the home and its internal air quality.

What additional policy interventions are needed for social housing, leaseholders, landlords and tenants?

- We have set out above the dramatic improvement that can be offered to whole estates of inefficient homes when 'proven home efficiency improvement' becomes the project or scheme success criteria. We believe social housing providers should be able to bid in to Government's new £50m scheme with similar projects.

- In other words, Government should hold auctions inviting social housing to bid in with estate level projects with a contractor partner with proposed 'assured improvement' proposals to the estate. So rather than subsidise insulation measures, the bids should set out;
 - how much energy would be reduced per home
 - what price would that improvement be delivered for and;
 - how would improvement be measured (i.e. how would the measurement be independently verified with what degree of accuracy)
- This replicates the commercial offer in Belgium described above. In these tenders, the social housing provider required applicants for the large scale retrofit of 100s of homes to measure the performance before and after retrofit, create the specification for that retrofit and quality assure the outcome.
- For context, a translation of one of those tenders is below followed by our sister company Knauf Energy Solutions position statement on a proposed 'renovation wave' in the EU.

How to procure verified performance?

- Below is a translated section of a recent Belgian social housing procurement exercise to commission proven retrofit and performance improvement in existing homes.

2. PERFORMANCE OF THE CONTRACTOR

The services to be delivered by the contractor must at least cover the following:

1. Prior monitoring and reporting to the Contracting Authority

The preliminary monitoring presupposes the installation of measuring equipment with energy-related sensors that measure the energy level in the social housing concerned. At least the following energetic parameters will be measured (non-exhaustive list): e.g. temperature, CO₂, humidity, gas and / or energy consumption, heating system performance and movement.

In view of the preliminary monitoring to be carried out, it is important that the measuring equipment can be placed in the home in a modest manner, so that its use does not hinder the residents. Thus, the pre-measurement during the reference period leads to representative results on energy consumption and energy efficiency.

The prior monitoring results in a report to the Contracting Authority with insight into the energy consumption and energy efficiency of the social housing

2. Propose solutions and alternatives

Social housing must be treated until they reach (at least) E-level 40. This is the maximum permitted E-level for a new-build home in Flanders today. [*the E level is Belgium's equivalent of SAP which underpins the EPC*]

On the basis of an investigation of a specific social home, and the results of the prior monitoring of the same home, the contractor determines which energy savings are necessary in order to achieve the E-level E40 and by means of which interventions this is feasible and in accordance with the measures included in the chart of measurement in appendix 4. It also shows the alternatives in this respect. The Contracting Authority then chooses which measures it wishes to see realized. In this respect, the Contracting Authority undertakes to opt for measures that make the target of E level E40 feasible.

Energy-saving measures means: all measures with a view to reducing energy consumption. The energy-saving measures can consist of works, as well as services, as well as installation of installations and supplies. The contractor is responsible for everything, from the detailed study to the actual implementation.

If it is possible to achieve a better E-level than E40 and the Contracting Authority opts for this, this better E-level must be guaranteed.

More details can be found in the technical provisions (see Title 7 "Technical provisions" accompanying these specifications).]

3. After-monitoring and reporting of energy performance

After the energetic renovation and installation work has been completed, the same equipment as during the previous monitoring is placed in the social housing concerned. The purpose of these post-measurements is to determine to what extent the work carried out leads to an improvement in energy efficiency and energy savings and / or whether the desired E40 level (or better if so agreed) has been reached and the contractor's result guarantee is satisfactory.

The assignment is all-in. The contractor is responsible for the study and monitoring of social housing, designing, installing, renovating, organizing, managing and ensuring high quality energy efficiency and energy saving works (including installation of installations) for each of the participating social housing units (and apartments), including preparatory and post-intervention work. This also includes obtaining the necessary permits (if necessary), safety coordination (if necessary), etc. The contractor takes account of this "all-in" in its pricing.

Knauf Energy Solutions' submission to the EU Renovation Wave proposals

The EU's Renovation Wave proposals come at a time when the digital revolution can help make it a reality, allowing buildings to be transformed from climate villains at the edge of our energy system to climate champions that play an active role in supporting a secure and stable energy system. New digital approaches allow governments, finance providers, owners and tenants to finally know that the promised energy and carbon savings they invested in have been delivered. The same technologies, coupled with low energy buildings, create active homes that can support the grid through services such as peak load shifting. The EU Renovation Wave must ensure that high quality digitally enabled renovations can flourish.

The final quality of an energy efficiency measure is often invisible to the customer, meaning the market struggles to reward quality. This then drives a market dynamic where sub-optimal work often outcompetes quality work, undermining the overall efforts to scale up energy efficiency renovation. This dynamic is known as "The Market for Lemons" for which George Akerlof won the 2001 Nobel Prize.

Digitally enabled renovation approaches, that provide highly accurate information on the actual energy efficiency savings delivered, can upend this dynamic. To deliver a major win, the EU Renovation Wave must be structured to ensure "The Market for Quality" displaces the one for lemons, whilst supporting a rapid scale up. Certain key policy elements can make this happen:

1. **Create a Market for Performance, Not Measures:** the financing and grant measures of the Renovation Wave should be based on the energy efficiency performance improvements made to buildings, not the tick-box list of measures installed.
2. **Incentivize Performance:** the digitalization of the economy makes it inevitable that real performance approaches will supplant the current modelled approaches (e.g. EPCs) as they provide a higher level of accuracy and accountability. Whilst for the renovation of single-family homes these real performance approaches are just getting started, they already have a significant role in larger buildings (e.g. schools and hospitals). EU funding should accelerate this transition by ensuring that real performance approaches get paid a "Quality Premium" in terms of grant finance and loan conditions and by trialing innovative policy approaches, such as feed-out-tariffs and power saving agreements where governments can choose to invest in 400,000 low carbon renovated homes, creating **Virtual Energy Infrastructure (defined as: "The metered energy savings removed from the energy system through the deployment of energy efficiency infrastructure")** rather than building a new carbon intensive power plant.
3. **Open up the Market:** The current energy system dynamics and state aid rules are not designed for allowing low energy, digitally enabled homes to play their full role in supporting the energy system or for rewarding them for doing so. To allow service providers to be able to offer and monetize these services for homeowners, the energy system needs to be adapted as do state aid rules to ensure that the huge societal benefits that energy efficiency renovation can provide are realized.

Finally More for Less: Supporting digitally enabled renovations can deliver a Renovation Wave that not only scales but is focused on delivering more energy efficiency at a lower cost. It will create a market that rewards performance and incentivizes market actors to drive up quality and drive down costs.

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