Assuring a Low Carbon Future

A WHITE PAPER BASED UPON A ROUND TABLE DISCUSSION

System Solution Providers

Proctor Group

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Assuring a Low Carbon Future

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Introduction
As part of the Proctor Group Technical presentations, a round table discussion was held with a panel of UK construction industry professionals to explore the future of Passivhaus and other low-energy design strategies as part of the journey towards Net-Zero and beyond.

Round Table Summary

In this round table discussion, the panel explore the future of Passivhaus and other low-energy design strategies as part of the journey towards Net-Zero and beyond. In doing so, a summary of some of the key requirements for meeting net-zero targets is given below:

Quality

It is clear that there is a climate emergency and an urgent need to decarbonise but to get there we need to have quality. A low-carbon future can't occur without a clear emphasis on quality. So, to achieve this requires a driven approach right from when someone puts pen to paper and writes a brief, to the use and operation of the building.

Across the construction industry, there are still serious misconceptions about what a low-carbon future means. Is it just off-setting, waiting for the grid to decarbonise, can we avoid retrofitting, and do we have to bother with high-performing buildings?

The need for a blended approach

In addition to the need for a decarbonisation agenda and the electricity in the National Grid becoming greener, we also need to look at demand reduction. The Climate Change Committee has set this out in its reports, but it is missing from many of our conversations about what net zero carbon means.

Costs - whole life costs

We are in a very volatile market now, with the cost of everything going up. Material costs are rising, and energy costs continue to go up, in the main, because we are continuing to use a fossilised base for our industry.

However, we need to look at energy costs not just in terms of the cost of the building but of the whole life costs of the building. Modular and off-site construction have applications that we should consider and learn from. Buildings need to be maintained properly in order to assure performance. Offsite construction can help to assure as-built performance through quality control processes in the factory, the ability to make continuous improvements with standardised processes and automated systems that reduce human error. If it is constructed to the required quality, there are ways to do it, but we also need to do it faster.

Delivery

Another crucial aspect in meeting the targets for net-zero is about how you deliver a low-carbon building? As a client, what quantitive benchmarks do you set in your brief to ensure that that is the service you get delivered? What do we need to consider in regards to how the building is managed and monitored? How do we avoid net-zero just being a box-ticking exercise that doesn't deliver the performance benefits required by the time we get to 2045 or 2050? It is important to ensure that we know who is in control of the carbon gap in building, where does the responsibility rest?

Returning to the topic of quality, adopting a culture where more time and more care about how our buildings are delivered will help address that gap and deliver genuinely zero-carbon or low-carbon buildings.

Finally, on delivery, it is not just about operational carbon but also embodied carbon. The BBC recently highlighted that there is only one PV recycling facility in the world, and that is in Grenoble, France, which opened in June 2023. So, currently, when we are putting PVs onto our buildings, there is no end-of-life plan for how to manage this on a global scale.

Methodologies

Of course, we need smart grid implementation, battery storage and to improve how we are using energy in our buildings. In addition, we need to consider low-carbon construction methods, sustainable materials, and whole-life embodied carbon.

The use of Passivhaus, which is designed in from the start, and calculated well in advance has a role here. Passivhaus is an energy methodology focused on reducing operational carbon or operational energy, so it doesn't at the moment deal with embodied carbon or whole-life carbon. However, by targeting demand reduction and looking at a reduced operational carbon of our buildings, the whole life carbon of that building can be seriously reduced alongside a decarbonisation strategy of the fuel source.

Passivhaus is a quality-assured methodology. It has been proven by monitoring buildings all over Europe and the UK. The Passivhaus approach has been successfully applied for the last three and a half decades in Europe and the last 15 years

in the UK. Currently, there isn't another energy target that is based purely on building physics globally that has that legacy of proof of performance. If it is worth drawing an analogy here, if you were to buy a car that only has 50% of its checks done on the production line, would you feel safe in that car, would you think that car is value for money? Why then do we do that with buildings? We procure and use buildings that don't satisfy all the quality assured requirements to operate and use that building, and ultimately they create and use more energy and add demand on the grid as well.

End of life - Deconstruction and re-use

Understanding what low carbon and whole life carbon really mean over the lifetime of a building will prove crucial. In addition, we must recognise the impact of demolition and encourage re-use but also understand that retrofit has its challenges and solutions as well as part of a low carbon future. Therefore, a two-pronged approach of demand reduction first as well as the decarbonisation and offsetting requirements of a project will be important.

What happens to a building when it is no longer needed at the end of its life? It might be demolished to make way for a new building using new materials, but it would be better if that building could be reused, and it might need to be repurposed to serve a new function. Of course, you might need to retrofit it to improve its energy performance. If it does need to be taken down, typically the materials end up in a landfill, which is the worst-case scenario. As an alternative, you might think about how materials can be recycled, and that sounds great, but it can be an energy-intensive process and result in further carbon emissions, so it would be better if those elements could be reused.

Design for disassembly - Material banks

We should see buildings as material banks with materials that we can use in future.

An example of this was in a building that Robertson built for COP26, which was an energy-efficient home that was designed for deconstruction and reuse. The building was planned to use a series of panellised timber frame components with ease of access to fixings that allowed it to be taken apart. Primarily, there was a plan for re-use, and they applied that methodology to another Robertson house type. Robertson planned for deconstruction and looked at what elements could be reused and gave them a high, medium, or low re-use potential as to how they could be reused after a 50-year period. They found that 95% of the timber in that building could be reused.

The results of the Robertson project are a good start, but we need to have the documentation in place to show what can be done with the materials, like how they can be taken apart and how they can be reused. We also need to think about how that data is stored. For example, it's great to have a digital twin and all that information in one place, but will we be able to access that in the future?

So, in summary, we need to design for disassembly to ensure a low-carbon future, and we need to see buildings as material banks for the future.

Developing new products for sustainability - Sustainability first

Another key part of our approach to ensuring a low-carbon future is in developing new products with a sustainability-first approach. Currently, the industry is still building new houses that aren't meeting the requirements of net zero.

Discussion Points

- Is net-zero enough?
- Misconceptions about Passivhaus
- Affordability and meeting the costs
- The role of education
- Accelerating the transition
- Retrofit methodologies
- Building regulations – help or hinderance?
- The road to net zero – the UK vs. other countries
- Materials re-use and warranties
- Do we need to reduce demand?

Is net-zero enough?

When we ask whether net zero is enough, it would be fair to say that the term net zero has become slightly meaningless. A lot of people misunderstand the term net zero and think that it means no carbon emissions at all. However, it only means that we are not putting additional carbon emissions into the atmosphere. So, the target net zero is not enough because of the damage that we have done since the start of the industrial revolution is locked in and would take decades to reduce even if we are able to introduce carbon capture technologies. If we could get buildings to carbon negative that would have a better impact on the environment.

First, it is important to understand what target you are aiming for. For example, are you aiming for operational net zero, or are you aiming for lifetime emissions net zero? In seeking to address this, the UK Green Building Council sets out various levels and definitions of net zero. To add to this, a recent study by the Nature of Climate Change looked at net zero not doing enough to address other issues, such as gases like methane. In the last five or six years, local authorities and clients and the general construction industry have had no real understanding of how to deliver those definitions.

If we are looking at the wider boundaries of what net zero is then we must consider reuse and the end of life. There are very few buildings in the UK now that are a verified net zero in both operational and embodied carbon. Just one building in London, Max Fordham's small residential house, is the only embodied and operational net zero building in the UK.

PV panels can generate a lot of electricity and energy from solar, but when we factor in end of life of use of buildings, the end of use of PV panels is a huge carbon factor that we simply haven't dealt with. So, offsetting on its own as part of net zero isn't the answer. We need to be mindful of material retrofit, future use as well as operational demand reduction.

Misconceptions about Passivhaus

As already mentioned in the summary, Passivhaus is a quality-assured energy methodology focused on reducing operational carbon or operational energy. However, there are still several misconceptions about Passivhaus.

For example, one of the most common misconceptions of Passivhaus is that you can't open the windows because it is airtight, which is certainly not the case. You can open the windows, and the building is definitely not too airtight because the ventilation is controlled. A Passivhaus building is breathing, but it is controlled breathing and so therefore it reduces the condensation risk.

Another misconception is that Passivhaus is expensive. This is not the case and in Robertson's experience they have delivered Passivhaus standard schools with a smaller uplift in capital costs. People quote numbers of 25-30% more expensive. It's helpful to remember the economy of costs on jobs at the moment: materials have been going up so the average project costs are 10-20% more expensive due to risk profile and how procurement sets costs in the current volatile global economy. The Passivhaus Trust has some useful guidance on costs (pre 2020) indicating that 'true cost' of passivhaus is more like 4% when assessed properly.

Having close relationships with contractors is helpful to understand the cost mechanisms better. In January 2023, several finishes went up, like intumescent up by 30%, and steel has gone up 80% per ton since March 2020. So, there is a huge pressure on the construction industry around costs, and it isn't anything to do with trying to achieve an energy standard. Part of the reasons for the rise in costs concerns changing over to heat pump technology and the huge pressure on clients to look at capacity around national energy infrastructure. In some cases, in London, several large housing and regeneration schemes are being stalled for three to five years by utility companies because they can't get the capacity to that part of London quick enough. If we were already designing projects based on super low energy demand reduction, that incoming capacity could drop, even with the electrification of fuel.

In some ways, there's a kind of macro balancing needed, so we must be mindful of how we diversify energy predictions, and how that affects the wider grid, and that it contributes to the overall reduction in demand on the National Grid. There needs to be a blend of solutions, not just renewables, because the grid doesn't always work at peak. It is fair to say that peak happens more often than in the past, but we need to be more rational in how we manage it.

There is also a common perception that Passivhaus is for self-builders seeking low energy, but there are also a lot of non-residential projects involving Passivhaus, for example, in education and commercial retrofit. It is worth mentioning here that a

group of ten local authorities across Scotland are voluntarily participating in a Passivhaus shared knowledge collaborative network. They share information and findings and work collaboratively to improve the quality gap.

The interest in Passivhaus in Scotland has been about quality and the fact that in educational buildings, in particular, there has been a catastrophic failure in construction over the last decade that has been well summarised and documented in the 2017-2018 Cole report. We also have Grenfell, which has been another catastrophic regulation failure. Part of what Passivhaus offers is a mechanism within a contract to benchmark and monitor quality. For example, say you wanted to monitor consistency and no gaps in insulation, well, that also applies to consistency and no gaps in fire cavity barriers and compartmentalisation of buildings in terms of fire strategy through the building fabric.

New compliance planning is coming out in Scotland, and the Health & Safety Executive legislation in England also reflects a very similar methodology. All this works towards requiring us to be more caring in how we inspect quality as we go through construction. By inspecting quality that coldly, we are delivering a better product, a product that responds better to environmental pressures, but also a very comfortable building to be in and occupy.

Affordability and meeting the cost

Perhaps another question in the move towards ensuring a low-carbon future is whether the building design profession, across all disciplines, can provide net zero designs across the board and whether clients will be ready to pay for the required construction and design costs.

In terms of cost, we must look at the whole life costs, and how it is going to save across the lifetime of the building. To save on whole life costs, you need to spend more time at the design stage. This may cost more in people's time, but the counter to this is that without this it is going to cost you more when the project ends up on site. You must factor in and consider how you can use less material, how you can optimise the structure and can switch different materials out of the building. So, it's a hierarchy of things that you need to go through to look at how you can reduce cost. In this bigger picture, both cost and carbon should be considered together.

It is also necessary to consider cost and affordability from the perspective of retrofit. So, how affordable is this in the private retrofit market sector? On the one side, with many, facing high interest rates and energy costs this type of work isn't affordable. However, during Covid the Passivhaus Institute brought together a series of DIY exercises specifically targeted at the homeowner to challenge this perception, and that to get a very low energy building, or a Passivhaus retrofit level building you could do a lot of it yourself at a much lower price. For now, these guides are only available in the German language, but the Passivhaus Trust is working on translating them so that individuals can be better informed about building physics.

However, this shouldn't be focused on homeowners only. Across the country we have a need to improve closer to 30 million buildings. The government should be driving this with legislation because it will alleviate fuel poverty and there are members of society that don't have the tools or instruments to even consider this DIY strategy or these approaches. There are some exciting developments already proving that you don't need to have a contractor to come in and spend a quarter of a million to retrofit your building. We can do this in a more robust way to address the energy gap, and the most sustainable building is a retrofitted existing one. So, if we can reduce the demand on the National Grid infrastructure with relatively little upfront costs that would be amazing.

There is a lot of ambiguity on funding, particularly in the private sector, with very little initiative to support the need. The public sector is leading in a better way on some funding initiatives, but again, it's not enough to act quickly enough.

For the average homeowner, there are competing priorities for the budgets available that lean more toward comfort and image than environmentalism. In some cases, people will spend £30K on a new kitchen, and some might think about spending money invisibly in their building for comfort or energy reasons. We are dealing with a huge pendulum of people's own personal pressures; can I afford to pay my mortgage and my bills at the end of the month?

As mentioned earlier in the DIY guides produced, The Passivhaus Institute was looking at some clever films on glazing or addressing airtightness and has been looking at non- domestic retrofit studies where the impact of just addressing airtightness whilst making sure that buildings are well-ventilated is quite significant. Regarding energy cost reduction, it's about being more informed. There is far more awareness amongst the younger generation in this area. Another school of thought is that we wait for the whole grid to decarbonise, but with the advent of electric car charging and the micro-generation that is happening in the National Grid, the fact is that costs are going to go up if we don't look at a reduction in usage of energy.

A case study example is Renfrewshire Council in Scotland. In 2022, the council set a tender to retrofit three thousand of their public sector buildings. The local authority was one of the early adaptors to recognise the push to de-carbonise those already in fuel poverty was going to leave communities in an even worse position financially without some form of fabric first approach being applied also alongside heat pump de-ployment.

Concerning the private sector, they are worried about the increase in fuel poverty as we push towards decarbonisation and switch to heat pump technology. The energy costs will increase even more just by changing the fuel and not addressing the fabric issues, so we are walking into other problems, especially those at the fuel poverty level.

The role of education

It is a real challenge to get the message out for people to modify their behaviour and modify their homes at a low cost. This is in opposition to the energy companies that don't want us to spend less on energy and the profits of large private companies and pension funds, ultimately limiting getting things done.

A study in London considered the energy use intensity of people living in the 1930s and 1920's semi-detached, terraced houses in London. The results varied tremendously depending on how they behaved around their perceptions of comfort. There is much work to do on education. We need a covid COBRA-type response to get the information out there.

Companies like Robertson are playing their part in educating the sector locally and nationally about the importance of energy-efficient buildings. The company performs Toolbox talks to supply chain partners on site. Robertson also encourages its supply chain to get training through the Built Environment Smart Transformation Centre in Hamilton and the Supply Chain Sustainability School. In addition to this type of approach by contractors like Robertson, online webinars are available from the Passivhaus Trust.
There is a lot of education out there - often aimed at the design stage and consultants, but explaining to tradespeople on-site why they are doing something in a certain way is often well-received.

Another example from Robertson is in educating pupils and students on energy use such as children and teachers at Riverside primary school in Perth that is a Passivhaus standard building. As a result of explaining why they have triple glazed windows, high performing walls, and natural materials throughout, the teachers and pupils are buying into the idea of the Passivhaus school and

the energy efficient measures. Two children told how they are now turning off their Xbox and switching the lights off because when it was explained to them that the energy they are using is generated somewhere and is creating damage somewhere else, they understood the implications.

Accelerating the transition

We have many existing technologies available, but ultimately, we need to increase the speed of transition. So, the question is, how can we accelerate the transition to net zero?

If we want to get there sooner, then it's going to be dependent on working together and sharing knowledge. The best solutions might not be about creating something new. It might be about innovating around what we already have. How can we make those incremental improvements?

It's also about having the right data and analysing it so that we can show where we can make the most significant improvements to accelerate it. In Scotland, Robertson is part of a group called Offsite Solutions Scotland. This consists of a group of pro-active off-site manufacturers coming together to share knowledge about how they can increase the use of off-site timber construction and address issues around quality and ensure that buildings perform as designed. They are leading joint innovation projects and collaborating with government and academia on projects set to transform the construction sector.

Retrofit methodologies

In respect of retrofit, there are several solutions, each with its own benefits and challenges. One example which was discussed by the panel was the lesser retrofit level under PAS2035.

In essence, the fact that there has been a methodology set and a person identified to oversee a retrofit strategy from design through to delivery is positive. However, there are wider implications of why we might deep retrofit a building, and these need to be challenged first in terms of suitability. Therefore, the suitability of a building going forward and the disruption that a building may cause as a result has to be factored in.

It is worth noting, that Passivhaus also has a retrofit methodology that is based on building physics and has a sensible approach to design, like not over insulating without thinking about ventilation, not putting in insulation and not addressing airtightness which would create mould and condensation risk issues and ultimately affect occupant health. In all cases, we need to be informed regardless of which standard of retrofit we are aiming for so that the building is left in a healthy state.

There are some serious challenges around retrofit in respect of the suitability of schools. it is estimated that in the health and education sectors there are perhaps 1000's of buildings made of autoclaved concrete or materials that are nearing their end of life, this has been well publicised in the media recently. Whilst longevity in terms of whole life carbon may not be possible with these buildings, the repatriation of materials within the whole life carbon of the materials involved should be prioritised and incentivised. This raises another series of questions, can you really retrofit a building where the structure is failing? Is there a way of repairing that structure or reusing it to a lesser grade at the end of its life?

Building regulations - help or hinderance?

Is it fair to say that in some cases building regulations may introduce constraints on achieving the required outcome? For example, a topic raised was that even with the planned changing in building regulations the target set for U values doesn't align with feasible options for the client.

For example, on a narrow site where you'd like to use more sustainable materials, but the thermal targets force you to use PIR products. Although you can achieve the regulation targets within the site constraints there doesn't seem to be an option for negotiating this in a case-by-case basis unless you are refitting.

The A. Proctor Group recognises that there are some very hard to treat areas especially when it comes to insulation. In some of these, it may be that it isn't possible to achieve the requirements. On retrofit this is understandable because that wasn't the design requirement back then. However, even on a building well over 100 years old there are solutions on the market such as aerogels that would offer a potential solution for what needs to be achieved.

It should be noted, that in front of Scottish government at the moment, is a bill to create Passsivhaus as an acceptable equivalent way of achieving building regulation compliance in Scotland for housing.

The road to net zero - the UK vs. other countries

Inevitably, within the panel discussion, the question arose as to how the UK is performing on the road to net zero compared to other countries. If one considers the recent Climate Change Committee report the UK is clearly not at the top end of the list. Performance against net zero remains a challenge for all countries, with huge questions being asked about how to decarbonise and the speed at which they are doing it.

There is some confusion about how different agendas are working. For example, the high energy policy level and several policies moving towards heat networks decarbonising buildings with various funding streams and requirements. In Scotland, aims to create 20-year plans for local authorities to establish and roll out heat network low carbon heating, is one aspect, however, neither of these talk or connect to the heat and building standards. We have net zero carbon standards coming out in England, and Scotland that are nuanced and different.

So, a major flaw is that we don't have a common approach. We have a common ambition, but the common approach can dilute the actual delivery of some of these ambitions and create confusion.

Some countries are much better at measuring embodied carbon in buildings and already have the requirement to set targets. We may have to do it because clients are asking for it or it revolves around certain funding, but other countries are already measuring embodied carbon in the buildings and are starting to set targets based on that. In some places they already have a deconstruction plan in place.

The UK is so behind in targets. How can we be consistent over a 20-year period on targets when you have governments changing and policies changing so frequently?

Materials re-use and warranties

So, what are the implications for material reuse and what is the position of building warranty providers regarding the re-use of materials?

Currently, a building can be deconstructed before the materials reach their end of life. There are many things to consider if the materials are going to be reused. For example, it depends on how the build has been detailed and whether there has been damage, such as through moisture.

One project example in point includes Harris Academy Secondary School in London. Although the brief and delivery of 'designing for de-construction' was delivered, it couldn't be truly applied to all materials in the same manner due to current supply chain and innovation limitaitons. More of this needs to be reported on to obtain a better picture of material re-use in the industry. Zero Waste Scotland has also done some interesting research on this. The ambition was to design for deconstruction, so the building is mainly CLT panels with some concrete in-situ. As a result of the sloped nature of the site and the manufacturing of the CLT panels and their fixings, a percentage of the panels were wasted and unable to be reused.

An important part is the possibility for material re-use is in the standardisation of materials. For example, when Robertson analysed their house types every single panel in the building was different, with different sizes between ground and first floor. It would have undoubtedly been easier to reuse those panels if they were standardised. In terms of other materials, it is important to have a regular maintenance program to ensure that things are not getting damaged and to ensure they can be reused in the future.

On another project, for a Cross-Rail site in London, all the steel was deconstructed and brought to a different site. The steel was removed, and strength tested, then re-warranted as suitable for use. This is not the norm in the industry, as understandably, engineers are nervous to commit a new warranty to the materials for re-use.

Manufacturers aren't actively supporting this initiative either. So, we talk about green steel, but, we have no idea how green that steel is. As an example The Steel Construction institute identified problems in the supply chain trail of how steel is processed/ where it comes from in the UK. This creates ambiguity in the steel industry around % of recycled steel in components, or quantity of steel plants invested in working electric arc furnaces in the UK and their contribution to the overall % (the de-carbonised steel concept). Steel is one example, but we need to improve on the confidence levels of what the retest results are and how we can encourage reuse.

If we can look at a building like a repository for the future that we just take pieces of the building out to reassemble or refurbish and use elsewhere that's a powerful way of conserving resources.

Do we need to reduce demand?

Perhaps some fundamental questions we need to ask are: Aren't we just consuming too much? Should we stop building new buildings? Coupled with this, what compromises should we be considering in our daily lives to give us a chance of a genuine sustainable future?

There is some suggestion that we are at the beginning of societal change. Regarding addressing behavioural change, a major investment into an educational approach is needed.

What we see is much debate but the lack of a holistic approach. We don't see a common approach to how we can tackle it and change behaviours like we did with Covid. This common approach is hugely lacking and is a decisive factor in the challenge to address the urgent need for behavioural change.

" I believe the success of the A. Proctor Group is down to a solid foundation of innovation backed up by an excellent, loyal and committed team, every one of them playing an important role in our continued success. Scotland provides us with a unique platform to launch our ideas, systems and products. I am fiercely proud of this heritage and our brand."

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