SCOTTISH BUILDING REGULATIONS: REVIEW OF ENERGY STANDARDS

'CALL FOR EVIDENCE'

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CIBSE consents to this response being published and to the Scottish Government contacting us about this response and any related topics.

The Chartered Institution of Building Services Engineers (CIBSE)

1. CIBSE is one of the leading global professional organisations for building performance related knowledge. The Institution and its members are the primary source of professional guidance for the building services sector on the design, installation and maintenance of energy efficient building services systems to deliver healthy, comfortable and effective building performance. Our focus is on adopting a co-ordinated approach at all stages of the life cycle of buildings, including conception, briefing, design, procurement, construction, operation, maintenance and ultimate disposal.

2. CIBSE publishes guidance related to heating, cooling, ventilation, lighting, public health engineering, fire safety and sustainability of building engineering services.

Consultation Response

Topic 1: Carbon Factors

Building type (domestic/Non-domestic): All

Nature of work (new build/extension/alteration etc.): All

Aspect of 2015 energy standards: Carbon Factors

Comments

Scottish Building Standards should use updated carbon emissions values for grid electricity, such as the ones proposed in the recent update to SAP. For SAP version 10, electricity emissions factors are being proposed to be updated to 0.233 kg.CO_2/kWh (Previously 0.519 kg. CO_2/kWh). The CO_2 factors for grid electricity used within the Scottish Building Standards at the moment do not represent current grid electricity CO_2 emissions, and predicted values over the coming years are set to fall significantly.

According to the government's greenhouse gas conversion factors, which are to be used in all required sustainability reporting, for 2017 the average carbon factor for grid electricity was 0.351 kg. CO_2/kWh (over the UK as a whole, this value is even lower when considering Scotland separately) and the electricity grid is predicted to decarbonise even further over the coming years (see page 36 from the UK Government's energy and emissions projections, reproduced below) to see that it should reach approximately 0.100kg. CO_2/kWh by 2027). Currently the overly high factor of 0.519 kg. CO_2/kWh incentivises the use of fossil fuel technologies that are higher in carbon value than others (such as gas boilers or CHP over heat pumps).

However, with very low electricity carbon factors, measures should be considered to encourage the use of technologies with higher Coefficients of Performance (COP), such as heat pumps, with typical COP in excess of 2.5, rather than direct electric systems with a COP of 1. COP is a measure of energy efficiency, the higher the value the better.

In Norway (which has a carbon neutral grid), building regulations require the input electrical energy to be less than the heat load - i.e. the average COP must be > 1). This is important to ensure that we use energy as efficiently as possible and not just use low carbon electricity wastefully, to reduce overall demand and to reduce pressure on the National Electricity Grid.

To align with broader Scottish Government policies such as the Climate Change Plan, which sets out ambitious targets for Scotland in terms of carbon reductions for the country, we must encourage designers to specify both low carbon and energy efficient technologies. To achieve this the carbon factors in the required energy modelling calculations must be updated, and consideration given to efficiency as well as emissions.

Figure 5.2: Emissions intensity (vs EEP 2016), gCO_2e/kWh[*3]

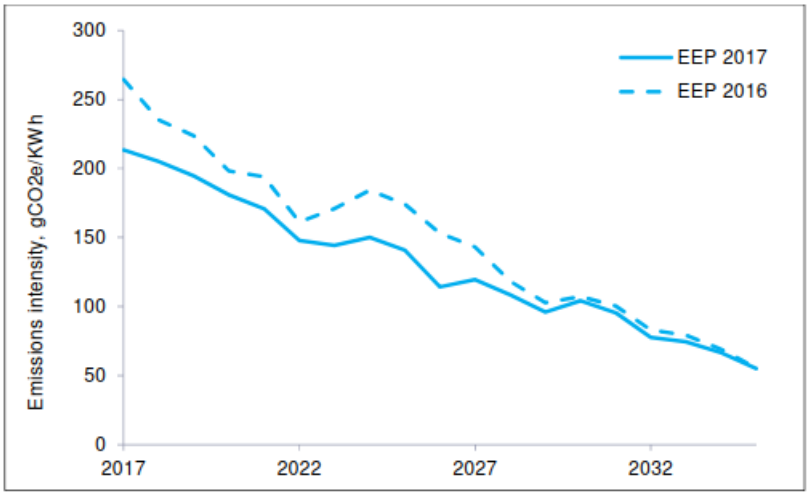

Figure 1 UK Government Updated energy and emissions projections 2017 (pg 36)

Evidence provided

Extract from the updated SAP guidance showing new proposed CO_2 values.

UK Government GHG (Greenhouse Gas) Conversion Factors for Company Reporting for 2017 (attached)

UK Government Updated energy and emissions projections 2017, issued January 2018 available from https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2017 (Figure 5.2 above is reproduced from page 36)

Topic 2: Designed versus as-built performance

Building type (domestic/Non-domestic): All (but primarily non-domestic)

Nature of work (new build/extension/alteration etc.): All

Aspect of 2015 energy standards: Designed versus as-built performance

Comments

We strongly support the proposal to review designed versus as-built performance of buildings within the revised Scottish Building Standards. However we believe that whilst a requirement to compare as built and designed performance is a step in the right direction, it will not be enough to close the so called "performance gap".

Some clients may just do energy monitoring and comparison as a tick box exercise with no intention of improving the result, which will not deliver the intended policy benefits.

To significantly improve the quality and performance of new and refurbished buildings (and there are more refurbishments than new buildings each year) incorporation of some form of post occupancy assessment and improvement, for example using elements from the "Soft Landings" Framework (which has been adapted into a British Standard, BS 8536-1:2015, Briefing for design and construction. Code of practice for facilities management.). Requiring buildings to achieve high Display Energy Certificate (DEC) ratings would also make a real difference, although may not be feasible within the Scottish Building Standards, and may require other legislative provision.

DECs are currently required for all public buildings in England, but not Scotland. They measure the actual energy use of buildings (from meter readings), and having a target for this focuses the design team on operation rather more than predicted EPC (Energy Performance Certificate) ratings, which are a theoretical measure of how energy efficient a building should be.

Significant research has been undertaken (for example see Better Buildings Partnership, "A Tale of Two Buildings") that shows that there is in reality little or no relationship between the actual and theoretical energy performance of buildings, i.e. you can have a building with an EPC B rating that in reality uses just as much energy as an E rated building. The following figure shows this for a number of buildings.

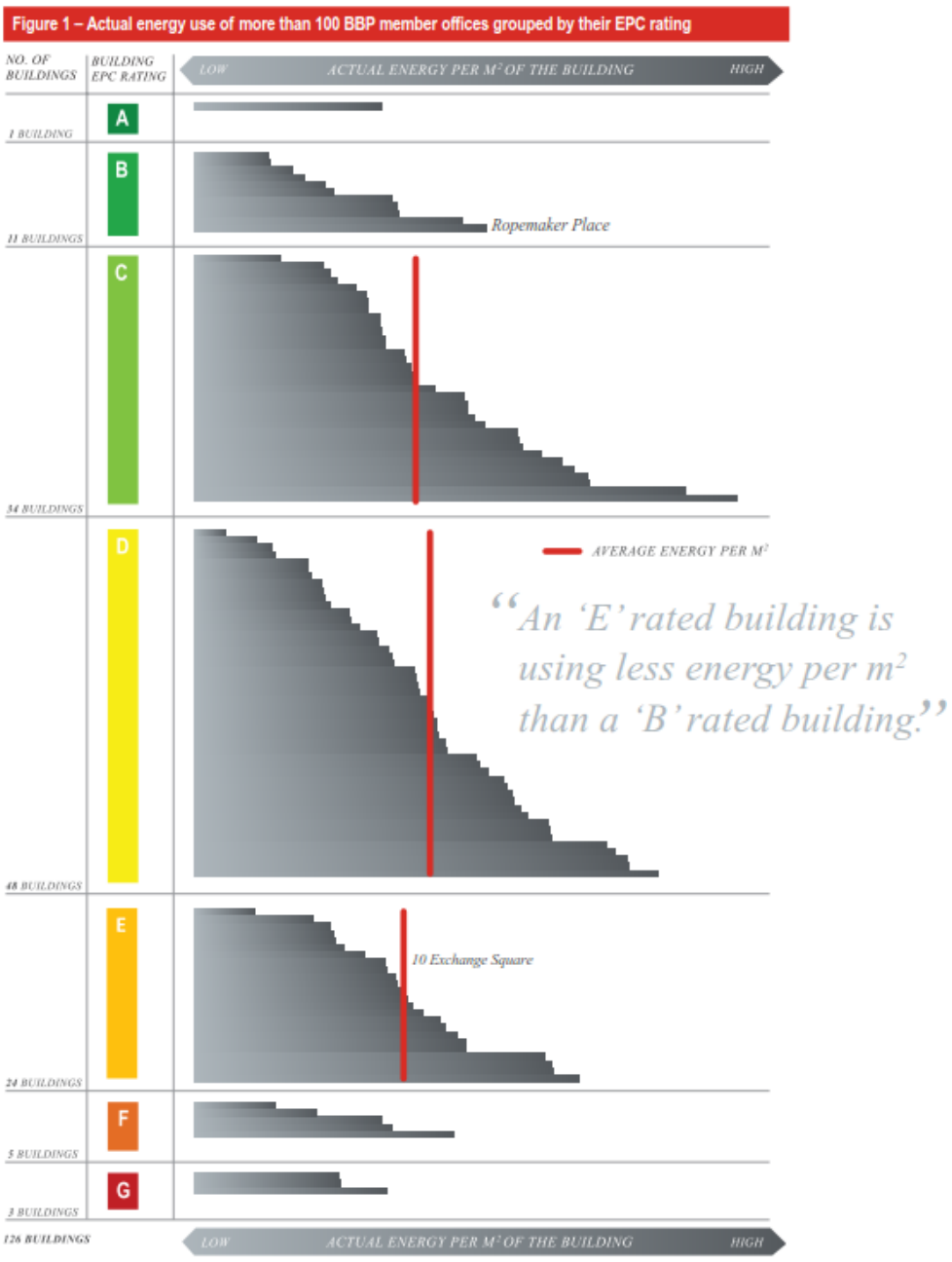

Figure 2 Better Buildings Partnership, "A Tale of Two Buildings", 2012 (page 5)

A key finding of the recent review of building regulations and fire safety in England related to the provision of information about buildings beyond handover – termed the "golden thread" of information. This is a key failing in many buildings and leads to a significant loss of performance, as well as having safety implications. The report proposed a requirement for digital asset models, which would go some way to ensuring that information about what has been built is handed over. It would not, on its own, solve the performance gap, but would go some way to assist.

There are many reasons for this performance gap and the Soft Landings Framework was created by a team led by Cambridge University nearly 20 years ago to address this issue. The Soft Landings framework was further developed by BSRIA, and forms the basis for BS 8536. If elements from the framework were part of building standards then we would have much better performing buildings. The five main stages include:

1. Inception and briefing: Engage a Soft Landings Champion to facilitate the process. Clarify roles and responsibilities of project team, carry out workshops to take on board lessons learnt from previous projects and to ensure the views of building users and managers are heard.

2. Design development and review: Embedding Soft Landings within design specification and tender documentation. Reviewing progress against set targets including energy model. Identify risks to the building's operational performance and agree mitigating actions for each stage of the project development.

3. Pre-handover: Involve designers, builders, operators, controls specialists etc. to ensure that handover is well planned, including staff familiarisation and training.

4. Initial aftercare: Greater involvement of the project team to be available to assist with user queries, react to problems and pass on knowledge. Seasonal Commissioning and fine tuning during operation should be included.

5. Aftercare in years 1 to 3 after handover: Monitoring and review of building performance. Project team make regular visits to observe the building in use, review the operation of the systems and make observations to assist in fine tuning the systems. The project team also support the building operators and occupants as they familiarise themselves with the building, helping to identify emerging issues and agree solutions.

There is a body of research available showing that significant energy savings can be achieved through the whole process. The aftercare element alone has the potential to deliver savings using in use energy monitoring and seasonal commissioning elements to compare actual energy consumption to predicted values, identify any issues with the systems installed and fine tune and address these problems.

The following figure shows the benefits of aftercare on the Hive building in Worcester, which won a CIBSE Building Performance Award for its sustained performance over a period of time following handover.

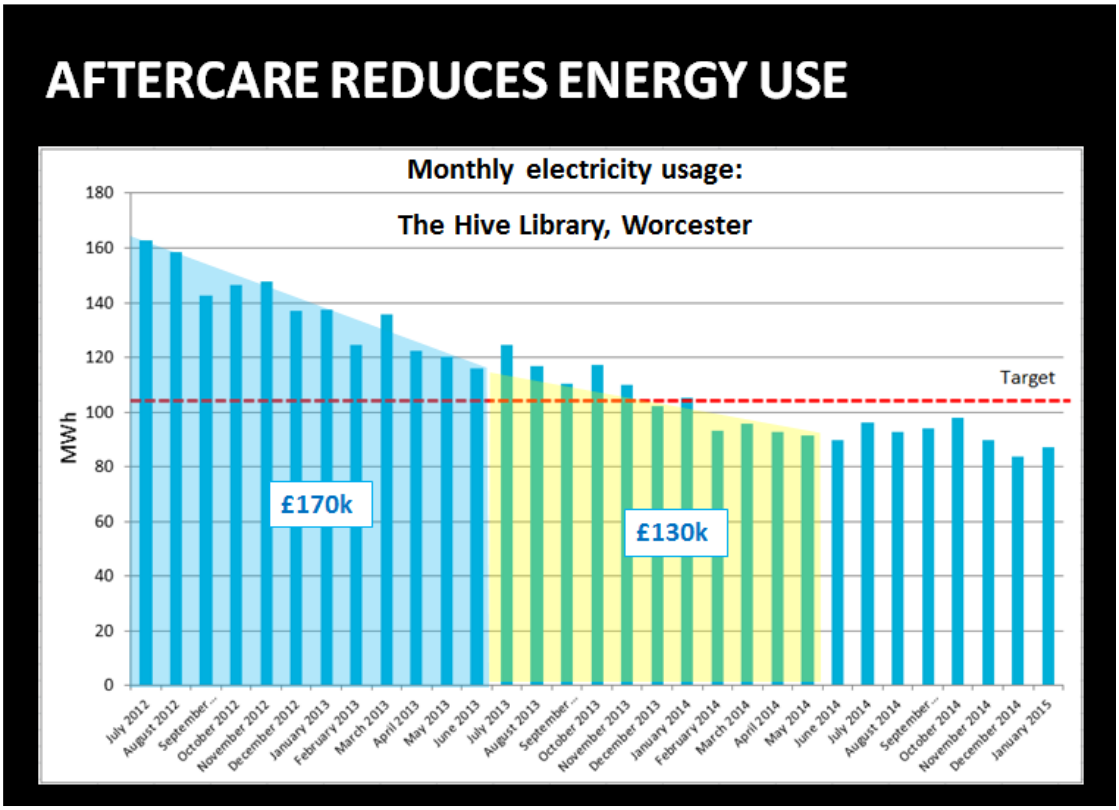

Figure 3 Electricity savings achieved during the aftercare for one of our projects

There is no clear guidance available for seasonal commissioning to cover what contractors should do as part of this work. Some consultancies have created bespoke schedules to include in tender documents setting out these roles and responsibilities (see evidence attached).

Some of the key benefits of aftercare can be summarised as:

- Supports appropriate staff in understanding the building operation.
- Enables emerging issues to be discussed with the designers and agree solutions.
- Facilitates the achievement of a comfortable internal environment.
- Highlights areas where improvements could be made to improve comfort, reduce running costs or modify the provision of facilities to meet changing needs.
- Facilitates the optimisation of building systems.
- Allows building performance to be benchmarked.

Requiring the use of more detailed and more realistic energy modelling such as CIBSE TM54: "Evaluating Operational Energy Performance of Buildings at the Design Stage" for more complex buildings would also help to address the performance gap. This approach requires designers to consider the actual intended operational use of a building and not just the standard default values required for basic energy certification.

There would need to be scope for smaller buildings to complete a less onerous version, perhaps aftercare or Soft Landings would only be required for projects over, for example, £5M. Also consideration would be required into how these initiatives would be policed, possibly requiring building control to see evidence that such a contract is in place for this work or that it is included in the tender documents.

Enhanced training around handover is also part of the Soft Landings process which is very important to make sure the users understand how to use their building in the most energy efficient way. Part of this is creating user friendly building user guides. This is a requirement within the domestic building standards, but should also be part of non-domestic standards. Also how is this element enforced?

Evidence provided: See figures and references in text.

Copies of the Better Building Partnership document and of the Seasonal Commisioning framework are attached.

Topic 3: Fabric energy efficiency targets

Building type (domestic/Non-domestic): All

Nature of work (new build/extension/alteration etc.): All

Aspect of 2015 energy standards: Fabric energy efficiency targets

Comments

For non-domestic building it is not currently mandatory to meet fabric energy efficiency targets. This means that the thermal performance of buildings can be poor and designers will just add on extra PV (photovoltaic) panels to meet the requirements and pass section 6. This is a perverse outcome of over-emphasis on carbon at the expense of energy efficiency. It is clearly not ideal and changes should be made to the Scottish Building Standards to stop this happening. To reduce carbon emissions the approach should always be firstly to reduce demand through improving the fabric performance and passive design strategies, then secondly installing efficient systems and only then, installing renewable generating plant such as PV.

Members in Scotland report that they have not observed significant change in building fabric (insulation) specifications since 2015, if any, compared to the 2010 standards.

Specifying good fabric performance in terms of U-values to be achieved etc. is one thing. Making sure that this has been constructed correctly is another matter. As items such as insulation are "hidden" it is often harder to check it has all been installed appropriately. These issues can greatly affect building energy performance and emissions over the whole life, and be very costly to remedy, but relatively low cost to prevent at construction. Use of thermal imaging would really help this matter. Currently air tightness testing is mandatory within building standards, but thermal imaging is not. The only times we have seen thermal imaging being used is for BREEAM projects where it is enforced. Here it has been really useful to be able to identify issues with the insulation. Also if thermal imaging is a requirement in building standards it should also be a requirement for the contractor to rectify any defects found.

Topic 4: Setting Standards in terms of energy and emissions

Building type (domestic/Non-domestic): All

Nature of work (new build/extension/alteration etc.): All

Aspect of 2015 energy standards: Setting Standards in terms of energy and emissions

Comments

We are in agreement of the proposal to set performance targets in terms of energy rather than just emissions, but we think that perhaps both energy and carbon emission targets should be set. We agree using energy targets will set a stronger focus on energy demand reduction. This method will also discourage the specification of inefficient direct electric systems. This method should also help encourage designers to think more about reducing the energy demand through improved fabric performance and efficient systems rather than relying on complex renewables to compensate for poor building fabric.

Members have worked on projects in Denmark and Norway, where the equivalent to Section 6 calculations, (BE 10 it was called at the time) were based on kWh rather than CO_2, but they applied factors e.g. if you used a low carbon heating method (i.e. the district heating network) you got to take 20% off your heating energy. There is scope for Scotland (and the wider UK) to learn from these examples.

Topic 5: National Calculation Methodology Issues

Building type (domestic/Non-domestic): All

Nature of work (new build/extension/alteration etc.): All

Aspect of 2015 energy standards: National Calculation Methodology Issues

Comments

There are aspects of the National Calculation Methodology - Standard Assessment Procedure (SAP) & Simplified Building Energy Model (SBEM) that we consider are not representative and present challenges in calculating and reporting building energy performance. These include:

- Carbon factors are not accurate (see explanation in topic 1 above)
- District heating losses are not accurate - see for example http://www.maxfordham.com/research-innovation/new-metrics-for-communal-heating-design
- Hot water load is substantially overestimated particularly for certain types of building. This leads to oversized plant, extra cost and also more complex designs that are not required. For example we have seen this issue in sports centres where the model has over-estimated the hot water demand significantly. CIBSE is currently undertaking research with Heriot Watt University into water demand modelling to help update the figures used.

- Theatre models - We have designed many theatres and the models always assume high usage during the day as well as night, but most theatres tend to operate mostly during the evening. Not many theatres put on shows and events in their main auditorium during the day and so the energy estimates for theatres is usually much higher than reality.
- Rural locations - we find that the model calculations are often forcing us down an overly complex route for rural buildings for example needing to use heat pumps to pass, which is not ideal. In rural areas there is often a lack of skilled installers and maintenance contractors. Clients without a specialist maintenance team are less able to keep on top of the maintenance regimes required for complex installations and then have struggled to get people out at short notice to fix problems. In previous building standards we felt forced down the path to specify biomass which we have seen that caused clients in rural locations a lot of difficulties, but now the standards promote the use of heat pumps. This is not ideal for rural locations that need systems that are easy to maintain and low cost to run. However heat pumps are lower in carbon which needs to be promoted.
- Perhaps heat pumps are less prone to failing compared to biomass (and less of an issue for air quality), but if there is a drive to increase the use of heat pumps, this needs to be matched by more training and there is a significant issue with grid reinforcement. Direct electric heating doesn't really break and with a gas boiler any plumber can fix them, so there has to be a way to improve market provision for the support and maintenance of lower carbon technologies.
- PV use - The generation from PV should be tied more closely to the building energy use and there need to be incentives for battery storage. At the moment there's no link between what you generate from your PV and how it's used. This has been noted above under fabric efficiency where there is a diconnection between energy efficiency and focus on low carbon technology.
- In Scotland EPC ratings are based on CO_2 per m^2. Buildings with inherently high energy consumption (such as a swimming pool) will have a very poor rating - even if it is the lowest energy swimming pool in the country. In England the EPC rating is normalised to the notional building - i.e. a C rating represents a building regs pass. In Scotland a good swimming pool with have a G rating.
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Topic 6 Energy Storage

Building type (domestic/Non-domestic): All

Nature of work (new build/extension/alteration etc.): All

Aspect of 2015 energy standards: Energy Storage

Comments

The new Scottish Government Climate Change Plan says that the Government will be advocating the use of energy storage systems. To align with this broader government goal and to help address the growing issue of demand management within the national

grid, the Scottish Building Standards update should incentivise the use of energy storage, such as electric battery storage and heat storage systems. Demand management within the national grid is becoming more and more an issue now with increased use of unpredictable renewables and increased demand through electric vehicles and electrification of heating through heat pumps. Electrification of heat means the demand for electricity will fluctuate throughout the seasons much more than before. Increased use of renewables as the source of electricity also fluctuates seasonally. Increased use of storage will help to balance these peaks and troughs and prevent wastage (currently wind turbines are sometimes turned off as there is too much electricity for the grid to cope with, and then at other times when we do not have enough and we need to import it from abroad).

On a building level electric battery and heat battery storage can be used. There could be extra benefit in the energy model for using these items. If installing PV, particularly for domestic buildings, a battery should be required, or the model should reward installation. This is particularly important for domestic as in most cases the PV panels are generating electricity when it is sunny during the day when most people are out at work. Using a battery allows the users to benefit from the electricity generated by their panels and there would be fewer issues with demand management on the national grid. This has really taken off in Germany, where the German Government have offered subsidies for energy storage for homes with PV. In the energy model there is a CO_2 reduction percentage for use of PV. An extra percentage reduction for storage plus PV would help incentivise this technology. At the moment there's no link between what you generate from your PV and how it's used.

7 Electric Vehicles & Car Charging

Building type (domestic/Non-domestic): All

Nature of work (new build/extension/alteration etc.): All

Aspect of 2015 energy standards: Electric Vehicles and Car Charging

Comments

We agree with proposals to work with Transport Scotland, to investigate provision of Electric vehicle (EV) charging points or enabling infrastructure within new buildings. This is very important to include in the Scottish Building Standards. However requirements need to be very clear. The charging points need to incorporate Smart Charging software and Time of use tariffs (TOUTs) i.e. when you drive home from work and plug in your car it shouldn't start charging till off-peak time during the night unless you need a quick charge to go out later that evening, otherwise this will put extra pressure on the electricity grid. Peak time is 6pm-8pm.

We strongly agree this should be included within Scottish Building Standards, but are unsure if this should be covered by Section 6. Electric vehicle car charging points would actually increase the building energy use, so would they be included within the energy model as it would then penalise those with a charging point? It may be more suitable to for this to be included in a different section of the standards. If included within Section 6

then the modelling implications would need to be clearly thought through to ensure electric vehicle car charging is incentivised and not penalised (or used for gaming!).

Evidence provided

Max Fordham LLP Electric vehicle design considerations summary document. (Contributed with permission).

Topic 9: Training

Building type (domestic/Non-domestic): All

Nature of work (new build/extension/alteration etc.): All

Aspect of 2015 energy standards: Training

Comments

Architects are less skilled now than before for example in areas such as thermal bridging. Upskilling and training is required in areas such as this. Installers also need to be upskilled e.g. heat pump installers to ensure that complex and new renewable technologies are installed correctly to maximise the savings achieved.

Rural areas often lack skilled installers and maintenance contractors. Clients without a specialist maintenance team are less able to keep on top of the maintenance required for complex installations and then have struggled to get people out at short notice to fix problems. We have seen that many rural locations have struggled with biomass for this reason. Heat pumps are less prone to failing compared to biomass, but if there is a drive to increase the use of heat pumps, this needs to be matched by more training.

Topic 10: Section 7 Sustainability

Building type (domestic/Non-domestic): All

Nature of work (new build/extension/alteration etc.): All

Aspect of 2015 energy standards: Section 7 Sustainability

Comments

When will Section 7 - Sustainability be updated? Currently the certificate has limited meaning as you can get a silver rating by default for passing the Section 6 Energy Standards. Sustainability is a lot more than just energy use and carbon emissions. We should be ensuring buildings are designed to adapt to climate change (in terms of overheating, flood risk etc.), have good indoor air quality, reducing pollution (noise, air, light etc.), ensuring sustainable construction management procedures are followed such as the CCS scheme, reducing onsite energy consumption, construction waste management etc. Scottish Building Standards could be more ambitous in terms of sustainability. These items are addressed within BREEAM, but as BREEAM is not mandatory many clients are choosing not to pursue it. It would be helpful if Section 7 incorporated some of the themes within BREEAM.