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Energy efficiency in buildings

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CREDS responds to consultations and calls for evidence from government, agencies and businesses, providing insight and expertise to decision-makers.

This response was created for the House of Commons Select Committee on Business, Energy & Industrial Strategy call for evidence into energy efficiency in buildings.

The consultation response written on behalf of CREDS by Peter Mallaburn and Tadj Oreszczyn at UCL, with input from Cliff Elwell, Ian Hamilton, Gesche Heubner and Robert Lowe, and from Nick Eyre, Tina Fawcett and Kay Jenkinson at the University of Oxford.

The full consultation response, as submitted, is below.

UK Research and Innovation
EPSRC Engineering and Physical Sciences Research Council
E·S·R·C ECONOMIC & SOCIAL RESEARCH COUNCIL

Written evidence from the UKRI Centre for Research into Energy Demand Solutions (CREDS)

Introduction

1. CREDS is a major initiative of the Energy Programme of UK Research and Innovation. It is a distributed research centre, involving 13 universities, with the building team located at University College London (UCL). CREDS began in April 2018 and will run to March 2023, with a budget of £19.5 million. More information is on our website.

2. This submission was prepared by Peter Mallaburn and Tadj Oreszczyn at UCL, with input from Cliff Elwell, Ian Hamilton, Gesche Heubner and Robert Lowe, and from Nick Eyre, Tina Fawcett and Kay Jenkinson at the University of Oxford.

3. Our answers to the Committee's questions are provided below, beginning with a summary and short section outlining our view of the future direction of energy efficiency policy in the UK. We confirm that we would be happy to provide further evidence to the Committee either in writing or in person.

Executive Summary and Recommendations

4. Energy efficiency policy in the UK is adrift. Our view is that this is because policy focuses on technologies and costs and not on the wider "multiple benefits", such as productivity, health and welfare and lower public spending. A shift to such a benefits-driven, demand-led approach is proving to be successful in other countries and could be replicated here.

5. Buildings could benefit significantly from this approach because of the untapped savings potential and wide range of multiple benefits that policy can exploit. However current policy focuses on the building and not the user. Also the EPC itself suffers from a range of accuracy and reliability issues that significantly reduces its value as a policy tool.

6. We strongly recommend that UK energy efficiency policy be reconfigured to take a multiple benefit approach. We suggest that buildings could be used to pioneer this approach given the potential and the range or international exemplars available to learn from.

7. However we consider it crucial that the government accepts that energy efficiency cannot be left to markets alone. Government needs to intervene to help businesses and householders recognise and realise the value of energy efficiency so that they can make the necessary investments themselves.

Strategic comments: a new direction for energy efficiency

8. The UK's strong performance on emission reductions would have been impossible without energy efficiency. We pioneered emissions trading and obligation schemes and had one of the most comprehensive programmes in the world. However this legacy has now been lost. New policies are

proposed but with no clear strategic vision and little time left to make an impact on the fifth Carbon Budget.

9. To understand where we go from here, we need to learn from the past[1]. In the 45 years since the oil shocks, policy has gone through two stages. The first, driven by fuel prices and competitiveness, focused on "technology-push" such as standards and subsidies. The second, from around 1990 and driven by climate change and energy costs, focused on overcoming investment barriers such as finance and skills.

10. However the Green Deal showed that energy costs were not enough especially when coupled to over-reliance on market forces coloured by austerity[2]. The end-result was too dependent on private finance and completely misunderstood householder needs. Similar lessons are being learned with business policies such as the Carbon Reduction Commitment.

11. In the last 5 years new policies are emerging that move beyond energy costs to the wider "multiple benefits" of energy efficiency[3] such as health and comfort, productivity and competitiveness, and innovation. These "market pull" policies exploit the specific benefits that energy efficiency brings to business and householders.

12. The common feature of these policies is that they focus government intervention on the strategic value of energy efficiency to end users. The right mix of policies is used to catalyse investment and, properly managed, allow the government to pull back when the market has built enough capacity to do the "heavy lifting" itself. A good example of this is commercial building energy performance disclosure in Australia.

13. There is no reason in principle why the multiple benefit approach cannot be developed in the UK and fit within a UK policy landscape. The problem is that these policies rely on a close, long-term, strategic relationship with key market actors. However with the defunding of the Carbon Trust and Energy Savings Trust in 2012 government no longer has the capacity to manage programmes of the complexity needed.

Who should have responsibility to pay for energy efficiency?

Ultimately, with the right policies, no-one.

14. Current policy is based on energy cost savings being greater than the up-front investment cost of energy efficiency. This was the basis of the "Golden Rule" underpinning the Green Deal. This holds true for the very largest and intensive energy users.

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[1] Mallaburn, P. & Eyre, N. (2014): Lessons from energy efficiency policies and programmes in the UK from 1973 to 2013. Energy Efficiency 7, 23-41.

[2] Rosenow, J. & Eyre, N. (2016): A post mortem of the Green Deal: Austerity, energy efficiency, and failure in British energy policy. Energy Research and Social Science 21, 141-144.

[3] International Energy Agency (2014): Capturing the multiple benefits of energy efficiency. IEA, Paris.

15. But for most of us energy cost savings are both marginal and difficult to realise so that the cost of realising them easily outweigh the benefits. For buildings the "landlord/tenant divide" means that the costs and benefits usually accrue to different actors, which makes matters even worse.

16. However in the last 5 years new policies are being developed that focus on the non-cost "multiple benefits" of energy efficiency:

- For householders an energy efficient home is quieter, easier to maintain, more comfortable and easier to mortgage.
- An energy efficient business is more productive, has access to new customers and government funding a stronger reputation and lower compliance risk.
- An energy efficient building is easier to let, has a higher capital value and realises better rental income, longer leases and void times.
- An energy efficient public sector reduces public spending, allows more services to be delivered and shows leadership to the wider economy.
- An energy efficient economy creates high value jobs, fosters innovation, creates new business models and boosts productivity.

17. UK policy needs to shift away from a simplistic focus on energy costs to a multiple benefits approach. To do this, three things are needed:

- First the government needs to recognise that, properly configured, energy efficiency is a public good. At present, the inference is that energy efficiency is a burden to be avoided or a public cost to be outsourced or minimised.
- Second there will be parts of the economy where the benefits of energy efficiency are too small to be worth chasing. The government needs to find ways of segmenting the economy so it focuses resources and political capital where it can do most good.
- And finally, as we have learned several times in the last 45 years, markets will simply not deliver energy efficiency on their own. Similarly well designed subsidies or regulations can significantly reduce fuel expenditure, carbon emissions, and improve health and comfort, however, poorly designed ones don't.

Should energy efficiency be considered a national infrastructure priority?

Yes.

18. Energy efficiency is an essential element of the delivery of an affordable, sustainable energy system. Building energy efficiency has a major impact on the viability of the electricity, gas and district heating infrastructure as well as the built stock. Energy efficiency also displaces investment in costly new energy supply, transmission and distribution infrastructure.

19. In many respects UK energy efficiency policy started as infrastructure policy[1]. In the early 1990s "Standards of Performance" (SOPs), the forerunner of today's ECO, were set up on the US

"least cost planning" basis where energy efficiency took precedence in the public accounts if it was cheaper than building a new power station or reinforcing the grid.

20. SOPs are used to provide energy efficiency programmes funded by a small levy on energy bills. The intention was for SOPs to cover all energy users (the Energy Saving Trust was the energy agency set up to do this) but politics intervened, and the ECO and its predecessors just apply to households. Since 2010 the focus has narrowed further so now it just applies to fuel poor households, with everyone else deemed "able to pay".

21. Ironically the UK's original SOP approach (now known as Energy Efficiency Obligation Schemes - or EEOS) was copied by the EU (then the EEC) for its early energy efficiency policies. The UK is the only country to restrict its EEOS to the residential sector.

Existing housing stock: Are the Government's targets to improve the Energy Performance Certificate (EPC) ratings of our existing housing stock ambitious enough?

Is there sufficient support in place to deliver targets for all homes to be EPC band C by 2035? Is the Energy Company Obligation (ECO) an adequate mechanism to ensure fuel-poor homes are upgraded to EPC band C by 2030?

For both questions, no.

22. Policy based on EPC targets have the potential to grow in importance as the policy environment moves to a more performance-based approach. Also linking EPC performance to the provision of finance, debt and subsidy will put EPCs in the spotlight and increase the legal exposure of the process generating them.

23. With this in mind we have significant concerns about the use of EPCs:

- Our evidence[4] shows that a Band C target will typically deliver only 20 to 30% of the energy savings that a SAP calculation would predict. This is because most D and E homes already use gas as if it were in a EPC Band C house.
- An EPC is an outdated way of valuing efficiency. It does not consider the wider benefits, such as health, welfare and comfort as well as reduced generation and infrastructure costs. Many of these costs and benefits are rapidly evolving.
- A Band C target is a very blunt instrument. For example, it may be more cost effective to apply more external insulation than required by Band C to avoid additional reinstallation costs in the future.
- More generally we have seen major discrepancies operating on a number of levels in the EPC data: between different assessors, between different classes of property, between assessments on the same property, between different EPC assessment regimes.

[4] A.J. Summerfield, T. Oreszczyn, J. Palmer, I.G. Hamilton, F.G.N. Li, Love J. , R.J. Lowe, What do empirical findings reveal about modelled energy demand and energy ratings? Comparison of gas consumption across the English residential sector, submitted to Energy Policy 8th December 2018.

Private rented sector: are the Government's private rented sector regulations for energy efficiency for both residential and commercial buildings ambitious enough?

No. Please refer to our comments relating to Band C EPCs above, and our comments below on progress on energy efficiency in the non-domestic sector

Are there implementation and enforcement challenges that need to be remedied?

Yes. We have serious concerns about the accuracy and reliability of EPCs.

24. To keep costs down and allow buildings to be compared, EPCs are snapshots based on the assessor's professional view of the building's physical characteristics and using standard assumptions on occupancy, heating times, air change frequency, system sizing and location. This approach is fine when it works, but all too often there are serious issues around the accuracy and reliability of EPCs, illustrated by two examples from our own research:

- **Problems with the underlying assumptions.** Until 2016, the government's SAP model was using the wrong U-value for solid wall properties[5], which meant that 30% of properties may have a worse rating than they deserved (see Figure 1 below). This has been rectified, but not all assumptions have been rigorously tested and so until they are SAP will not be accurate.

- **Problems with the assessment itself.** Analysis of EPC's from 1.6 million existing dwellings[6] each having two assessments suggests that a dwelling falling into one band has a high probability of shifting to a worse of better band purely by chance, see Figure 2 below, over half of highly rated buildings (A or B) get a worse rating second time around. Also, it seems that EPC assessors are simply not recognising energy efficiency measures: 77% of assessments failed to spot triple glazing[7] in BedZED one of England's first zero carbon developments. This combined with other mistakes meant that 30 out of 43 properties (70%) were given a C, or worse, rating when they should be rated A or B.

[5] Li et at (2014): Solid-wall U-values: heat flux measurements compared with standard assumptions. Building Research and Information.

[6] Crawley et al, "Quantifying the uncertainty of England and Wales EPC ratings using 1.6 million certificates", UCL Energy Institute, in preparation.

[7] Janet Young, Towards Zero Energy Buildings: Lessons Learned from The BedZED Development, UCL PhD Thesis, September 2015.

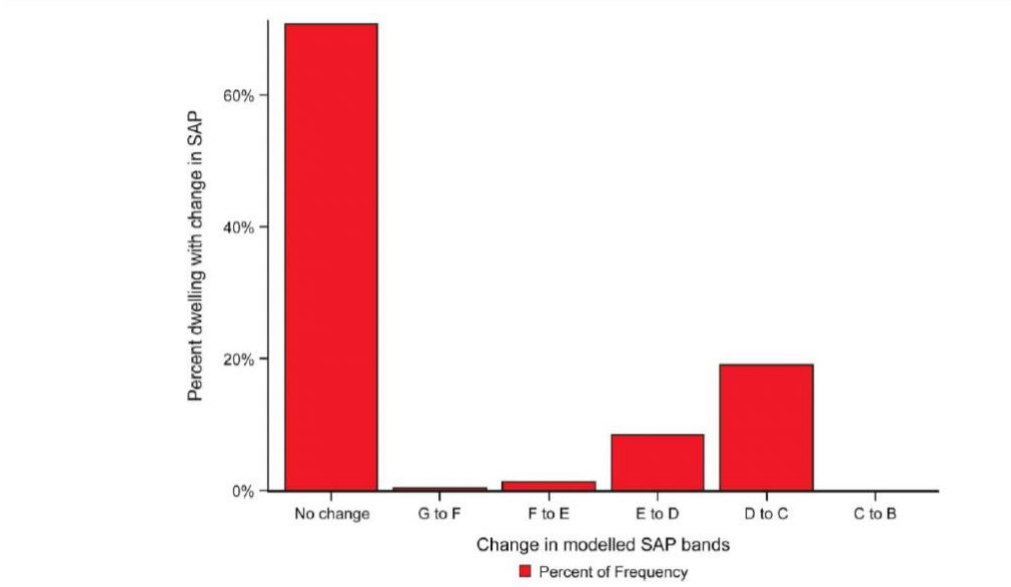

Figure 1: percentage of solid-wall dwellings that would move up an EPC band if the U-value for the solid wall were changed from 2.1 to 1.3 Wm²/K. From Li et al 2014.

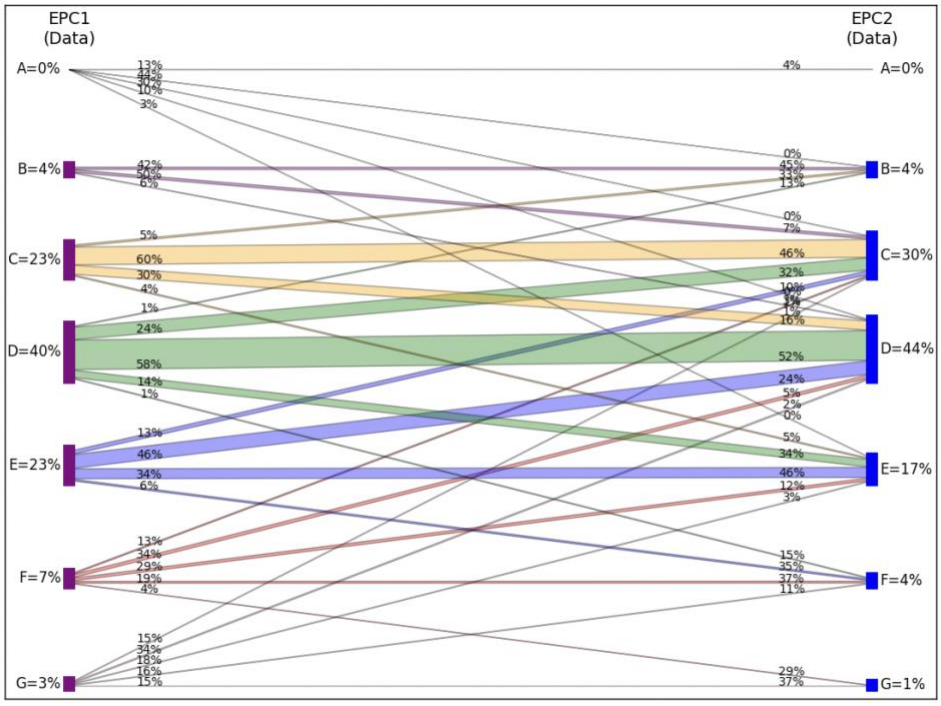

Figure 2. Visualisation of the extent of change of second EPC from first EPC for individual dwellings.

25. Both of these issues have serious consequences, but the BedZED example is particularly important because the properties involved, being highly efficient, attracted a price premium when originally sold that the occupiers would not have been able to recoup based on the second EPC rating.

Addressing accuracy and reliability issues

26. Improving the transparency of the EPC process is critical to improving reliability. Currently only a subset of data is made publicly available. Release would enable homeowners and researchers to question inputs into EPCs which in turn could improve the reliability if assessors were aware that their assumptions could be questioned.

27. We also think that it is important to very clearly label EPCs that have been cloned, i.e. generated from similar properties rather than detailed inspection[8]. Cloning is a legitimate time saving activity to replicate EPCs for similar properties. However, it is important that such cloned labels are clearly logged in the EPC register.

28. The reliability of EPCs could be improved by linking EPC data to smart meter data. UCL has been working on a method that method uses smart meter and weather data and allows actual building energy performance to be compared to predicted, without being confounded by the effects of occupancy[9][10]. This work is being taken forward by BEIS as part of the Smart Meter Enabled Thermal Efficiency Rating (SMETER) Innovation Competition[11]. Comparing in use, as built, smart EPC's with surveyor EPC's could play a significant role in reducing the performance gap when installing energy efficiency measures.

Regional disparities: Are there regional disparities, including in off-grid areas, in the delivery, costs and uptake of energy efficiency measures? If so, how could these be overcome?

Yes.

29. A review of the Warm Front scheme[12] "show that the uptake of measures among vulnerable households broadly mirrored the concentration of fuel poverty risk across England. Ethnic minority households made fewer applications to the scheme but were more likely be approved."

30. More generally[13], "Across England, fabric and heat efficiency interventions were shown to be highest in the North East and North West regions and lowest across London and much of the southern region (Figure 3). The uptake incidence rate (i.e. total number of installations for the period 2000– 07 over the total number of dwellings in 2005) for the fabric measures is highest around midland and northern cities such as Leicester, Birmingham, Liverpool, Manchester, Leeds and Hull. Heating system installations are also found in the large urban areas in the north and also in smaller cities in the south (e.g. Milton Keynes, Oxford, Southampton and Portsmouth)."

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[8] Energy performance certificates for dwellings in the social and private rented sectors. A guide to generating Energy Performance Certificates for similar dwellings owned by the same landlord, DCLG July 2008.

[9] Summerfield, A. J., Oreszczyn, T., Hamilton, I. G., Shipworth, D., Huebner, G. M., Lowe, R. J., & Ruyssevelt, P. (2015). Empirical variation in 24-h profiles of delivered power for a sample of UK dwellings: Implications for evaluating energy savings.

[10] Chambers, Jonathan David; (2017) Developing a rapid, scalable method of thermal characterisation for UK dwellings using smart meter data. Doctoral thesis (Ph.D), UCL (University College London).

[11] https://www.gov.uk/guidance/innovations-in-the-built-environment#smart-meter-enabled-thermal-efficiency-ratings-smeter-innovation-programme

[12] Hamilton, I., Agnolucci, P., Oreszczyn, T., Goodbye Warm Front: Evaluating the Delivery of Energy Efficiency Retrofits in Low-income Homes in England from 2005 to 2012, 2015 International Energy Program Evaluation Conference, Long Beach

[13] Hamilton, I., Shipworth, D., Summerfield, D., Steadman, P., Oreszczyn, T., & Lowe, R., (2014) Uptake of energy efficiency interventions in English dwellings, Building Research &Information, DOI: 10.1080/09613218.2014.867643.

31. Scotland, Wales and Northern Ireland have different devolved powers with regards to energy policy. Scotland has developed the Energy Efficient Scotland programme, and Wales the Energy Efficiency Strategy for Wales. CREDS research is going to develop knowledge and capacity multi-level governance. We will investigate comparisons between England and Scotland as well as researching different energy strategies, actions and outcomes at local authority level.

32. Earlier work by CREDS researchers has argued that more systematic, comprehensive and faster improvements in energy saving could be achieved through clearer UK and devolved national government frameworks for local authority action on low energy buildings and clean energy[14].

Non-domestic sector: What does existing evidence indicate about progress being made towards greater energy efficiency in public and commercial buildings?

33. Whilst emissions from industrial processes and households have fallen, emissions from non-domestic buildings have not[15]. Service sector energy use (around 93% of the total) is 10% higher now than 1970[16], with a 63% drop in energy intensity over the period more than offset by a rise in activity as the UK has shifted to a service-based economy. In 2014 this long-term decline in energy intensity ended and has since risen by 11%[17].

Buildings are an ideal sector for aggressive policy intervention because the multiple benefits available are significant. Efficient buildings attract a premium as a capital asset and higher returns, lower voids and longer leases when rented. They are also better places to work and offer significant reputational benefits when used as corporate headquarters. The benefits accrue to a wide range of actors: tenants, developers, investors and governments.

34. However the main reason for the lack of progress in the sector is the "performance gap" between regulated and actual performance. Tenants, investors & occupiers have no visibility on the performance of the assets they are seeking to own/occupy and cannot realise the benefits Developers are unable to provide tenants with accurate data to be used to justify investment or quantify the benefits of improved performance.

35. The problem in the UK is that the regulatory system focuses on predicted and not real-world performance, leading to a "compliance culture". Several countries have had considerable success moving to an end-user, demand-led "performance culture", of which the best example is the Australian commercial building regime.

[14] Webb, J., Tingey, M., & Hawkey, D. (2017): What we know about Local Authority engagement in UK energy systems: Ambitions, activities, business structures and ways forward. UK Energy Research Centre.

[15] BEIS (2018a): Energy consumption in the UK.

[16] BEIS (2018b): Helping businesses to improve the way they use energy. Call for Evidence.

[17] Committee on Climate Change (2017): An independent assessment of the UK's Clean Growth Strategy. From ambition to action.

36. We strongly recommend that the UK moves to a similar performance-based regime. The minimum energy efficiency standards (MEES) are a step in this direction. However it is too early to judge their impact. There are significant *de minimus* exemptions and relying on EPC banding is fraught with problems as we explain above.

37. UCL carried out research for BEIS looking at performance-based policies[18]. The key lesson is that a new "hybrid" policy approach works best, with government working in a long term, strategic partnership with industry. Key elements of this approach include:

- Leadership by government, through direction-setting and by minimum performance standards for buildings occupied by the public sector and their own estate.
- A system of in-use performance ratings and metering that clearly distinguishes between landlord's "base building" energy use and the energy used by tenants and establishes clear accountability for the energy use.
- Sufficient resources and expertise to ensure that the ratings methodology is robust, effectively marketed and easy to understand by all market players.
- Benchmarking and demonstration activities to spread best practice between market leaders and to promote the benefits of improved performance to the rest of market.
- Emerging advanced data analytics offer large potential to provide these services at low cost, and to support development of new service industries
- When the market is ready, appropriate regulations to enforce minimum performance reporting and disclosure with the aim of removing the worst performing buildings.
- A flexible system of market evaluation and feedback that allows policy to adjust as techniques improve and adapt or be withdrawn as the market begins to transform.

[18] Mallaburn, P. (2018). A new policy framework for business energy efficiency. UCL Energy Institute.