

## Enabling sustainable electrification of the UK economy

### Technological innovations and climate change: Onshore solar power

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The UK Green Building Council is an industry network with a mission to radically improve the sustainability of the built environment by transforming the way it is planned, designed, constructed, maintained and operated. As a charity with over 700 member organisations, we span the entire sector from some of the largest property owners, managers and developers, manufacturers, multidisciplinary advisory and engineering firms, energy providers and distributors and banks through to public sector bodies including the NHS, MOD and many local authorities as well as many SMEs.

#### Background

The Environmental Audit Committee (EAC) has launched a new inquiry examining the challenges and opportunities arising from the increasing use of electricity to power the economy of Net Zero Britain. As part of this it has issued a call for evidence. <https://committees.parliament.uk/call-for-evidence/3121/>

#### Summary

We very much welcome this inquiry by the Environmental Audit Committee, again showing leadership in an important aspect of the transformation the UK needs to make in the face of the climate and nature emergency.

This inquiry highlights the opportunities of, and barriers to the UK's solar power ambitions. UKGBC agrees that urgent action is required to ensure the UK can gain the optimal benefit of solar.

To make the most of these opportunities we highlight the importance of homes and buildings as a platform for solar – especially for new build where appropriate design can integrate solar as part of a clean whole house/building energy system. Such energy systems can provide the home owner with wholly renewable energy with which to run their home (for heating and power), and while the degree of energy supplied will vary by location, orientation and building type, the integration of storage technologies will allow the building to maximise the benefits of 'its' energy day to day and week to week.

While most buildings can deploy solar, the regulatory regime - neither the planning nor energy regulatory regimes, are aligned to smart energy capable homes and buildings as the norm. Yet the BEIS/Ofgem Smart Systems and Flexibility Plan (2021) highlights the fundamental importance of ensuring energy demand, and the infrastructures of demand, are as flexible as the variability of renewable supply. Without out the match of demand flexibility with supply variability there are significant additional costs of extra generation and network costs for the now higher peaks of demand.

Homes and buildings are the most important energy demand infrastructure, an importance that will only grow as EV numbers increase and more and more EV charging happens at home, the work place or other built environment settings. The right approach to new build and retrofit (upgrade) standards AND energy system regulation will enable home and building owners to play their part in providing a lower cost, more consumer-friendly net zero energy system.

In UKGBC's recent Heat and Building [scorecard](#) we highlight progress against the Heat and Building Strategy and identify key measures that could speed the arrival of a net zero built environment. A major opportunity this year is to set a Standard for new build that prompts design and build of smart energy capable homes and buildings AND facilitate greater renewable solar deployment

# Consultation response

Smart Energy Capable Homes and Buildings can help enable sustainable electrification of the UK economy.

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## Terms of reference questions

*The National Grid and the Government's energy targets*

### **1. What challenges does connecting more renewable electricity to the grid pose, both for those businesses and households who wish to connect to it, and for grid operators?**

The EAC is right to recognise that the ubiquity of renewable energy means renewable electricity can be captured and deployed at every scale from the home to the 'energy farm'.

Understanding this ubiquity and all that flows from it is a significant challenge to connecting more renewable energy, i.e., almost every home, building, office, school, hospital, et al can capture some renewable energy for its own use, not all energy has to be generated far away at large scale. As ubiquity of renewable energy drives decentralisation of the energy system, more and more local actors are looking at how they might take an opportunity, be that a household, a community, a local authority. Importantly they are bringing new resources and funding to the net zero challenge.

At present the energy demand of a typical home is met at the time it is required, there is no management or buffer between that demand and it needing to be met. The gross demand from the home is 'seen' by the networks and met immediately.

A smart energy capable (SEC) home will typically have energy storage and control systems. These provide some in-house energy ready to supply any demand, such as the battery as many EV owners already have in place to charge their car. With the right design this internal capacity can be installed to match much of the needs of the particular building. To some extent the storage has an energy function that is similar to the food system function of a fridge freezer. If we did not have these food storage devices everyone would have to shop for their breakfast, and we would have a far greater number of convenience stores or cafes in every community.

For these SEC homes demand can either be met by internal capacity or by the networks. Price and other signals from the network can inform which is the most appropriate response, which can include Building to Grid (B2G). B2G should be much more useful to the energy system than Vehicle to Grid V2G given building have known locations, will generally have greater storage capacity, and unlike an EV can also have energy capture, i.e., solar PV, adding to its capabilities.

This in turn means that while electrification of cars, and heating for homes, will see a rise in domestic electricity demand, a SEC Home will be able to offset some of this increased demand with its own solar PV supply. What was once an immediate gross demand can now be a managed net demand.

With 40% of existing homes (~10m) being semi or detached there is considerable potential in their upgrade to SEC, while all new homes could be designed to be energy capable from the start – the right building standard from 2025 will help deliver this, in turn reducing the demand being made on the electricity distribution system, and supporting the ban on fossil gas heating systems.

In the particular case of the household, a home that is renewable energy capable will often also reducing the energy system costs incurred by the rest of us as it will tend to show demand that is symbiotic, i.e. it

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would manage its energy demand, using its own supply and storage, rather than be an unintelligent demand at the point of use we currently have – this in turn creates peaks of demand, typically morning and evening which sets the requirement for the size of the overall system. Energy capable homes and building can significantly reduce the size of the system we will need, even with the switch to increasing electrification.

As the Smart Systems and Flexibility Plan 2.0 (Jul'21) highlights enabling demand side flexibility could save many tens of billions over the coming decades by avoiding the building of excess generation capacity, or network infrastructure, otherwise required to meet a higher peak demand. Yet even in 2023 there are new homes being built and connected to the energy system that are energy inefficient – drawing disproportionately from the system and existing users, requiring more energy than they should for heat and power. We all in turn pay for that excess capacity through charges in our energy bills.

The UK's ability to reach 100% renewable energy will significantly depend on our ability to reduce demand for energy, and to use the energy we do effectively. The infrastructures we put in place now will affect our ability to do this, starting with the homes we build – will they continue to lock in excessive, inefficient, unproductive energy use?

Many of the business plans for the DNOs prepared for the RII0-ED2 cycle (running April 2023 to March 2028) highlight the need to help install EV charging, heat pumps and other Low Carbon technologies (LCTs). Yet these plans tend to describe installations in isolation, higher electricity demand without management. More needs to be done to ensure DNOs promote optimised solutions such as SEC Homes, as they will allow more domestic energy technologies to be connected within a given substation headroom. We acknowledge Ofgem's changing language moving to CER, Consumer Energy Resources, as a way of describing the growing prevalent of these technologies.

We know homes that are smart and energy capable will be energy effective, supporting the grid lowering bills and providing households with a cleaner, cheaper to run home, while also helping avoid greater costs to all other customers.

Building the best homes we can from 2025, will help enable sustainable electrification of the UK and its economy.

**2. To what extent do the following act as barriers to the UK's targets to decarbonise the power supply? How well is the Government addressing these barriers, and what else can be done to address them? What, if any, targets should be set in these areas?**

- a. grid connection delays and bottlenecks, onshore and offshore;
- b. lack of, or delays to developing, necessary infrastructure;
- c. insufficient scale or capacity;
- d. supply chain and skills constraints, and
- e. access to finance

**3. How resilient is the National Grid? How does it need to adapt to achieve the Government's targets of (a) decarbonising the UK power system by 2035 and (b) becoming a net zero economy by 2050? What changes are needed to promote resilience through diversity of supply?**

Some of the answer to both (2) and (3) lie in whether buildings are viewed as future energy assets, building on the B2G capability of smart energy capable homes. If this is accepted then the profile of grid connections changes as homes become more capable and self-reliant; the necessary infrastructure will then start with what homes are equipped with, reducing some of the other network and generation infrastructure

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requirements. As will all other areas of net zero retrofit and upgrade skills, capacities and finance are all issues requiring further attention, yet the ubiquity of homes and buildings, combined with the ubiquity of renewable energy means they are an important levelling up solution in waiting.

4. **What contribution do, or should, localised mini-grids make to achieving the Government’s targets of (a) decarbonising the UK power system by 2035 and (b) becoming a net zero economy by 2050? What role ought there to be for decentralised energy distribution points and distributed energy generation in the future of electricity supply?**

As the ubiquity of renewable energy drives decentralisation greater numbers of non-energy actors are engaging in what this means for them. In practice this can be seen to take two overarching forms, (i) behind the meter solutions or (ii) between the meter solutions.

In both cases the meter/metering is smart, digitally connected and capable of working autonomously. Automation and machine learning can underpin smart control, akin to the energy management systems common in modern cars. Such systems are perhaps ten years ahead in vehicles, though the growth in EVs and home charging should close this gap

*Behind the meter* describes homes that have an integrated, interoperable home energy set-up, where energy capture, storage and different uses are considered as a whole, and where home energy demand is coterminous with supply. These homes are designed to be energy productive, built to a high standard to minimise losses they also capture and store energy to help provide heat and power to the users, and in some cases support wider grid operation. They will show a lower peak energy demand to the wider system, and can shift any peak they may have to a cheaper or lower energy demand time of day, also helping the system.

From a householder’s perspective they are the homes that allow them to charge their EV at home, from power the house has captured and stored itself; a home built to require less energy that can also provide a lot of that energy itself, leading to much reduced energy bills. Depending on the tariff or Smart Export Guarantee (SEG) they can also produce an income.

They include a range of approaches:

- Homes As Power Stations (HAPS), being deployed as part of the Swansea Bay City Deal;
- Active Buildings, developed from the on-going SPECIFIC research programme as well as a parallel four-year UKI programmes for demonstration and research (AB Centre and AB Centre Research Programme);

*Between the meter* describes a local area arrangement where local energy supply and demand assets are separate yet connected. Each will have its own metering and smart controls deliberately interacting with the other. These can support local renewable energy action, help optimise local demand and supply, or circumvent local grid constraints. They are often described as Smart Local Energy Systems (SLES), with examples across the country, including:

- The UKI programmes under Prospering from the Energy Revolution (PFER) supporting the demonstrators at
  - Energy Super Hub Oxford
  - Project LEO, Local Energy Oxfordshire
  - The ReFLEX project, Orkney
- The research programme EnergyREV – it identified over 700 examples of local energy schemes as well as developing tools and insights about further deployment of SLES

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- Some of the approaches and practice of SLES are being mainstreamed in some parts of the country by DNOs (e.g., SSEN involved in parts of the PFER demonstrators).

Both *behind* and *between* approach could make a significant contribution to the future energy system and its decarbonisation should government facilitate and incentivise their widespread deployment.

They can deliver an important part of the optimised energy system we will need if we are to make the most of variable renewable generation (e.g. reduced curtailment payments, see more [here](#) in one of the ‘white papers’ of the ABC RP).

It is clear that many households, and other local actors, are already adopting *behind* or *between* approaches respectively, in part driven by EV take-up and local NZ ambitions, yet local and decentralised schemes are not encouraged by the existing Ofgem regime, home retrofit expectations, nor building standards for new build.

5. What role will, or should, artificial intelligence play in decarbonising UK’s power supply?
6. **To what extent will the measures in the British Energy Security Strategy and the Powering Up Britain plan deliver the Government’s high-level targets of (i) decarbonising the UK power system by 2035 and (ii) becoming a net zero economy by 2050?**

Neither fully recognise the opportunity of smart, energy capable homes, which risks householders missing out on the benefits of homes that are cheaper to run, cleaner and easier to operate – while also supporting local and national net zero ambitions.

In practice it may be more problematic than just missing out. If the growing number of EV owners follow many of the earlier users, they will install solar PV and batteries and may expect a return, both from saving in their own in-house use, and through SEG or other flexibility payments (noting recent National Grid trials). If they find the system still doesn’t value their energy capability or worse changes to prevent them from benefitting that will have detrimental impacts on their wider net zero buy-in – after all some of these returns could help their other actions.

Smart, energy capable homes can enable buy-in and reward many more net zero actors; energy inefficient homes lock people into homes that are expensive to run, need improvement and deny them an opportunity to benefit from the net zero economy.

7. **How will the design of the future grid incorporate adaptation measures so as to minimise the potential impacts on the electricity system from extreme weather events, such as Storm Arwen in November 2021?**

Future grid design should reflect the growing deployment of energy assets at the user end of the network, the EV, the EB (Electric Building), assets that can provide energy as well as be flexible in their energy use (Building to Grid (B2G) as well as Vehicle to Grid).

If almost every car will be an EV, almost every semi or detached house with a drive will be capable of being a charge point, and hence of being V2G or B2G. Some 40% of UK homes are semi or detached. It would be a profound flaw if future design failed to consider what these homes could offer, when their energy capability could allow them to be self-sufficient for days at a time. That energy self-sufficiency would mean future storm disconnection would have much lower impact.

Smart energy capable homes are, by design, an adaptation measure.

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### *Storage and flexibility*

8. What developments, including technological developments, and incentives are required in the areas of:
  - a. storage;
  - b. transmission and distribution;
  - c. **demand management and flexibility, and**
  - d. **interconnection with neighbouring grids?**
9. **How will the expected growth of demand for electricity to power low-carbon technologies such as electric vehicles and heat pumps affect how supply and demand is balanced across the electricity system?**

Too much of the estimated growth of electrical demand is based on unmanaged demand and unintegrated demand and supply technologies.

As we highlight above, SEC homes are designed to integrate these demand low-carbon technologies with energy capture, typically through solar PV. Co-located energy capture and use, with storage and controls will go some way to balancing demand and supply at the point of use, also meaning that the rise in electricity demand from electrification seen by the networks could be lower than the gross total new demand of EV or electrical heating. Storage and control will also move some of the demand seen by the networks away from peak, making better use of the system 24/7.

Upgrading homes at scale and the setting of smart, energy capable standard for new homes would affect the net electricity demand seen by the electricity networks reducing system costs to all.

### *Governance and institutional arrangements*

10. Are the current governance arrangements for the grid fit for purpose? To what extent do the proposals in the Energy Bill address any issues in governance?
11. Does the current Electricity System Operator—or will the proposed Future System Operator—have sufficient powers? If not, what further powers will they need?
12. Is there enough resource available—across the Electricity System Operator, regulatory bodies, Government, and network companies—to deliver policy, regulatory and industry workstreams at the pace necessary to achieve Government targets? If not, what additional resource is required?
13. Is Ofgem fit for purpose as a regulator to deliver the increase in electricity supply and grid connection needed? Should Ofgem have a net zero remit?
14. Could the introduction of competition in parts of the network be used to reduce the cost to consumers in delivering a net-zero power system?
15. Is the five-year business plan cycle appropriate to achieve the overarching objectives of delivering a net zero grid by 2035 and a net zero economy by 2050? How does the pricing review process need to evolve to achieve the UK's strategic objectives on decarbonisation?

In considering each of these questions the future role of homes and building as energy assets, smart and energy capable, B2G will make a difference to successful solutions. For example, governance arrangements will need to take account of the governance and delivery of planning, building regulations and building

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control, and the non-energy actors as much as energy system considerations; local authorities will clearly have a much-increased role.

### *Planning, local government and communities*

16. What barriers are there in the planning process? Do the proposed changes to the National Policy Statements on energy infrastructure address these adequately? Can the grid development required be undertaken wholly under the nationally significant infrastructure project planning arrangements in the Planning Act 2008?
17. **Is land availability a constraint? If so, how can the constraint best be addressed?**

Land availability can in part be addressed by making the most of the solar platform offered by homes and buildings.

The 2022 Solar Feasibility Study by Power Markets suggests *five per cent of unused rooftop equates to 2,500 hectares of south facing roof space; while statistics identified by the United Kingdom Warehousing Association (UKWA) found that unused roofs on warehouses total 18,500 acres of land meaning the UK is missing out on 15GW of solar energy.*<sup>i</sup>

18. **How can communities be encouraged to accept the infrastructure required to increase capacity? What compensation, if any, might be required?**

The net zero transition raises key questions of who benefits and how they benefit. A focus on homes and buildings should ensure a wider spread of benefits than an approach that was more tradition, just based on swapping fossil fuel power stations for renewable farms. We will need some of that, yet the ubiquity of renewable energy means many more locations and scales of renewable energy technologies come into play. And while the 'farm' may have scale benefits it requires a significant scale of funding, socialised over many users.

Building based energy capture can engage householder and communities, it can provide them with direct economic benefits while reducing costs to others. If the regulatory systems governing energy and the built environment were to properly accommodate them and their potential many could be spurred to their own action simply on the basis of a return on activity, i.e., a Smart Export Guarantee suited to their use (flexibility).

The level of impact likely for communities that are now having to 'accommodate' new energy farms and grid infrastructure suggests the support and return they should receive will be many orders on magnitude greater than the SEG.

19. **What potential is there for community energy schemes to contribute to sustainable electrification? How can they be encouraged to develop?**

- a. **We would add "What potential is there for Home and Building Based energy schemes to contribute to sustainable electrification? How can they be encouraged to develop?"**

It would be an artificial and unnecessary constraint to restrict homes and buildings from the contribution they can make to sustainable electrification.

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It could also be a counter-productive constraint. Many EV users are already fitting Solar PV and storage to enable home charging. That capability could also power their Heat Pump or other electrical heating system. As more and more households take this path, they may all expect to be able to benefit from a SEG, and will hope to avoid the policy problems and closure of FeedInTariffs.

### **20. What role are local authorities playing in delivering the Government's targets to decarbonise the grid by 2035? Should net zero energy plans be mandated at a local level?**

Local authorities will be key to the UK's success in achieving net zero. They clearly have an important role in supporting the deployment of SEC Homes and Buildings, through Planning, Local Area Energy Planning, building control or their own actions on homes and buildings, helping their community reach net zero.

UKGBC convenes a forum of over 50 local authorities working to scale up the retrofit of existing buildings within their areas. Many have declared climate and nature emergencies and are highly motivated to support social housing tenants and owner occupiers to upgrade their homes and to support local installers and supply chains to skill up and scale up. They could be a huge engine behind delivering the Government's targets but they are significantly under resourced. The plethora of packages for local authorities from Government are consistently over complicated and restrictive and short term in their funding cycles.

Local authorities should be empowered and supported to set net zero energy plans at a local level with their own carbon budgets consistent with the climate science and nationally consistent approaches to carbon accounting. But a mandate without the resources to deliver risks failure.

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<sup>i</sup> [https://www.solarpowerportal.co.uk/news/using\\_5\\_of\\_uk\\_commercial\\_rooftop\\_space\\_for\\_solar\\_could\\_save\\_12.6\\_billion\\_an](https://www.solarpowerportal.co.uk/news/using_5_of_uk_commercial_rooftop_space_for_solar_could_save_12.6_billion_an)