THE ASSOCIATION FOR RENEWABLE ENERGY & CLEAN TECHNOLOGY

Homes Fit for the Future

Opportunities to meet and surpass the Future Homes Standard

An REA briefing to align the construction and energy sectors to reach our net zero target.

Briefing Paper

Spring 2020

Introduction

Despite the transition to the low carbon energy system being well underway, just 1% of new homes built in 2018 were rated EPC band A (Ministry of Housing, Communities & Local Government, 2019). Strong progress has been made in decarbonising the power sector, although it is now clear that the buildings sector lags behind. Cross-sector collaboration between the construction and energy industries, and immediate action, is imperative to meeting our newly adopted net zero GHG emissions target by 2050.

The built environment contributes to around 40% of the UK's carbon footprint (UK Green Building Council, 2017). The Committee on Climate Change also recently released their damning report on UK housing (Committee on Climate Change, 2019), stating that it is simply "unfit to withstand the challenges of climate change". The report finds that emissions reductions from the UK's 29 million homes have stalled, while energy use in homes – which accounts for 14% of total UK emissions – increased between 2016 and 2017.

It is also well understood that homes and buildings have a key role to play in the transition to a decentralised energy system. On-site renewable energy generation, alongside clean tech such as EV charging and battery storage systems are crucial to creating the smart homes of the future. Not only is this part of a

move to create more affordable, comfortable and healthy living spaces, but it is also striving to democratise the energy system by engaging prosumers and offering them the power to address climate change through their energy generation and consumption. The rollout of smart homes can also reap macro benefits such as offering grid flexibility to reduce the risk of blackouts and lower infrastructure costs, creating sustainable jobs, improving air quality and health, alleviating fuel poverty and more. This position paper demonstrates the opportunities for the upcoming review of Part L of the Building Regulations (titled Conservation of Fuel and Power), as a method to kick-start the renewables revolution within the built environment. New buildings offer a no-regrets, obvious solution to tackling long-term carbon emissions reduction and improving housing stock.

This briefing calls for six key policy implementations which are crucial as a baseline for all new buildings:

1. **Solar PV Roofing mandated as minimum standards**
2. **All new buildings to be smart electric vehicle charge point "ready"**
3. **Energy Storage mandated in all new buildings or developments**
4. **Three-Phase electricity supply as standard**
5. **Renewables and Clean Tech to be fairly acknowledged in Energy Performance Certificates (EPCs) and the Standard Assessment Procedure (SAP)**
6. **Renewable heat as standard in all new developments**

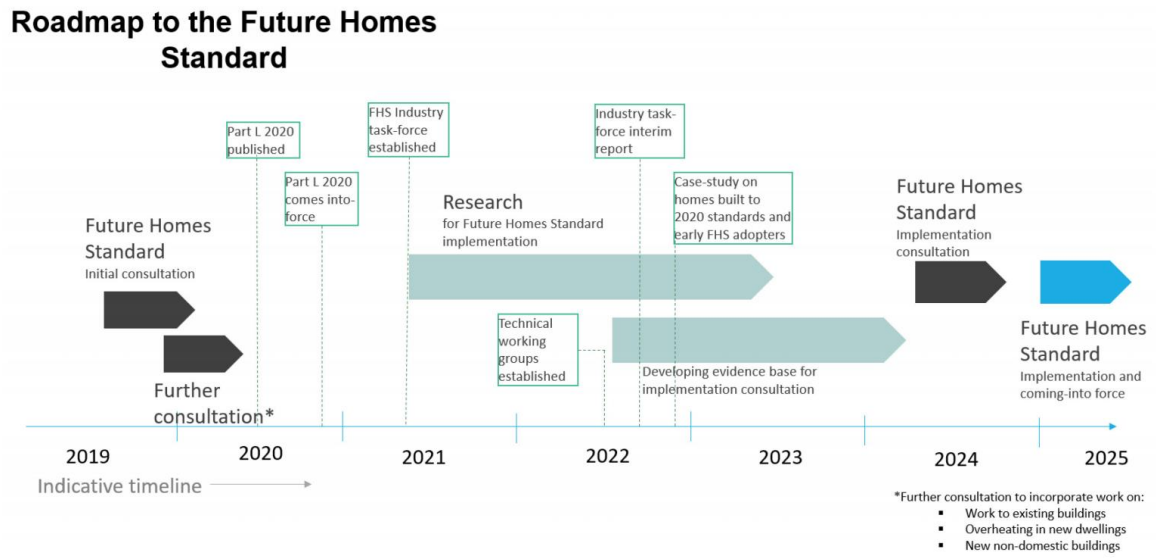
What has government committed to so far

In a flurry of consultation announcements and high level targets, the government has taken a turn from its position in 2015 which scrapped the zero carbon homes policy – estimated to have cost consumers around £200 in potential savings on a household's energy bill per year (Waite, 2019). Increasing pressure from the Committee on Climate Change, trade associations, campaign groups and especially recently, schoolchildren, has re-introduced the urgency of tackling emissions in construction, with standards for new buildings offering the first opportunity for action. The key policy focus areas include:

BEIS/MHCLG - Part L review	• Part L of the builiding regulations addresses the "conservation of fuel and power" • Current govenrment thinking includes the electrification of heat through heat pumps, and solar PV or Solar thermal supporting this, in addition to district heating • First consultation closed 7th February 2020
Future Homes Standard	• To be introduced by 2025 • Confirmed that all new homes will be off the gas grid • Built to a "world leading" energy efficiency standard • Part L review provides primer for improved standards • Green Finance Strategy also announced £5 million to help the financial sector develop green home finance products, like green mortgages
Industrial Strategy - Grand Challenges Buildings Mission	• At least halve the energy use of new buildings by 2030 • Establish the world's first net-zero carbon industrial cluster by 2040 and at least one low-carbon cluster by 2030 • Up to £170 million Innovation funding for "Transforming Construction"
OLEV / Energy Performance in Buildings Directive (EPBD)	• Consultation released on 15th July 2019 on min. 7kW chargers in new dwellings, derrived from the EU EPBD • Non-residential buildings with more than 10 parking spaces may have to install at least one recharging point, and install ducting for at least one in five spaces • Residential buildings with more than 10 parking spaces may have to install ducting infrastructure for every parking space
Standard Assessment Procedure (SAP)	• Crucial to EPC assessments, but very slow to be updated hence negative discrimination against emerging technologies • Reviewed fully every 3-5 years alongside part L • SAP 11.0 overhaul to be introduced in 2025 • Will look build on energy storage rating, integrate wider system flexibility value, improving methods of rating renewables and clean tech

Future Homes Standard

The UK has set in law a target to bring all its greenhouse gas emissions to net zero by 2050 – one of the most ambitious targets in the world. Homes – both new and existing – account for 20% of emissions. Despite progress in reducing emissions from homes, we need to go much further. New homes being built now and in the next 5-10 years will still exist in 2050 and therefore we must ensure that the energy efficiency standards set for them put the UK on track to meet the 2050 target. As part of the journey to 2050 the government have committed to introducing the Future Homes Standard in 2025. An initial consultation released in December 2020 set out what government thought a home built to the Future Homes Standard would be like. They expected that an average home built to it would have 75- 80% less carbon emissions than one built to current energy efficiency requirements (Approved Document L 2013). They also outlined that they expect this will be achieved through very high fabric standards and a low carbon heating system. This means a new home built to the Future Homes Standard might have a heat pump, triple glazing and standards for walls, floors and roofs that significantly limit any heat loss.



The initial consultation outlined expected timeframes for the research and implementation of the standard, with further consultation on work to existing buildings, overheating in new dwellings and new non-domestic buildings following soon after. They envisage research into the Future Homes Standard to commence from 2021 alongside the establishment of an industry task-force, and research to continue into 2023. From 2022 they propose to begin to develop an evidence base with the intention of consulting on the implementation of the Future Homes Standard in 2024.

Recommendations

Numerous property and construction stakeholders have come forward to voice their commitment to progress and leadership in this space. Stakeholders including Barrat Developments, Berkley Group, JLL, Lendlease, RIBA and more, signed a letter to the Secretaries of State in March 2018, calling on them to use the Environment Bill to tighten new build standards "without delay" (UK Green Building Council, 2018). Formal negotiations have also opened to progress a built environment sector deal (as of 22nd July 2019) led by the previous Minister for Business and Industry at BEIS, and the Minister for Housing and Planning at MHCLG (Malthouse MP & Stephenson MP, 2019).

Notwithstanding the election and its results, action is needed from government to define the policy framework, and put in place strong foundations for energy and construction industries to work together to innovate and build this space. Baseline requirements though, should be rolled out in all new buildings as soon as possible, if we are to meet our net zero GHG emissions targets. These minimum requirements include the following technologies.

1. Solar PV roofing as mandatory in all new buildings

Solar PV offers a solution for buildings to generate their own clean electricity, effectively becoming mini-power stations (or “active buildings”). This engages tenants in energy democracy, and offers a dependable method to tackle fuel poverty.

Retrofitted solar PV has an average payback time of 9.5 years (Greenmatch, 2019), unlike standard roofing which is a sunk cost. This means that over a 30 year period, solar roofs will not only be effectively free, but will have paid back 2-3 times their cost. This is without government support, although Smart Export Guarantee tariffs will allow prosumers to sell their excess power to the grid from 2020. Significant cost savings can be realised when installing solar PV on a new building, rather than when retrofitted, as scaffolding for example, will already be in place.

Solar PV costs have been falling rapidly since their initial development, and we are now seeing innovations from UK manufacturers such as Solar Roof Tiles (which can blend into roofs clad with concrete or clay roof tiles, or slates), solar glass (used for large office blocks or greenhouses), and solar bricks, falling to competitive prices. Clarification in legislation is also required on these building integrated solar innovations, confirming permitted development rights to local authorities on

technologies such as solar tiles, solar glass and solar bricks – see box 1 for more on this.

Micro grids are also encouraged for apartment blocks, or relevant developments, offering greater savings than standalone houses due to the reduced costs of one large installation over many small installations, in addition to better utilised energy consumption (due to a larger range of consumption patterns from consumers) in comparison to smaller standalone installations.

Box 1 - Innovations in Solar and Legislative Change Required

- Commerical installations - Panels must be situated at least 1 meter from the edge of the roof to recieve planning permission. This should not be required for building integrated solar panels or solar tiles on pitched roofs, to utilise the available space for energy generation.
- Solar tiles, solar glass and solar bricks should not be subject to visual impact regulations, considering their similarity to roof tiles, and are a perfect fit for properties in conservation areas and World Heritage Sites.

University of Cambridge Apartments

Photon Energy installed solar PV across 9 apartment blocks, including student accommodation, homes for staff and supporting facilities.

"The brown roof and pebbled areas created obstacles that had to be worked around, but installation was carried out to a high standard across the development."
Adrian Wells, Project Manager at Wates

Carbon emissions

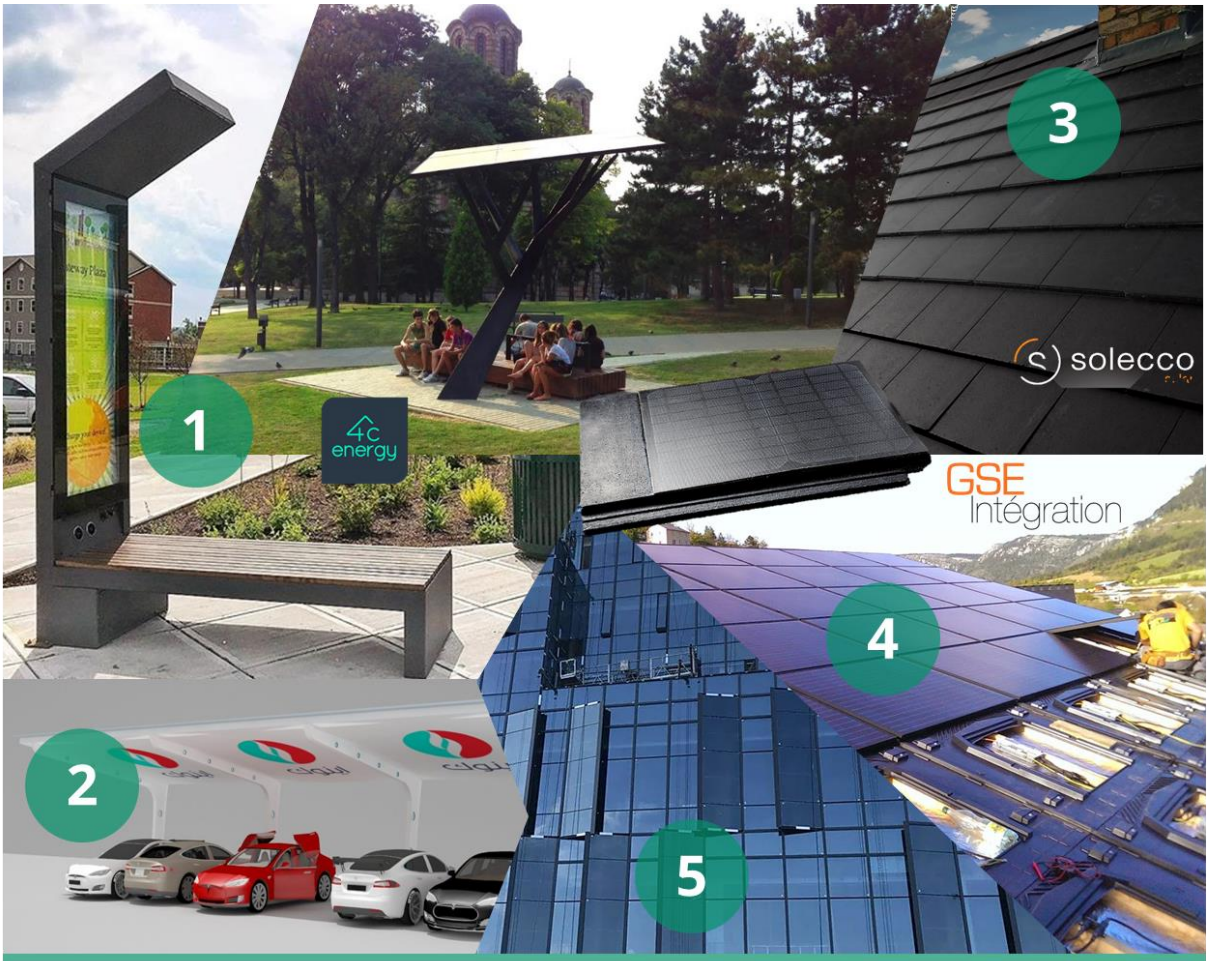
- Generates 262,355 kWh/annum, saving 136.2 tonnes carbon per annum
- equivalent to 450,000 car miles

Project Details

- 1,175 SunPower 327 Wp modules, K2 D-Dome mounting systems and Zeversolar inverters
- Cost at around £3,000 per 3kWp unit – average UK home size

Social Impact

- Aims to overcome Cambridge's rising land prices & overcrowding
- Development promotes sustainable living through triple insulation layers, a district heating system and solar PV



INNOVATIONS IN SOLAR

1. Solar Street Furniture

4C Energy's technology developed to cut solar PV modules to shape, has allowed for them to develop a line of street furniture including solar powered benches, which also incorporate Wi-Fi and USB phone charging.

2. Solar car port

Popular at workplaces, and shared/public parking, solar car ports designed and installed by REA members including Solisco, 4C Energy and Flexi-Solar, offer an in-built solution to EV charging. Excess electricity generation can also power nearby buildings or be solar back to the grid, and a range od designs offer marketing opportunities and shading solutions.

3. Solar roof tile

Solecco's solar roof tile is offered in a range of shades and styles including mimic slate and terracotta. Combining style and power, solar tiles are a plug & play solution optimising roof space and offering a solution for conservation area and aesthetically driven developments.

4. Roof integrated mounting system

Building integrated photovoltaics have become a common solution for new builds due to their ability to bypass the requirement for other roofing materials to be laid underneath, lowering capex costs. GSE Integration's flexible mounting system allows for a range of panels to be installed, backed by Velux standards.

5. Solar glass

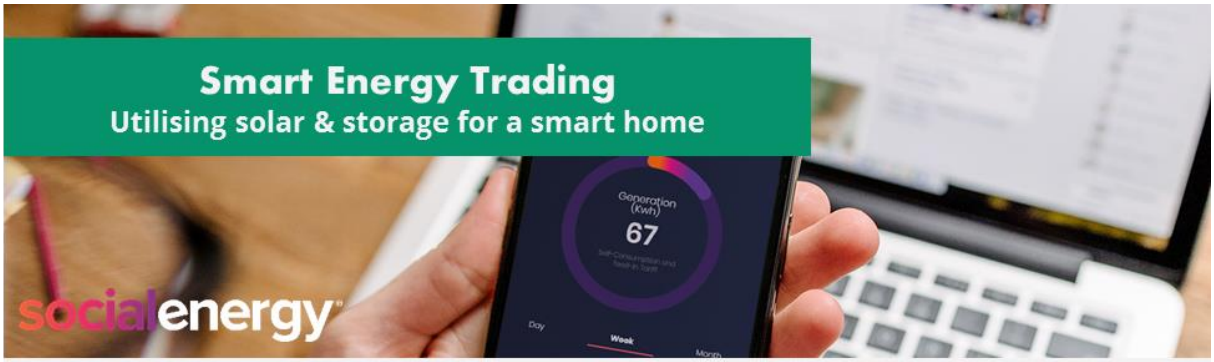
To date a more common development abroad, solar glass enables sky scraper office blocks to become in-city power stations, although another profound solution is its application in greenhouses for farming – allowing off grid/self generation to power HVAC and monitoring systems.

2. Energy storage as mandatory in all new buildings or developments

Energy storage costs are also falling rapidly, with Bloomberg NEF finding that there has been an over 73% fall in Li-ion battery pack costs since 2010 (Bloomberg NEF, 2017), and these are expected to fall further with the rollout of electric vehicles which use the same technology as most small scale and domestic battery storage systems.

The rollout of battery storage and other energy storage applications in homes or developments (for example a new housing development installing storage at the sub-station site) offer benefits to the homeowner, through utilising self-generation, and also to the wider energy system through grid balancing services. By storing power at off peak times, and selling it at peak times, this would be another active revenue generator and would help reduce consumer bills further which may be facilitated through the Smart Export Guarantee (REA, Government Confirms Details and Timeline for a Smart Export Guarantee, 2019) helping tackle fuel poverty. This therefore also reduces grid reinforcement costs, effectively lowering consumer bills across the UK (rather than only among new homeowners), and reduces our reliance on fossil-fuel powered peakers as dispatchable power generation – supporting the wider energy system to meet net zero targets quicker.

Commercial and industrial sites offer larger opportunities, with storage systems and their associated services helping control energy costs and often offering additional revenue streams to the operator through newly developing flexibility markets, or colocation with EV charging and generation assets such as solar.



Connected Homes to Support our Power System

Social energy are creating connected homes of the future, today. Saving customers money whilst also balancing the grid by helping to handle power surges, their smart AI technology manages solar and energy storage effortlessly, without affecting the customers energy consumption habits.

"My bill was so low, I thought it was wrong. My system is amazing!"
Social Energy Customer

Connected Systems

- Social Energy are working with government and research bodies to develop an EV charging, proposition and smart boilers too.
- They are also working with Social Housing providers – developing a solution for those in fuel poverty.

Project Details

- The average return on investment is 8 years
- The battery and hub include a 15-year warranty and 30-year returns.

Savings

- Customers save up to 70% on their electricity bills
- Reducing grid- electricity consumption by approximately 42% per year, swapping it for green energy powered by their own solar panels.
- Customers receive (on average) £103 in bill credits from energy trading & frequency response.
- Customers also benefit from a 5.6p/kWh smart export tariff, for power they sell back to the grid.

3. Electric Vehicle smart chargers, or the infrastructure to enable these, as mandatory in all new homes

Government has announced a ban on the sale of new Internal Combustion Engine (ICE) vehicles by 2040 (Pfeifer, 2018), with numerous auto manufacturers bringing their own deadlines forwards. The introduction of charge points in all new homes is required to both ensure smooth rollout of charging infrastructure and to support wider energy strategy interests in improving system flexibility. Support for charging hubs and on-street charging where homes do not have access to off-street parking is also required.

In line with the Energy Performance in Buildings Directive, the Office for Low Emissions Vehicles has released a consultation on its plans for EV Charge points in new residential and non-residential buildings. The proposals span existing non-residential and new buildings, making amendments to part L of the Building Regulations to allow for those details set out in the table below (Department for Transport, 2019).

The REA is supportive of the proposed amendments, seeking all new homes to be equipped with the necessary cabling to allow for the installation of an EV chargepoint and recommends that all such charge points installed should be smart enabled, to allow for consumers to maximise the benefits offered by future Time of Use Tariffs rewarding them for shifting their demand to times which support the wider energy system. There are pre-existing workstreams on 'smart' EV charging

ongoing through the AEV Act and Government EV Taskforces, which the REA and members are engaged with and the outcomes of which should form the basis of future EV chargepoint standards in new buildings.

	Existing	New
Residential buildings	Every building undergoing major renovations with more than 10 parking spaces to have cable routes laid in every parking space.	Every building with an associated parking space must have a charge point.
Non-Residential	At least one charge point in buildings with more than 20 car parking spaces, applicable from 2025.	Every building with more than 10 parking spaces to have one charge point at least, and cable routes for a charge point for one in five spaces

The Hague Football Stadium

Alfen's energy storage system can store the solar energy that is generated from the stadium's roof top PV, to power fans' electric vehicles, and the pitch lights, during the night.

"Through this initiative, we hope we will further stimulate the use of electric vehicles and consequently improve the air quality in our city."
Ton Koning, Program Manager Air Quality at the municipality of The Hague

On-site Generation

- Stadium able to utilise their solar power generation at night, reducing bills
- EV charging creates an additional revenue stream & caters to new customers

New Revenue Streams

- New energy trading revenue stream with addition of storage
- Supporting wider energy system smoothing out surges in consumption from EVs and storing excess renewable energy generation

Project Details

- 2MW Li-ion battery with 20 EV charge points in a hub, added to an existing 800 kW rooftop solar PV installation
- advanced load balancing platform to maximize the utilisation of the existing grid connection

4. Three phase electricity supply as mandatory in all new buildings

A move towards the electrification of heat in many buildings, the growth of home smart technologies, and the switch from fossil fuel transport, to electric based, will lead to larger power loads being placed on new homes. To support this development, three phase electricity supply should be required in all new buildings to ensure safe and optimised energy generation and consumption. Currently, many homes are unable to take a load of more than 3.6kW of power due to their single phase power supply, meaning many solar PV installations are capped at this (despite space for more power generation), or they install 4kW systems which spill electricity at peak generation times – wasting energy. Our Three Phase Supply position paper (REA, 2018) found that the additional cost to home builders would be a minimal amount per home for cabling, and it also details information on minimal changes to distribution boards and termination boxes which would be required, again, at a minor cost.

Wider reviews are required around grid connection costs for new developments, as currently DNOs (Distribution Network Operators) must charge for the greatest capacity required for a home's connection to the grid. This causes an overestimate in demand for homes and buildings which actually support the wider energy system through offering flexibility, rather than increased peak demand.

Three phase supply would enable the creation of active buildings and flexibility assets, through generation such as solar panels co-located with behind the meter

storage, or vehicle to grid technologies, in a truly decentralised, low carbon, flexible energy system.

Box 2 - Active Buildings - preparing our infrastructure for a flexible energy systm

- Grid connection costs - costs involved in connecting homes to the grid fall on housebuilders, and with increased energy loads resulting from self generation, higher energy consumption due to electrifying transport and heat, and the introduction of flexibility services, homes & buildings play a new role in our energy system transitioning away from purely consumers to active participants.
- Current regulations around the distribution of the costs of the grid are being revised, primarily though the Targeted Charging Review, and Access and Forward Looking Charges review.
- The government announced in Nov 2019 its decision to resturcture the charging regime, implementing a fixed capacity charge, which does not account for flexibility on the grid & penalises renewable power generators, and flexible buildings.
- The REA urges that these hurdles are reduced through the access and forward looking charges review (currently scheduled to be implemented in 2023) as soon as possible.
- It is recommended that a three phase meter is fitted to serve apartment blocks, with submetering, rather than separate metering for the common parts (landlords supply) and each dwelling. This is to allow for any potential solar/on-site generation installations to serve the whole building, including dwellings, rather than be restricted to serving the common parts. Further research is also required around electricity supply licencing, peer to peer trading and general landlord-tenant sale of power.

Energy Efficient Homes Built For The Future

Sero Energy is working in conjunction with Pobl Living, Tirion Homes and the Active Building Centre to build 225 low carbon homes utilising fabric first construction, renewable energy generation & storage.

"The homes at Parc Eirin won't have any gas so they'll have batteries, solar PVs, ground source heat pumps and super-fast car chargers. They will be extremely innovative and should significantly reduce the amount people spend on their bills."
Julie James, Minister for Housing and Local Government

Technologies

- All homes have energy storage and 3 phase vehicle charging
- Every home is heated via ground source heat pumps

Project Details

- Sero will monitor and manage each home's usage and optimise energy use
- Residents will remain in control of their energy usage via the Sero Life App

Integration with Grid

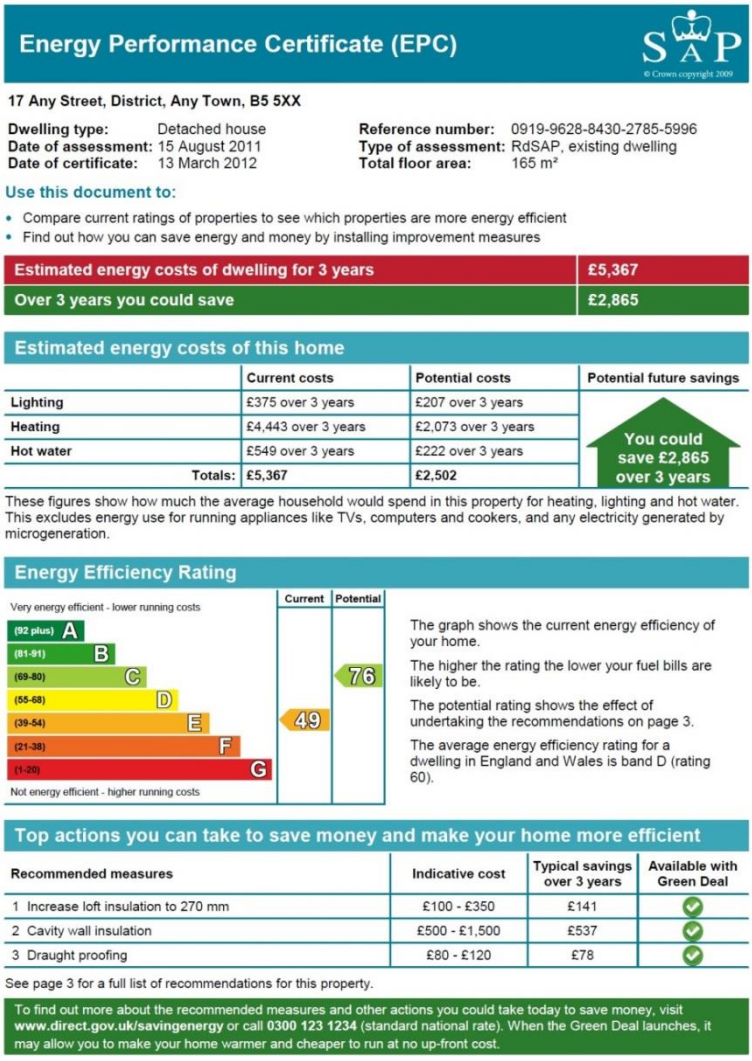
- Control systems on all technologies (including heat) enable the homes to support the grid system
- Largest development of it's kind in the UK with heat, electricity and transport optimisation

5. Renewables to be better acknowledged in SAP

One of the most pertinent measures of a building's "green" credentials is its Energy Performance Certificate (EPC) rating. EPCs are a tool which offer an A to Grating based on energy efficiency technologies and immoveable features in a building, such as insulation and boilers. They are used by a range of stakeholders, including consumers (to understand their expected energy bills and gain recommendations into how to upgrade their home), tenants (when choosing properties to rent), landlords/investors (when undertaking due diligence on acquisitions), policy makers (for a holistic view of the quality of the UK's building stock), policy measures such as the minimum energy efficiency standards (MEES – which ban the letting of extremely energy inefficient properties), financial institutions (whom are developing innovations in finance such as "green mortgages" rewarding those who choose to purchase more energy efficient buildings) and more.

The ratings are calculated through a complex set of data collection and analysis called the "Standard Assessment Procedure" (SAP or SBEM for commercial buildings), which takes into account a number of variables for the measured installations, including efficiency, cost, carbon intensity and more, offering a numeric rating from 0 to 100. This is then translated into an A – G rating for ease of understanding.

The SAP requires frequent updates, especially where technologies are falling in cost, improving efficiency, and reducing their carbon intensity rapidly – which can be seen at its peak in renewable energy and clean technologies. Current SAP calculations are extremely out of date, meaning renewable energy technologies, especially including solar, energy storage, and heat pumps, are at a strong disadvantage in comparison to longstanding, carbon intensive technologies such as gas boilers. The most recent version of the calculation methodology, SAP10 was introduced in July 2018, and will apply with the next update to building regulations, although work is ongoing on SAP 11, which looks to offer a more accurate overhaul of the method used to complete the assessment. Currently, despite now being in the third quarter of 2019, building regulations still rely on SAP 2012.



Energy Performance Certificate (EPC)

SAP © Crown copyright 2009

17 Any Street, District, Any Town, B5 5XX

Dwelling type: Detached house
Date of assessment: 15 August 2011
Date of certificate: 13 March 2012
Reference number: 0919-9628-8430-2785-5996
Type of assessment: RdSAP, existing dwelling
Total floor area: 165 m²

Use this document to:

- Compare current ratings of properties to see which properties are more energy efficient
- Find out how you can save energy and money by installing improvement measures

Estimated energy costs of dwelling for 3 years	**£5,367**
Over 3 years you could save	**£2,865**

Estimated energy costs of this home

	Current costs	Potential costs	Potential future savings
Lighting	£375 over 3 years	£207 over 3 years	You could save £2,865 over 3 years
Heating	£4,443 over 3 years	£2,073 over 3 years	
Hot water	£549 over 3 years	£222 over 3 years	
Totals:	£5,367	£2,502	

These figures show how much the average household would spend in this property for heating, lighting and hot water. This excludes energy use for running appliances like TVs, computers and cookers, and any electricity generated by microgeneration.

Energy Efficiency Rating

	Current	Potential
Very energy efficient - lower running costs		
(92 plus) A		
(81-91) B		76
(69-80) C		
(55-68) D		
(39-54) E	49	
(21-38) F		
(1-20) G		
Not energy efficient - higher running costs		

The graph shows the current energy efficiency of your home.

The higher the rating the lower your fuel bills are likely to be.

The potential rating shows the effect of undertaking the recommendations on page 3.

The average energy efficiency rating for a dwelling in England and Wales is band D (rating 60).

Top actions you can take to save money and make your home more efficient

Recommended measures	Indicative cost	Typical savings over 3 years	Available with Green Deal
1 Increase loft insulation to 270 mm	£100 - £350	£141	✓
2 Cavity wall insulation	£500 - £1,500	£537	✓
3 Draught proofing	£80 - £120	£78	✓

See page 3 for a full list of recommendations for this property.

To find out more about the recommended measures and other actions you could take today to save money, visit **www.direct.gov.uk/savingenergy** or call **0300 123 1234** (standard national rate). When the Green Deal launches, it may allow you to make your home warmer and cheaper to run at no up-front cost.

Figure 1 – Example of a domestic energy performance certificate (EPC)

SAP 11 methodologies should be updated as soon as possible, to allow for a more robust method which can keep up with technological advances and fairly reflect the benefits of renewable energy and low carbon technologies and should be updated more frequently. Once complete, this should also be implemented with the introduction of the upcoming review of building regulations, not years later.

True Zero Carbon Homes For The Private Rental Sector

Sero Homes is delivering true Zero Carbon, actively tracking grid Carbon intensity to adjust energy demand. A first of its kind neighbourhood in Wales.

"The principles underpinning our vision for housing are simple – people's homes should minimise the harm done to our planet and they shouldn't cost the earth to run."
James Williams – Managing Director of Sero Homes

Energy Efficiency

- Using high energy efficiency and thermal mass to enhance comfort and operation.
- Heated via ground source heat pumps linked to MVHR.

Project Details

- Tenants' energy usage is incorporated as part of their monthly rent.
- Energy drawn from the grid will be replaced in equal carbon measure; thus balancing the grid to achieve Zero Carbon.

Optimising Conditions

- Zero Carbon optimised into the design from the outset. Utilising built form and thermal mass to enable further balancing of heating and cooling loads.

6. Renewable heat must be included in all new homes and developments

Decarbonising heat is one of the largest challenges facing the built environment; heating is the second largest source of greenhouse gas emissions in the UK after transport (Department for Business, Energy & Industrial Strategy, 2019). However, current government support under the Renewable heat Incentive (RHI) is only budgeted up until 2021, and there are currently no clear future polices incentivising the use of renewable heating in all new buildings.

The Committee on Climate Change has made clear that it will be necessary for almost all heating in buildings to be decarbonised by 2050 if net zero is to be realised. As such, with targets of no new homes being connected to the gas grid by 2025, new homes built today must have renewable heating mandated through the Future Homes Standard. Failure to do this will result in significant future costs for both homeowners and Government when retrofitting homes with renewable heating and high energy efficiency materials.

It is crucial that the Future Homes Standard incorporates heat in two respects:

1) **Mandating the use of high energy efficiency materials, thereby reducing the energy demand of properties**

2) **Ensuring all homes utilise a suitable low carbon heating system**

The nature of heat demand within different types of building means that there is no 'one size fits all' solution. Rural areas, apartment blocks, houses and commercial buildings all face differing challenges and opportunities. Building Regulations will need to reflect this by specifying that the most suitable form of low carbon heating is used and that these systems genuinely meet the needs of the building and its occupants. This calculation will need to consider technology and operational costs, the heat load required, ability to utilise the gas or electricity grid, proximity to industrial heat producers (such as biomass or energy from waste CHP plants) and the ability of new developments to utilise heat networks. As such the Future Homes Standard will need to reflect the 'toolbox' of solutions now available as well as ensure that suitable standards are in place so that, when installed, systems are fit for purpose.

Some of the key technologies expected to play a role here include:

- ***Heat pumps*** –The electrification of heat is expected to play a very prominent role in new builds, where new energy efficient properties are well suited to heat loads provided by air, water or ground source pumps. Air-source heat pumps for example are very well suited to residential apartments and houses in cities or towns due to their small internal and external space requirements. Consideration will, however, need to be given to the increased electricity demand on some localised grid infrastructure, especially when combined with an increasing numbers of electric vehicles.
- ***Biogas, biomethane and other green gases*** – most suited to existing commercial and residential sites already connected to the gas grid. An instant and direct replacement for natural gas, green gas from Anaerobic Digestion and thermal gasification can be used to produce clean heat in cooking, hot water and space heating.
- ***Biomass*** – a versatile alternative particularly suited to contexts where a high heat load is required and/or where levels of energy efficiency are low, typically in off-gas grid rural areas and certain on grid urban areas (e.g. district heating). There is also potential in urban areas with larger residential or commercial sites, such as schools and hospitals or in new developments combined with heat networks. Utilising biomass is also particularly efficient where there are significant capacity or grid connection cost constraints.
- ***Renewable Heating Fuels:*** Bio-propane and Bio-LPG offer a drop in low carbon alternative for off gas grid homes and commercial sites that would traditionally burn fossil oil for heat. The ability to use existing heating technology, but burn a renewable fuel instead of a fossil fuel, enables an affordable solution for decarbonising heat.

- ***Hybrid systems*** – green gases combined with heat pumps also allow for the installation of lower powered heat pumps in localities where there are constraints on the electricity network (where grid connection costs prove to be high), and switching to green gas such as biomethane from AD or thermal gasification, renewable hydrogen and bio-propane when electricity prices are high, offering a low carbon cost relief for large heat consumers.
- ***District heating*** –heat networks for local areas can be powered by a range of technologies, such as biomass boilers, CHP plants or geothermal heat. Despite being relatively immature in the UK, district heating offer a particular opportunity to decarbonise heat in more populated areas, where a number of homes could share resources; as well as in non-domestic clusters (e.g. industrial estates). District heating networks should also be encouraged in new rural, multi-property developments.
- ***Solar thermal*** – this technology provides baseload water heating which may be most suited to domestic or commercial settings with high energy efficiency levels, or low heating requirements.

Further support for decarbonising heat will be needed to ensure installation of the above systems are cost effective and can compete upon a level playing field with fossil fuel alternatives. Wider energy polices beyond building regulations are required to address these challenges. The REA's Bioenergy Strategy (REA, REA Bioenergy Strategy, 2019) provides recommendations as to exactly how this can be done.

Active Homes Neath

Active Homes is a UK social housing exemplar. Low carbon and low running costs, affordable heat and affordable power, the BEIS "Building for 2050" project is also conducting an independent review of the Active Homes project.

"The Active Homes will feel homely, warm and comfortable, and pleasant to live in. They will generate most of their energy needs from the roof and wall coverings. This will dramatically reduce tenants' bills."
Elfed Roberts, Head of Projects Pobl Group

Renewable Heat

- The Active Homes have no gas supply
- A transpired solar collector cladded wall provides heating in combination with an air source heat pump.

Data and Insights

- Government department BEIS will analyse energy performance data and review the design construction process, and conduct social science research with tenants to determine occupant satisfaction.

Project Details

- A community of sixteen homes, the 2- and 3-bedroom houses and 1-bedroom apartments, demonstrating how integrated renewable technologies can reduce energy consumption and provide people with a healthy home environment.
- Active Homes is an Active Building Centre project collaboration between Pobl Group, Neath & Port Talbot County Borough Council, and Specific Innovation and Knowledge Centre led by Swansea University.

Conclusion

The upcoming review of Building Regulations Part L (conservation of fuel and power) offers an immense opportunity to kick-start the transition of the buildings sector in its transition to zero-carbon in line with newly adopted UK targets of net-zero GHG emissions by 2050.

Bringing together the construction and renewable energy and clean tech sectors, is imperative to realising the prospects at stake, for both consumers – in creating more cost-efficient, healthier, and more sustainable living spaces, and the wider energy sector – in offering decentralised power generation and flexibility services to reduce grid reinforcement costs.

This position paper highlights six key areas for new buildings where action can be taken now, as minimum standards for the next set of building regulations. These solutions offer a no-regrets, first step to the decarbonisation of the built environment. They include:

1. **Solar PV powering all new buildings**
2. **Energy Storage utilising power generation and supporting flexibility**
3. **Electric Vehicle charge points, to offer a seamless transition for consumers to zero carbon transport**
4. **Three phase electricity supplies as standard, to support the electrification of heat and support other smart technologies**
5. **Renewables and Clean Tech to be fairly acknowledged in EPCs and SAP**
6. **Renewable heat as standard in all new developments**

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Case Studies

All case studies have been collated by the REA from member and non-member companies. These are all live projects across the UK and Europe. Click the case study to find out more by visiting their website.

Active Homes Neath

Active Homes is a UK social housing exemplar. Low carbon and low running costs, affordable heat and affordable power, the BEIS "Building for 2050" project is also conducting an independent review of the Active Homes project.

"The Active Homes will feel homely, warm and comfortable, and pleasant to live in. They will generate most of their energy needs from the roof and wall coverings. This will dramatically reduce tenants' bills."
Elfed Roberts, Head of Projects Pobl Group

Renewable Heat

- The Active Homes have no gas supply
- A transpired solar collector cladded wall provides heating in combination with an air source heat pump.

Data and Insights

- Government department BEIS will analyse energy performance data and review the design construction process, and conduct social science research with tenants to determine occupant satisfaction.

Project Details

- A community of sixteen homes, the 2- and 3-bedroom houses and 1-bedroom apartments, demonstrating how integrated renewable technologies can reduce energy consumption and provide people with a healthy home environment.
- Active Homes is an Active Building Centre project collaboration between Pobl Group, Neath & Port Talbot County Borough Council, and Specific Innovation and Knowledge Centre led by Swansea University.

The Hague Football Stadium

Alfen's energy storage system can store the solar energy that is generated from the stadium's roof top PV, to power fans' electric vehicles, and the pitch lights, during the night.

"Through this initiative, we hope we will further stimulate the use of electric vehicles and consequently improve the air quality in our city."
Ton Koning, Program Manager Air Quality at the municipality of The Hague

On-site Generation

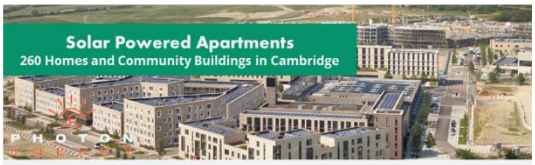
- Stadium able to utilise their solar power generation at night, reducing bills
- EV charging creates an additional revenue stream & caters to new customers

New Revenue Streams

- New energy trading revenue stream with addition of storage
- Supporting wider energy system smoothing out surges in consumption from EVs and storing excess renewable energy generation

Project Details

- 2MW Li-ion battery with 20 EV charge points in a hub, added to an existing 800 kW rooftop solar PV installation
- advanced load balancing platform to maximize the utilisation of the existing grid connection



University of Cambridge Apartments

Photon Energy installed solar PV across 9 apartment blocks, including student accommodation, homes for staff and supporting facilities.

"The brown roof and pebbled areas created obstacles that had to be worked around, but installation was carried out to a high standard across the development."
Adrian Wells, Project Manager at Wates

Carbon emissions

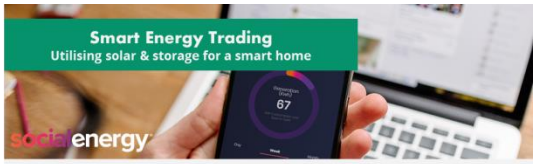
- Generates 262,355 kWh/annum, saving 136.2 tonnes carbon per annum
- equivalent to 450,000 car miles

Social Impact

- Aims to overcome Cambridge's rising land prices & overcrowding
- Development promotes sustainable living through triple insulation layers, a district heating system and solar PV

Project Details

- 1,175 SunPower 327 Wp modules, K2 D-Dome mounting systems and Zeversolar inverters
- Cost at around £3,000 per 3kWp unit – average UK home size



Connected Homes to Support our Power System

Social energy are creating connected homes of the future, today. Saving customers money whilst also balancing the grid by helping to handle power surges, their smart AI technology manages solar and energy storage effortlessly, without affecting the customers energy consumption habits.

"My bill was so low, I thought it was wrong. My system is amazing!"
Social Energy Customer

Connected Systems

- Social Energy are working with government and research bodies to develop an EV charging, proposition and smart boilers too.
- They are also working with Social Housing providers – developing a solution for those in fuel poverty.

Savings

- Customers save up to 70% on their electricity bills
- Reducing grid- electricity consumption by approximately 42% per year, swapping it for green energy powered by their own solar panels.
- Customers receive (on average) £103 in bill credits from energy trading & frequency response.
- Customers also benefit from a 5.6p/kWh smart export tariff, for power they sell back to the grid.

Project Details

- The average return on investment is 8 years
- The battery and hub include a 15-year warranty and 30-year returns.

True Zero Carbon Homes For The Private Rental Sector

Sero Homes is delivering true Zero Carbon, actively tracking grid Carbon intensity to adjust energy demand. A first of its kind neighbourhood in Wales.

"The principles underpinning our vision for housing are simple – people's homes should minimise the harm done to our planet and they shouldn't cost the earth to run."
James Williams – Managing Director of Sero Homes

Energy Efficiency

- Using high energy efficiency and thermal mass to enhance comfort and operation.
- Heated via ground source heat pumps linked to MVHR.

Optimising Conditions

- Zero Carbon optimised into the design from the outset. Utilising built form and thermal mass to enable further balancing of heating and cooling loads.

Project Details

- Tenants' energy usage is incorporated as part of their monthly rent.
- Energy drawn from the grid will be replaced in equal carbon measure; thus balancing the grid to achieve Zero Carbon.

Energy Efficient Homes Built For The Future

Sero Energy is working in conjunction with Pobl Living, Tirion Homes and the Active Building Centre to build 225 low carbon homes utilising fabric first construction, renewable energy generation & storage.

"The homes at Parc Eirin won't have any gas so they'll have batteries, solar PVs, ground source heat pumps and super-fast car chargers. They will be extremely innovative and should significantly reduce the amount people spend on their bills."
Julie James, Minister for Housing and Local Government

Technologies

- All homes have energy storage and 3 phase vehicle charging
- Every home is heated via ground source heat pumps

Integration with Grid

- Control systems on all technologies (including heat) enable the homes to support the grid system
- Largest development of it's kind in the UK with heat, electricity and transport optimisation

Project Details

- Sero will monitor and manage each home's usage and optimise energy use
- Residents will remain in control of their energy usage via the Sero Life App

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