Cost of Carbon Reductions in New Buildings Study

West of England Non-Technical Introduction

The study was jointly commissioned by the four local authorities in the West of England (WoE) area; Bath and North East Somerset Council; Bristol City Council; North Somerset Council and South Gloucestershire Council. It will provide the evidence base for climate change policies within each authority's Local Plan as required by the submitted West of England Joint Spatial Plan[1] (JSP) which is the overarching planning policy for the WoE. Policies that address carbon emissions and energy performance in buildings can provide co- benefits: higher quality buildings with lower energy bills and a more healthy and comfortable internal living environment.

This non-technical introduction sets the scene, explaining the main concepts underpinning the study, and summarises the local rationale for climate change policies in the West of England.

Setting the Scene

What is carbon dioxide and climate change and why is it a problem? The principal concern is carbon dioxide (CO_2) which is released into the atmosphere by burning fossil fuels, for example coal or gas in power stations, gas in heating boilers or petroleum for transport. The CO_2 forms a "blanket" in the earth's atmosphere. Globally, 97% of publishing climate scientists agree that human activity, chiefly the release of CO_2 and other gases, is causing global temperatures to rise. The 10 warmest years have occurred since 2000[2]. The summer of 2018 was the joint hottest on record[3] with a heatwave across the Northern Hemisphere causing widespread droughts and wildfires. The International Panel on Climate Change (IPCC) 2018 report states that there are 12 years left to prevent global temperatures rising beyond 1.5° C which would cause very severe impacts[4].

West of England response: The section in the study on "Policy Context" summarises the strong commitment to addressing climate change at the international and national level. This commitment is carried forward in the West of England which has a combined target to reduce CO_2 emissions by 50% by 2035 from 2014 levels. This is an 'absolute' target, meaning that it remains the same even if the population increases. However the population is expected to increase significantly; the WoE JSP allocates locations for 105,500 new dwellings and 82,500 new jobs. Any additional CO_2 resulting from this growth will make our already challenging climate change target harder to reach.

Local planning policy: To address the emissions from these new buildings, JSP Policy 5 proposes that development should be zero carbon by taking the following approach: *"Minimise energy demand and maximise the use of renewable energy, where viable meeting all demands for heat and power without increasing carbon emissions".* The JSP states that this is to be delivered through the more detailed policies in each of the local authorities' Local Plans which are currently being developed, based on evidence produced using a consistent methodology across the WoE. This study provides the evidence.

All of the WoE local authorities already have carbon reduction policies within their existing Local Plans. Each local authority is now revising its Local Plan in line with the JSP and intends to strengthen its carbon reduction policies. New Local Plans are subject to Examination in Public to assess whether the policies within the Local Plan are deliverable. A key consideration is that policies are "viable" e.g. will not stop development from coming forward by imposing costs that developers cannot afford to meet. Viability studies will be undertaken by the councils to assess this and will take the costs of low and zero carbon development produced in this study into account. The results of viability testing will inform the selection of policies for each authority area.

What are zero carbon buildings? CO_2 emissions from buildings are split into two categories; regulated and unregulated emissions. Regulated emissions are covered by Building Regulations; broadly the fabric and services

[1] https://www.jointplanningwofe.org.uk/consult.ti/JSPPublication/consultationHome
[2] NASA 2018: https://climate.nasa.gov/scientific-consensus/
[3] Met Office 2018: https://www.metoffice.gov.uk/news/releases/2018/end-of-summer-stats
[4] UNFCC 2018: http://ipcc.ch/report/sr15/

(e.g. boilers, lighting) that are found in a new building prior to occupation. Unregulated emissions arise from plug-in devices owned by the occupants and constitute around a third of the total emissions. There are two definitions of zero carbon; either zero regulated emissions, or zero regulated and unregulated emissions, also called 'true zero carbon'. The study looks at reducing both definitions of zero carbon.

The study looks at three ways to reduce carbon based on the well-established 'energy hierarchy'. At the top of the hierarchy is energy efficiency, secondly, onsite renewable energy and lastly carbon offsetting or 'Allowable Solutions'. These are described below:

1. Energy efficiency: Energy efficiency, or using less energy to begin with, is the most important way to reduce CO_2 at the new-build stage. This is because it is hard to improve energy efficiency once the building is occupied, e.g. to put in wall or floor insulation or repair gaps that cause energy loss and draughts. Energy efficiency measures often last for the building's lifetime whereas renewables may need replacing. Importantly, a well-insulated, non-draughty home is also more healthy and comfortable to occupy and has lower energy bills.

   The study finds that per unit of CO_2 saved, energy efficiency is more costly than adding renewables. This means that unless a policy specifically requires energy efficiency, developers may opt for lower cost renewables instead and miss the benefits of energy efficiency.

2. Renewable energy: Building- mounted renewable energy can reduce bills and provide a secure energy supply. Solar photovoltaics (electricity) is currently the most common, however renewable heat can also be used, for example heat pumps which use an electric pump to extract heat from the ground or air, producing a lot of heat per unit of electricity used.

3. Offsetting or Allowable Solutions: The study suggests that zero carbon might not be possible to achieve on-site at a reasonable cost in all cases. To meet the climate change targets, these carbon savings could be funded offsite at lower cost. An established method for this is known as 'Allowable Solutions' whereby developers pay a cost per tonne of carbon over the lifetime of the development. Funds can be used for measures such as insulating existing buildings (which can also address fuel poverty) or off site renewable energy. For the study, a cost of £95/ tonne of CO_2 is assumed based on the price of mitigating carbon offsite.

The performance gap: Unfortunately, the way a building performs in practice is often different from how it is assessed at the design stage. The so-called 'performance gap' means that energy use is often more than double that anticipated[5].

Two factors contribute to the performance gap; firstly poor quality control during the design and build stages and secondly if occupants are not properly briefed on how to use the building, e .g. its heating or ventilation systems. The WoE authorities are looking to address both factors. Passivhaus certification addresses the first factor through rigorous quality control; studies show that Passivhaus buildings require little or no heating in winter to remain warm and comfortable with fresh air. The second factor can be addressed by requiring better handover to occupants or the monitoring of building performance post occupation.

The national energy transition: The proportion of renewable energy in the UK grid has risen from under 5% in 2004 to over 30% in 2018. This means that the grid electricity is 'decarbonising' rapidly. Importantly, decarbonisation has not yet been reflected in the national Building Regulations Part L calculations. When Part L is updated to take account of this, it may become cost effective for developers to switch from using gas boilers to heat pumps to meet the Part L requirements. The study sets out the implications of this and advises that the policy is reviewed when Part L is updated.

[5] CIBSE (2016) https://www.cibsejournal.com/general/home-truths-innovate-uk-building-performance-evaluation-programme-report/

Climate change and the West of England

Climate change impacts: The West of England is already suffering the impacts of climate change and these could escalate as the incidence of extreme weather rises. There is an increasing health risk of overheating, particularly in urban centres and disproportionately affecting young, elderly or infirm residents. The elderly population is higher than the national average in South Gloucestershire, North Somerset and Bath and North East Somerset.

Flooding is also a major risk in the West of England, endangering both homes and critical infrastructure. Due to the low lying nature of North Somerset, around thirty per cent of land area is covered by Environment Agency Flood Zone designations. Bristol is one of the top 10 UK cities for surface water flood risk; it threatens approximately 26,000 homes and businesses[6]. In Bath and North East Somerset nearly 750 residential properties are estimated to be at risk of surface water flooding[7]. In South Gloucestershire climate change brings an increased risk of flooding associated with the River Severn needs to be mitigated and adapted to.

Climate change action**:** The WoE Authorities have for many years been carrying out ambitious climate change. Below are some of the targets and measures and the current planning requirements around energy performance.

Bath & North East Somerset's Environmental Sustainability and Climate Change Strategy sets an overarching carbon reduction target for the area of 45% by 2029, in line with the government's target to cut national emissions by 80% by 2050. Actions include a local green energy tariff, energy efficiency in existing homes, supporting community energy schemes and delivering energy efficient construction projects including an award-winning sustainable office building at Keynsham Civic Centre. The Council requires new build projects to reduce regulated CO_2 emissions by 19% beyond Building Regulations.

Bristol City Council has a long history of working to tackle climate change and fuel poverty; in 2015 Bristol was the first UK city to be awarded the title of European Green Capital. The Council met its goal of reducing its own emissions by 40%, five years early and now aims to cut emissions by 65% by 2020 from a 2005 baseline. The council's Corporate Strategy puts Bristol on course to be run entirely on clean energy by 2050.Currently the Council requires new buildings to achieve a 20% reduction in regulated CO_2 through use of renewable energy.

North Somerset's Climate Local plan adopts the Climate Change Act target to cut emissions 80% by 2050 from 1990 levels. Actions taken by the Council include reducing CO_2 emissions from the Council's own buildings through renewable energy and refurbishment and achieving an average of a 14% reduction in energy bills for schools. Currently through the planning system, major development on greenfield sites is to achieve a 15% reduction in regulated CO_2 emissions.

South Gloucestershire's Climate Change Strategy sets a target to reduce CO_2 emissions by 80% (on 1990 levels) by 2050, in line with the 2008 Climate Change Act. The Council has implemented measures which have reduced its own energy consumption by 43% since 2010/11. Current planning policy requires major development is to achieve a 20% reduction in regulated and unregulated CO_2 emissions through use of renewable energy.

Challenges and further policy needed

The move to zero carbon homes presents some challenges across the UK and within the WoE. These will need to be addressed where possible through the planning system. These include:

- **Switch from gas:** With electricity decarbonising, it is important that new development does not 'lock in' the use of a fossil fuel, gas, for heating. Policy will aim to reward renewable heat at the expense of gas to facilitate this shift.
- **Pressure on the electricity grid:** As noted, a switch even to heat pumps as a source of heat would increase electricity demand and pressure on the grid. In addition to ensuring buildings use less energy, policy should find a way to reward energy storage and 'smart' energy measures that help to balance supply and demand on a decarbonising grid.

---

6 https://www.bristol.gov.uk/documents/20182/1308373/Bristol+preliminary+resilience+assessment+November+2015/70751e3c-e1ec-47af-94a0-3562833e9d40

7 https://democracy.bathnes.gov.uk/documents/s39319/02%20BANES%20LFRMS%20Summary%20151120.pdf

- **Overheating:** As buildings become better insulated, and the climate warms, the risk of overheating is increased. This can be managed through careful design however this is not necessarily the industry norm at present, so policy is needed.
- **Heat Networks:** Heat networks, whereby heat is supplied from a large boiler serving a number of buildings, rather than individual boilers within buildings, can facilitate the use of low or zero carbon heat sources or supply inefficient existing buildings. However it is important that a zero carbon source of heat for heat networks is found, since as the grid decarbonises, heat pumps will produce lower emissions than gas-fired Combined Heat and Power systems which currently often used in heat networks.