

# Renewable Energy Assessment: Core Strategy Greenfield Sites

Bath and North East Somerset Council

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## 1 Executive summary

Bath & North East Somerset Council aims to reduce district-wide emissions 45% by 2026. As a result, addressing climate change is a cross cutting objective of Bath & North East Somerset's draft Core Strategy and this is reflected in Core Policy 3: Renewable Energy, which sets the target for 100MWe of installed renewable electricity capacity and 165MWth of renewable heat capacity to be delivered in the district by 2029. This study lays out how specific sites can contribute to reaching this target, providing an evidence base for solar PV potential and a commentary on other technologies. This report has been delivered to inform Bath and North East Somerset Council's Core Strategy Update.

This report sits alongside an Excel spreadsheet model that Regen has developed for the Council. The model estimates the potential for each of the Council's greenfield development sites to accommodate solar PV and as a result the potential for each site to meet an onsite renewable energy requirement policy. The sites studied were: Whitchurch, SW Keynsham, E Keynsham, Odd Down and Weston.

The model contains a number of assumptions about the developments, the technology and the Feed-in Tariff to estimate the potential installed capacity, power output, carbon savings and revenues from installing PV on each site. The assumptions can be changed so that the model can be updated by the Council as circumstances change.

## Summary of recommendations

### **a. Solar PV on the 5 greenfield developments could create significant net revenues**

There is significant potential for the greenfield sites to accommodate solar PV. Over the 20 year lifetime of the Feed-in Tariff, the net revenues for these sites are significant.

### **b. All the sites have the potential to meet an onsite carbon reduction requirement (depending on the site layout), without the developer incurring a net cost**

The analysis of the potential for a renewable energy requirement policy shows that all of the 5 sites have the potential to meet either a 10 or 20 % carbon reduction requirement through solar PV installations on the buildings. E Keynsham Option 2 cannot meet a 20% carbon reduction requirement under this model due to the assumed layout of the site. The model needs to be updated with the site's actual layout once this is known, as the requirement could be met if the houses were laid out in more southerly directions. As the financial analysis shows, meeting a carbon reduction requirement need not be a net cost to the developer, due to the Feed-in Tariff revenues on offer and to the potential for third party delivery partners to be involved.

Further analysis of the viability could be undertaken when these sites get to the detailed planning stage. If the Council goes ahead with a carbon reduction requirement and developers do not want to take the opportunity to deliver onsite renewables, the Council could place the onus on the developer to demonstrate that meeting the reduction requirement is not viable.

### **c. Third party delivery partners would be interested in working with housing developers to deliver PV**

Developers who are not interested in taking up this financial opportunity themselves could be interested in working with a renewable energy delivery partner. There are a number of options for this type of model, such as working with a community group, the Council playing a role in delivery, or using a specialist renewable energy company.

### **d. Other renewable energy opportunities**

The potential for other types of renewable energy installations on the greenfield sites has not been analysed in detail. However, there may be the potential for near or offsite wind schemes to be contributed to through Allowable Solutions. In addition, the sites at Weston and East Keynsham could include district heat networks that connect to nearby anchor loads. The Odd Down site is adjacent to a district heat opportunity identified in AECOM's study and so a network in that area has greater potential.

## 2 Introduction

### 2.1 The opportunity

Bath and North East Somerset Council operates in a part of the country that has substantial renewable energy resources. There is the opportunity to incorporate renewable energy technologies into new build housing developments, in order to confront financial, social and environmental issues. These include rising energy bills, increasing numbers of fuel poverty households and working towards meeting the UK's emission targets and the local renewable energy target in Bath and North East Somerset.

Bath & North East Somerset Council aims to reduce district-wide emissions 45% by 2026. As a result, addressing climate change is a cross cutting objective of Bath & North East Somerset's draft Core Strategy and this is reflected in Core Policy 3: Renewable Energy, which sets the target for 100MWe of installed renewable electricity capacity and 165MWth of renewable heat capacity to be delivered in the district by 2029. This study lays out how specific sites can contribute to reaching this target, providing an evidence base for solar PV potential and a commentary on other technologies. This report has been delivered to inform Bath and North East Somerset Council's Core Strategy Update.

The PV model constructed allows the Council to calculate the potential for installing solar PV on 5 greenfield sites. Through a number of assumptions, the model estimates the potential installed capacity, power output, carbon savings, FiT income, bill savings and costs of installing PV across each site. The assumptions behind the model can be altered to enable the Council to adjust it as the site plans come together and as costs and the FiT change and the grid decarbonises in the future. The model could be used to demonstrate to developers the potential financial and environmental benefits of installing PV, supporting the Council in its negotiations with them. In particular, housing developers might be interested in working with third party PV developers.

In addition, the Council is assessing whether to introduce a renewable energy requirement, known in the industry as a 'Merton rule' style policy, for the sites. The latest versions of these policies require development to provide onsite renewable energy that produces sufficient energy to reduce carbon dioxide emissions from residual energy use in the development's buildings, usually by 10 to 20%. The PV model includes an analysis of the potential for the 5 greenfield sites to meet the requirements of such a policy through solar PV.

## 2.2 The approach

The evidence work brief is as follows:

Work	Output
1 Calculating PV potential	Figures for each site
2 Potential to meet a carbon reduction policy onsite	Figures for each site
3 Identifying third party/ community energy potential, liaising with BWCE on methodology	Feed into report
4 We will provide existing GIS layers that have been produced through other studies to check for renewable potential as follow: <ol style="list-style-type: none"> <li>1. Camco Renewable Energy Assessment: Wind &amp; hydro</li> <li>2. LUC Landscape Assessment: Wind</li> <li>3. AECOM District Heating Assessment</li> <li>4. Sustainability Statement (Whitchurch)</li> </ol>	Commentary on opportunities for wind
5 Write short report bringing together 1-4 above	Report

## 3 Method for PV potential

Work task 1 is to calculate the PV potential for the five Greenfield sites, providing for each site:

- kWp possible to install
- kWh produced
- CO<sub>2</sub> saved
- revenue generated

This was completed by creating an adaptable Excel file, which will be easy to use and re-usable by Bath and North East Somerset Council. Additional output calculations included in the work:

- cost to install total
- cost to install per household
- FiT revenue and grid export
- per household annual electrical bill savings

### 3.1 Data collection

In order to calculate power yields, the PV Potential Estimation Utility<sup>1</sup> online tool was used, which is also known as PVGIS. This is a European Commission tool which enables users to calculate daily, monthly and yearly irradiance and electricity production, based on a number of inputs and assumptions for very specific sites. This means accurate power outputs for a given installed capacity at a precise location could be calculated, without the need to use estimated capacity factors.

Data was collected for each of the sites and inputted into the Excel file. The following table details the variables that were relevant.

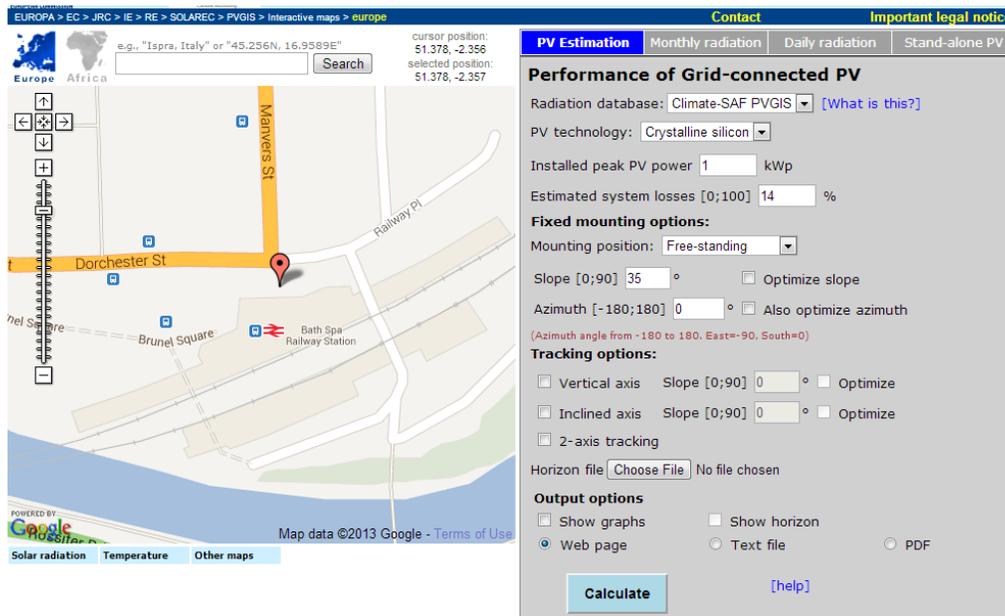


Figure 1: PV Potential Estimation Utility online tool

Variable	Chosen value	Notes / explanation
Radiation database	Climate-SAF PVGIS	This is the newest and most accurate climate model within PVGIS. Other options are older and/ or less accurate
PV technology	Crystalline silicon	This is the material the vast majority of solar cells are constructed with, being the most developed solar cell technology and providing the best compromise between cost and efficiency
Installed power	1 kWp	
Estimated system losses	14 percent	These are losses such as inverter and other system losses. 14% is the standard figure for these losses
Mounted position	Free standing and building integrated	Free standing (raised above roof on mounts) and building integrated are two different building techniques and have different

<sup>1</sup> <http://re.jrc.ec.europa.eu/pvgis/apps4/pvest.php#>

		efficiencies and benefits. Building integrated are less efficient and produce less power as there is not a free flow of air behind the panels, but blend into the building's construction more. Free standing panels are potentially more expensive, while producing more energy.
Slope	38 °	This is the optimised slope for the locations, providing the maximum power for a fixed system.
Orientation	SW, SSW, S, SSE and SE	Five different orientation data sets were collected, between SW to SE since these are the optimal for solar PV.

### 3.2 Assumptions

#### 3.2.1 Shading

Shading can have a drastic effect on a solar panel's performance, dramatically reducing its energy output. PVGIS has an integral feature to include horizon solar shading, so that is accounted for in the base data. However, solar shading from nearby houses and trees must also be included. The Excel file includes a feature to account for this additional shading.

Estimations were made on additional shading by studying the GIS files, looking at in what direction and at what distance potential obstacles were. Using trigonometry an approximate calculation found what portion of the sky would be shaded. This additional shading was then turned into a percentage loss in power by using a sun chart (Appendix A). This allowed an approximate calculation of the length of time the solar panels were shaded. This is a variable that can be changed in the Excel file.

#### 3.2.2 Density and orientation assumptions

At this high level survey stage, housing density has no quantitative effect on power production. However, it is assumed a larger site will be able to be more carefully planned, maximising power generation, and this can be seen in greater power production from larger sites.

Assumptions on number of houses and their orientation are based on studying the GIS files, maps and nearby housing developments. It is assumed that the new developments will follow the layout pattern of nearby existing housing estates to ensure that the new developments blend with those nearby. This leads to a prediction of the number of houses facing in each direction for each new development area.

### 3.2.3 Technology

The vast bulk of solar PV panels are constructed with a material called crystalline silicon. If a power production is required for alternative high efficiency technologies, an increase in power of between 5-10% could be assumed.

### 3.2.4 Estimated system losses

The estimated system losses are all the losses in the system that cause the power actually delivered to the electricity grid to be lower than the power produced by the PV modules. There are several causes for this loss, such as losses in cables, power inverters, dirt (sometimes snow) on the modules and so on. We have given a default value of 14%. If you have a good idea that your value will be different (maybe due to a really high-efficiency inverter), you may reduce this value a little.<sup>2</sup>

### 3.2.5 Slope

This is the inclination angle from the horizontal plane and for all sites, 38° was chosen. This is the average optimal angle calculated using PVGIS, and is also close to the roof pitch angle 12/9 for building purposes.

### 3.2.6 Grid losses

Since the majority of energy is not being exported and distributed across the grid, there is an increase in CO<sub>2</sub> saving. Grid transmission and distribution has a loss in energy of 7-8% in the UK, energy which is lost between power production and use. A grid loss figure of 7.7%<sup>3</sup> is used in this work; increasing CO<sub>2</sub> savings from PV installations, since energy is being delivered to the household from the solar panels rather than electricity being delivered from the grid. This is a variable that can be changed in the Excel file.

### 3.2.7 Grid CO<sub>2</sub> per kWh

The grid CO<sub>2</sub> per kWh data is taken from National Grid<sup>4</sup> and is currently 0.5 kg CO<sub>2</sub> per kWh. A graph of projected grid CO<sub>2</sub> reduction is placed in the Notes tab of the Excel file for reference. This is a variable that can be changed in the Excel file.

### 3.2.8 Cost per kWh installed

This is included in the Excel file as a variable that can be changed when new information on cost is available. Costs for solar panels are extremely variable since the solar panels themselves make up only between 40-60% of the overall cost. Balance of system components, labor, inverter and mountings take up the remaining amount and these costs vary depending on building practices and design. Installed costs for solar PV have fallen dramatically in recent years.

<sup>2</sup> [http://re.jrc.ec.europa.eu/pvgis/apps4/PVcalchelp\\_en.html](http://re.jrc.ec.europa.eu/pvgis/apps4/PVcalchelp_en.html)

<sup>3</sup> IEA Electricity Stats. <http://data.worldbank.org/indicator/EG.ELC.LOSS.ZS>

<sup>4</sup> National Grid. (2011). UK Future Energy Scenarios, (November).

The cost estimate in the work is taken from a report by Element Energy<sup>5</sup>. The cost used is £1,400 per kW installed. This is possibly a high estimate as the installer may be able to install the solar panels for less due to economies of scale. Cost estimates can also be taken from a DECC report<sup>6</sup> on the costs of solar PV, including future projections. This table is included in the notes tab of the Excel file for future reference.

At this high level stage, no cost differences were allocated to building integrated and free standing technologies.

### **3.2.9 FiT rate**

The feed in tariff rate used is the current figure of 13.41 pence (medium FiT rate due to multiple builds). This is a constant that can be changed in the Excel file.

### **3.2.10 Cost per electrical unit**

It is assumed the unit cost of electricity is 15 pence. This is taken from the 2012 average variable unit costs, calculated by the government.<sup>7</sup> The table from this document is included in the notes for reference. Electrical costs are expected to rise year on year, so the cost of electricity is a variable that can be changed in the Excel file.

### **3.2.11 Percentage household electrical use**

It is assumed that 50% of the electricity that the solar panels generate is consumed within the home, the remainder being exported. This is an assumption the FiT makes and is not metered unless a household system is over 30kWp. This is a constant that can be changed in the Excel file.

### **3.2.12 FiT electricity export tariff**

This is the current FiT export tariff rate, which is applied to 50% of generation. This could go to the developer, community group or individual houses. This is a variable that can be changed in the Excel file.

### **3.2.13 Time period**

The output calculations are for annual figures. For example kWh produced, CO<sub>2</sub> saved and revenue generated are all calculated on an annual basis.

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<sup>5</sup> Costs of building to the Code for Sustainable Homes. (2013). Element Energy, September).

<sup>6</sup> DECC. (2012). Solar PV cost update, (May).

[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/43083/5381-solar-pv-cost-update.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/43083/5381-solar-pv-cost-update.pdf)

<sup>7</sup> <http://tinyurl.com/nuexmya>

### 3.3 Output and assessments

The output figures are based on a number of constants detailed above. The majority of them are the same across all sites, and others are different for each site. The variables different for each location are:

- number of dwellings
- additional shading losses
- installed kWp per house
- number of houses facing in each direction (SW, SSW, S, SSE and SE)

Below are the variables which are the same across all locations:

Variables		
Grid losses	7.7	percent
Grid CO <sub>2</sub> /kWh	0.5	kg
Cost per kW installed	1600	£
FiT rate	0.1341	£
Cost per electricity unit (kWh)	0.15	£
Percentage household electrical use	50	percent
Electricity export per unit	0.0464	£

The output data for each site, including the assumptions for each are arranged in this document and on the Excel file as show in diagram below. In the Excel file, boxes that are variable and can change are coloured in yellow.

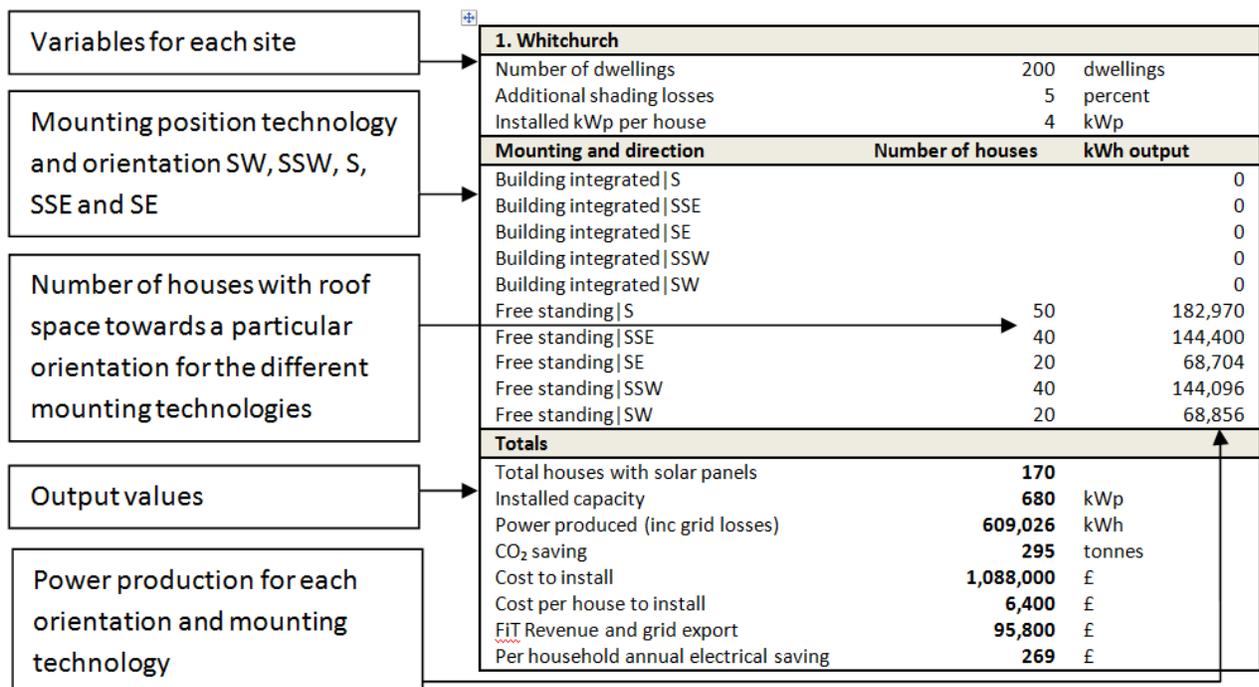


Diagram illustrating Excel file organisation

## 4 Summary of site by site potential for PV

Five greenfield development sites were studied: Whitchurch, SW Keynsham, E Keynsham, Odd Down and Weston. Since this study was undertaken in parallel with site allocation, for SW Keynsham, E Keynsham and Odd Down two options for site size and location were being considered at the time of this study. These options are referred to as “Option 1 and Option 2” for those particular sites.

It should be noted that the maximum installed capacities estimated are maximums based on the assumptions in the model. They could be exceeded if the assumptions change. In particular, they are dependent on assumptions regarding the density and orientation of the buildings in each site. The model should be updated when the layout of each site is known.

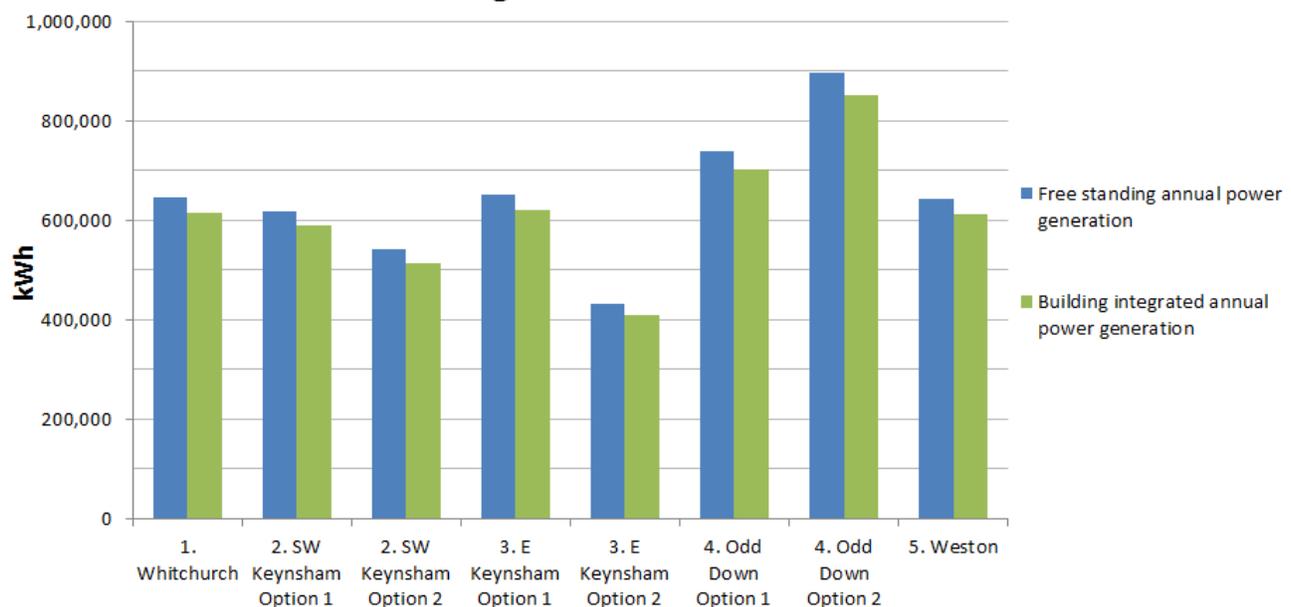
### 4.1 Free standing solar panels summary

		1. Whitchurch	2. SW Keynsham Option 1	2. SW Keynsham Option 2	3. E Keynsham Option 1	3. E Keynsham Option 2	4. Odd Down Option 1	4. Odd Down Option 2	5. Weston
Total houses		200	200	200	250	250	300	300	200
Total houses with solar panels		180	170	150	180	120	200	240	180
Installed capacity	kWp	720	680	600	720	480	800	960	720
Annual power produced	kWh	646,684	618,470	541,044	651,571	430,810	738,685	896,582	644,556
Annual CO <sub>2</sub> saving	tonnes	348	333	291	351	232	398	483	347
Cost to install	£	1,008,000	952,000	840,000	1,008,000	672,000	1,120,000	1,344,000	1,008,000
Cost per house to install	£	5,600	5,600	5,600	5,600	5,600	5,600	5,600	5,600
Annual FIT revenue	£	86,720	82,937	72,554	87,376	57,772	99,058	120,232	86,435
Annual grid export revenue	£	15,003	14,349	12,552	15,116	9,995	17,137	20,801	14,954
Annual per house annual average saving	£	269	273	271	271	269	277	280	269
Total annual revenue	£	150,225	143,671	125,685	151,360	100,077	171,596	208,276	149,730

## 4.2 Building integrated solar panels summary

		1. Whitchurch	2. SW Keynsham Option 1	2. SW Keynsham Option 2	3. E Keynsham Option 1	3. E Keynsham Option 2	4. Odd Down Option 1	4. Odd Down Option 2	5. Weston
Total houses		200	200	200	250	250	300	300	200
Total houses with PV panels		180	170	150	180	120	200	240	180
Installed capacity	kWp	720	680	600	720	480	800	960	720
Annual power produced	kWh	615,600	588,442	514,748	620,006	410,189	703,248	853,070	613,662
Annual CO <sub>2</sub> saving	tonnes	332	317	277	334	221	379	459	330
Cost to install	£	1,008,000	952,000	840,000	1,008,000	672,000	1,120,000	1,344,000	1,008,000
Cost per house to install	£	5,600	5,600	5,600	5,600	5,600	5,600	5,600	5,600
Annual FIT revenue	£	82,552	78,910	69,028	83,143	55,006	94,306	114,397	82,292
Annual grid export revenue	£	14,282	13,652	11,942	14,384	9,516	16,315	19,791	14,237
Annual per house annual average saving	£	257	260	257	258	256	264	267	256
Total annual revenue	£	143,004	136,695	119,576	144,027	95,287	163,365	198,168	142,554

### Annual power generation for free standing and building integrated at each location



## 5 Method for assessing potential for onsite carbon reduction policy

### 5.1 Assumptions and variables

In order to assess the potential for an onsite carbon reduction policy, a number of assumptions were made to build on the model for solar PV potential. These include:

Variable factor	Amount	Unit
Average annual household electrical consumption	3,300	kWh
CO <sub>2</sub> emission factor electricity	0.5	kg/kWh
Average annual per meter gas consumption	16,500	kWh
CO <sub>2</sub> emission factor gas	0.203	kg/kWh

Sources:

- <https://www.ofgem.gov.uk/ofgem-publications/64026/domestic-energy-consump-fig-fs.pdf>
- [ww.carbonindependent.org/sources\\_home\\_energy.htm](http://ww.carbonindependent.org/sources_home_energy.htm)
- [www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/48195/3224-great-britains-housing-energy-fact-file-2011.pdf](http://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48195/3224-great-britains-housing-energy-fact-file-2011.pdf)
- National Grid. (2011). UK Future Energy Scenarios, (November).

Further assumptions include:

- Homes can accommodate a 4kWp system on their roofs
- Additional solar shading from trees and other obstacles is between 4-6% depending on location
- The average energy consumption figures are taken from Ofgem's Domestic Energy Consumption Figures of 2011 for new build houses – i.e. they are for houses that meet 2010 Building Regulation energy efficiency standards.
- Gas use is based on per meter gas used as opposed to per household gas use (due to not all houses having a meter)
- Gas emissions factor includes losses and inefficiencies so can be regarded as a total adjusted emissions amount

Due to the assumptions made, this assessment gives an indication of whether a carbon reduction policy might be possible on each site; it is not definitive evidence on the viability of such a requirement for each site. This will depend on the detailed plans for each site, for example on the type of homes built, the energy efficiency measures that are incorporated and the resulting residual energy use, the direction the homes face and the size of the roofs.

In addition, developers may wish to meet a carbon reduction requirement through other forms of renewable energy, such as solar hot water, heat pumps or biomass heating. This analysis assumes that solar PV will be the cheapest way to meet a requirement and so does not take into account other technologies.

## 6 Results for assessing potential for onsite carbon reduction policy

### 6.1 CO<sub>2</sub> emissions for each location

The table below shows the total electrical and gas use for each site, as well as 10 and 20 percent of this total.

	House numbers	Electrical power consumption (kWh)	CO <sub>2</sub> from electricity use (tonnes CO <sub>2</sub> )	Heating power consumption (kWh)	CO <sub>2</sub> from gas heating use (tonnes CO <sub>2</sub> )	Total CO <sub>2</sub> emissions (tonnes)	10% CO <sub>2</sub> emissions (tonnes)	20% CO <sub>2</sub> emissions (tonnes)
<b>1. Whitchurch</b>	200	660,000	330	3,300,000	670	1,000	100	200
<b>2. SW Keynsham</b>	200	660,000	330	3,300,000	670	1,000	100	200
<b>3. E Keynsham</b>	250	825,000	413	4,125,000	837	1,250	125	250
<b>4. Whitchurch</b>	300	990,000	495	4,950,000	1,005	1,500	150	300
<b>5. Weston</b>	200	660,000	330	3,300,000	670	1,000	100	200

### 6.2 Number of houses with PV to meet a 10% or 20% onsite carbon reduction policy

The table shows the number of houses at each location that would need to have solar panels in order to meet an onsite carbon reduction of 10 percent and of 20 percent. The same variables and assumptions are applied to the below tables and outputs, as for the maximum potential in section three. A scaling factor was applied, which assumed that the same proportion of houses would face in each direction from SW to SE as when the maximum potential for PV was assessed. This means the number of houses facing in each direction is proportional to the maximum potential analysis, allowing for direct comparison.

10% total carbon reduction		1. Whitchurch	2. SW Keynsham Option 1	2. SW Keynsham Option 2	3. E Keynsham Option 1	3. E Keynsham Option 2	4. Odd Down Option 1	4. Odd Down Option 2	5. Weston
Total proposed houses		200	200	200	250	250	300	300	200
Total requirement for houses with 4 kWp solar panels		52	51	51	64	65	75	75	52
Installed capacity required	kWp	207	204	206	256	259	302	298	207
Annual power produced	kWh	185,682	185,682	185,682	232,103	232,103	278,524	278,524	185,682
Annual CO <sub>2</sub> saving	tonnes	100	100	100	125	125	150	150	100
Cost to install	£	289,427	285,818	288,282	359,070	362,047	422,300	417,514	290,383
Cost per house to install	£	5,600	5,600	5,600	5,600	5,600	5,600	5,600	5,600
Annual FiT revenue	£	24,900	24,900	24,900	31,125	31,125	37,350	37,350	24,900
Annual grid export revenue	£	4,308	4,308	4,308	5,385	5,385	6,462	6,462	4,308
Total annual revenue	£	29,208	29,208	29,208	36,510	36,510	43,812	43,812	29,208
Per house annual average saving	£	269	273	271	271	269	277	280	269

20% total carbon reduction		1. Whitchurch	2. SW Keynsham Option 1	2. SW Keynsham Option 2	3. E Keynsham Option 1	3. E Keynsham Option 2	4. Odd Down Option 1	4. Odd Down Option 2	5. Weston
Total houses		200	200	200	250	250	300	300	200
Total requirement for houses with 4 kWp solar panels		103	102	103	128	129	151	149	104
Installed capacity required	kWp	413	408	412	513	517	603	596	415
Annual power produced	kWh	371,365	371,365	371,365	464,206	464,206	557,047	557,047	371,365
Annual CO <sub>2</sub> saving	tonnes	200	200	200	250	250	300	300	200
Cost to install	£	578,854	571,635	576,564	718,141	724,094	844,600	835,028	580,765
Cost per house to install	£	5,600	5,600	5,600	5,600	5,600	5,600	5,600	5,600
Annual FiT revenue	£	49,800	49,800	49,800	62,250	62,250	74,700	74,700	49,800
Annual grid export revenue	£	8,616	8,616	8,616	10,770	10,770	12,923	12,923	8,616
Total annual revenue	£	58,416	58,416	58,416	73,020	73,020	87,624	87,624	58,416
Per house annual average saving	£	269	273	271	271	269	277	280	269

It can be seen in the tables below that in order to meet 10% of the annual CO<sub>2</sub> emissions of each location, approximately 25 to 26 percent of all proposed houses will have to have PV panels on, in various directions. Subsequently, 50 to 52 percent of all proposed houses will need to have PV panels on to meet 20% of total emissions.

<b>10% total carbon reduction</b>	<b>1. Whitchurch</b>	<b>2. SW Keynsham Option 1</b>	<b>2. SW Keynsham Option 2</b>	<b>3. E Keynsham Option 1</b>	<b>3. E Keynsham Option 2</b>	<b>4. Odd Down Option 1</b>	<b>4. Odd Down Option 2</b>	<b>5. Weston</b>
<b>Total houses</b>	200	200	200	250	250	300	300	200
<b>Total houses with solar panels</b>	52	51	51	64	65	75	75	52
<b>Percentage of houses with solar</b>	26%	26%	26%	26%	26%	25%	25%	26%

<b>20% total carbon reduction</b>	<b>1. Whitchurch</b>	<b>2. SW Keynsham Option 1</b>	<b>2. SW Keynsham Option 2</b>	<b>3. E Keynsham Option 1</b>	<b>3. E Keynsham Option 2</b>	<b>4. Odd Down Option 1</b>	<b>4. Odd Down Option 2</b>	<b>5. Weston</b>
<b>Total houses</b>	200	200	200	250	250	300	300	200
<b>Total houses with solar panels</b>	103	102	103	128	129	151	149	104
<b>Percentage of houses with solar</b>	52%	51%	51%	51%	52%	50%	50%	52%

These totals are well below the maximum potential for PV at each location, with the exception of E Keynsham Option 2. This is because the maximum potential on the E Keynsham Option 2 site has been estimated to be lower due to the layout of the site. The long, thin north-south shape of the site lends itself to the majority of the houses facing east-west, and there are therefore fewer houses facing in southerly directions than the other developments. As a result, a 20% carbon reduction requirement could be difficult to meet with solar PV alone on this site. If a 20% requirement was placed on the E Keynsham Option 2 site, its viability would need to be reviewed when the site layout is confirmed.

<b>Maximum potential for solar PV at each location (Free standing panels)</b>		<b>1. Whitchurch</b>	<b>2. SW Keynsham Option 1</b>	<b>2. SW Keynsham Option 2</b>	<b>3. E Keynsham Option 1</b>	<b>3. E Keynsham Option 2</b>	<b>4. Odd Down Option 1</b>	<b>4. Odd Down Option 2</b>	<b>5. Weston</b>
<b>Total houses</b>		200	200	200	250	250	300	300	200
<b>Total houses with solar panels</b>		180	170	150	180	120	200	240	180
<b>Installed capacity</b>	<b>kWp</b>	720	680	600	720	480	800	960	720

## 7 Third party delivery partners

There is the potential for onsite renewable energy to be developed by a third party, rather than directly by the housing developer. This could reduce or remove the costs of installing PV for developers, whilst potentially providing reduced cost electricity to the homeowners and a revenue stream to repay the investment made by the third party. A third party could be a commercial renewable energy company or a local community energy enterprise. Bath Core Strategy Policy CP3 cites “contribution to significant community benefits” as an assessment criteria for renewable energy projects.

By way of high-level market testing, the local social enterprise Bath and West Community Energy (B&WCE) were contacted to assess their interest in delivering renewable energy projects on new-build developments through a community benefit model. BWCE is a not-for-profit social enterprise with local shareholders and a Community Fund into which a portion of their revenues are contributed. BWCE have installed a range of renewable energy projects which they now own and operate.

BWCE stated an interest in working with new build developments. Their view was that for residential development, projects where the total installed capacity would be 200KW or more, spread over the dwellings in the development would be of interest. All the sites studied in this report meet that criterion. BWCE would also be interested in solar thermal, heat pump or biomass boiler solutions for developments of this scale. For a PV project on a single building, or ground-mounted PV installation, BWCE would be interested in projects with a minimum installed capacity of around 50 kW..

Other examples of third party delivery models include retrofit projects:

Mid Devon District Council worked with Anesco to install PV on 1000 of its social houses

Alliance Homes set up a framework to purchase one million PV panels in bulk, which it made available to the public sector alongside installing PV on 1,200 of its homes

## 8 Commentary on wind and district heating opportunities

### 8.1 Wind potential

Large scale wind is a particularly cost-effective renewable energy technology. Appropriately sited turbines can deliver significant amounts of renewable energy. Camco’s renewable energy study<sup>8</sup> shows that there is significant potential for wind energy in Bath & North East Somerset, taking into account the unique landscape and setting of Bath and the surrounding area. The sensitivity to wind turbines of the different landscapes in the area has been considered in Land Use Consultants report, Landscape Sensitivity Analysis for Wind Energy Development in Bath and North East Somerset.

<sup>8</sup> CAMCO. (2009). Renewable energy research and planning. (June).

[http://www.bathnes.gov.uk/sites/default/files/sitedocuments/Planning-and-Building-Control/Planning-Policy/Evidence-Base/Sustainability/renewable\\_energy\\_research\\_and\\_planning\\_-\\_june\\_2009.pdf](http://www.bathnes.gov.uk/sites/default/files/sitedocuments/Planning-and-Building-Control/Planning-Policy/Evidence-Base/Sustainability/renewable_energy_research_and_planning_-_june_2009.pdf)

Whilst the greenfield sites under examination in this report do not have the potential to include large wind within their boundaries due to the residential nature of the developments, wind may be an option that could be funded through Allowable Solutions, depending on how these are set out in national policy.

## 8.2 AECOM district heating assessment

None of the locations are directly within the AECOM heating assessment's main study areas<sup>9</sup>; however, it is possible to carry out a high level analysis of each site. As these are new greenfield developments, all locations have some potential for localised district heating linking the new houses; however, some have good potential for a district heating network with outside anchor loads. The right anchor loads can be the key to economic viability for a network as they provide baseload demand for the system.

District heating opportunity commentary		
Site	DH Network potential	Factors and commentary
1. Whitchurch	Potential for district heating network with several nearby anchor loads.	Close to multiple possible anchor loads, including a care home and school without roads or other major obstacles in the way. Space for energy centre.
2. SW Keynsham	-	-
3. E Keynsham	Potential for district heating network with several nearby anchor loads.	Close to multiple schools, industrial estates and employment centres with no roads in-between and possible space for heat energy generation. Space for energy centre.
4. Odd Down	Potential for district heating network with several nearby anchor loads.	Close to multiple schools, a superstore and a hospital. Most of these have no obstacles in the way such as roads, and space on site for an energy centre. Existing housing development next to site in good position to be a part of the network.  Site is also directly next to a potential opportunity identified by AECOM's heating assessment and so there could be potential for the new housing development to link to the network proposed by AECOM.

<sup>9</sup> AECOM. (2010). District heating opportunity assessment study. (2 November).

[http://www.bathnes.gov.uk/sites/default/files/sitedocuments/Planning-and-Building-Control/Planning-Policy/Evidence-Base/Sustainability/dhoas\\_part\\_1.pdf](http://www.bathnes.gov.uk/sites/default/files/sitedocuments/Planning-and-Building-Control/Planning-Policy/Evidence-Base/Sustainability/dhoas_part_1.pdf)

5. Weston	-	-
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## 9 Recommendations

### a. Solar PV on the greenfield developments could create significant net revenues

There is significant potential for the greenfield sites to accommodate solar PV. Over the 20 year lifetime of the Feed-in Tariff, the net revenues for these sites are significant.

### b. All the sites have the potential to meet an onsite carbon reduction requirement (depending on the site layout), without the developer incurring a net cost

The analysis of the potential for a renewable energy requirement policy shows that all of the 5 sites have the potential to meet either a 10 or 20 % carbon reduction requirement through solar PV installations on the buildings. E Keynsham Option 2 cannot meet a 20% carbon reduction requirement under this model due to the assumed layout of the site. The model needs to be updated with the site's actual layout once this is known, as the requirement could be met if the houses were laid out in more southerly directions. As the financial analysis shows, meeting a carbon reduction requirement need not be a net cost to the developer, due to the Feed-in Tariff revenues on offer and to the potential for third party delivery partners to be involved.

Further analysis of the viability could be undertaken when these sites get to the detailed planning stage. If the Council goes ahead with a carbon reduction requirement and developers do not want to take the opportunity to deliver onsite renewables, the Council could place the onus on the developer to demonstrate that meeting the reduction requirement is not viable.

### c. Third party delivery partners would be interested in working with housing developers to deliver PV

Developers who are not interested in taking up this financial opportunity themselves could be interested in working with a renewable energy delivery partner. There are a number of options for this type of model, such as working with a community group, the Council playing a role in delivery, or using a specialist renewable energy company.

### d. Other renewable energy opportunities

The potential for other types of renewable energy installations on the greenfield sites has not been analysed in detail. However, there may be the potential for near or offsite wind schemes to be contributed to through Allowable Solutions. In addition, the sites at Weston and East Keynsham could include district heat networks that connect to nearby anchor loads. The Odd Down site is adjacent to a district heat opportunity identified in AECOM's study and so a network in that area has greater potential.

a. Appendix A

