Guidance for complying with the climate change planning condition to reduce operational carbon of new dwellings in Swale by 50%

Part 1: Technical summary

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Prepared for Swale Borough Council

by Square Gain Ltd and STG Consultancy

June 2020

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Guidance for complying with the climate change planning condition to reduce operational carbon of new dwellings in Swale by 50%

Part 1: Technical summary

Introduction

This guidance has been produced for those seeking to build new dwellings in Swale, and to assist them with meeting the requirements of Swale Borough Council to reduce carbon emissions by 50% compared to current regulations (Building Regulations Part L1a 2013).

How to achieve the goal – local worked examples

It is recognised that all buildings are different, due to their form, fabric, services, location and orientation. In order to demonstrate that a 50% reduction in carbon is achievable, we have selected three real houses located in the borough of Swale, and the following case studies illustrate how these houses could comply. There are alternative ways of complying and these examples should be seen as illustrations only. We have selected what we believe is the most cost effective ways to it the 50% carbon reduction target, which may involve ensuring a reasonably thermal efficient building fabric, and the use of technologies that are well established in the mainstream market, and readily available at reasonable cost.

All properties that have been modeled by using the current regulatory compliance method SAP 12. Changes to carbon emission factors for electricity strongly favour the use of heat pumps for providing carbon reductions. The option considered in these examples are illustrative of possible solutions to achieving a 50% reduction. The potential for challenge of new standards to spur innovative new approaches should not be overlooked.

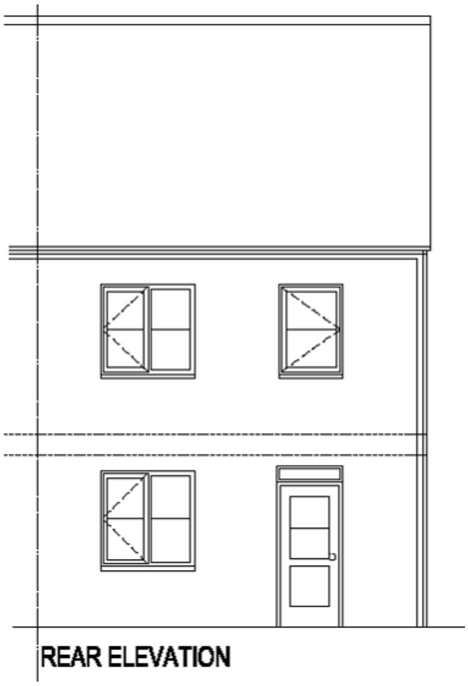
The examples have all been taken as stand alone properties, however SAP 12 will permit grouping (cluster SAPs), in particular in terraced properties and flats.

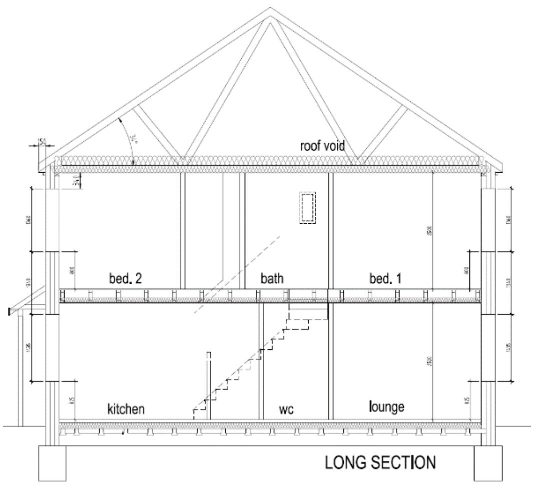
Improved energy efficiency is achieved through a combination of enhanced fabric standards and the use of low carbon heating and hot water sources.

The cost of achieving these standards are likely to decrease over time due to reducing technology costs.

Example 1: Mid terrace 2 bedroom

Figure 5: Elevations, sections and plans of the mid terrace 2 bedroom





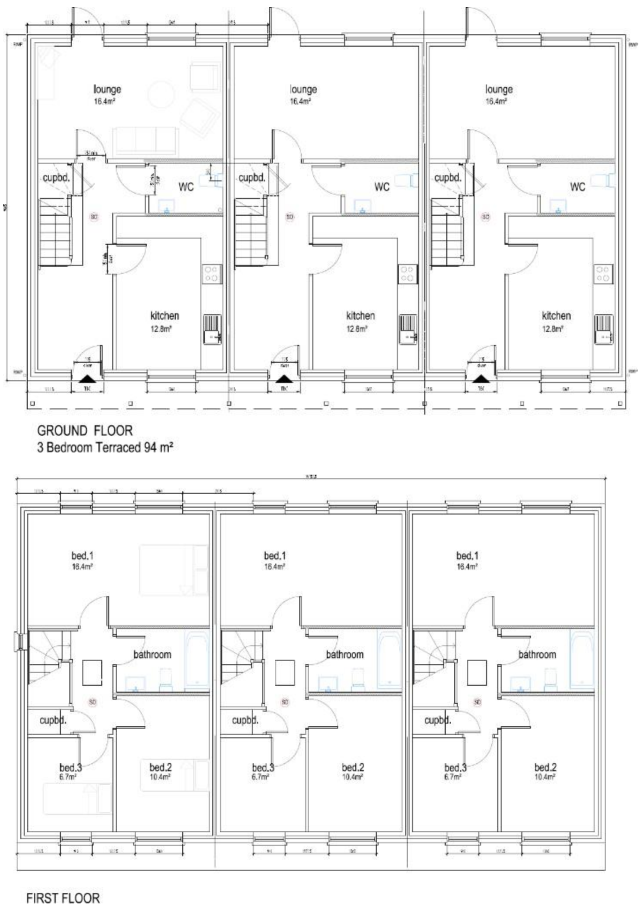


Table 1a: Dimensions

AREA	m^2
Total internal floor area	93.60
Exposed Net Masonry wall area.	30.41
Exposed Net Masonry Tile Hung	12.06
Semi-exposed wall	N/A
Party wall	95.40
Roof – Main Plane	46.80
Floor	46.80
Window and door openings	12.65
Orientation South East	SE
Living Area	16.60
HEIGHT	m
Ground Floor	2.50
First Floor	2.80

Table 1b: Heat loss

Heat loss Element.	Part L1A SAP Compliant specification U values W/m^2K	Option 1. Achieve 50% carbon reduction: ASHP & PV	Option 2. Achieve 50% carbon reduction: ASHP & Solar Thermal
Walls cavity masonry	0.24	0.24	0.24
Walls cavity tiled	0.23	0.18	0.18
Ground Floor	0.10*	0.11	0.11
Roofs Plane	0.13	0.11	0.11
Front Door	1.80	1.60	1.60
Party Walls U Value	0	0	0
Windows	1.60	1.20	1.20
Ventilation Type	Nat – intermittent Vent (3 fans)	Nat - intermittent Vent (3 fans)	MVHR Efficiency 90%
Air Permeability $m^3/h/m^2$@50pa	5	4	3
Thermal Bridging calculated Y-value	0.118- 17.55 W/mk	0.118- 17.55 W/mk	0.118- 17.55 W/mk
Thermal Mass	Low	Low	Low

*A ground floor U value of 0.10 W/m^2k was used to in obtaining a SAP pass in the original design SAP. This figure is not taken from regulations as they could use the 'backstop' value of 0.22 W/m2k in accordance with Part L1A. However, using backstop values would not achieve a Fabric pass even if lots of smart technology were used.

Table 1c: Heating, hot water supply and renewable energy

Item	Gas Boiler Efficiency: Winter 90.7% Summer 87.1%	ASHP Efficiency: Winter 336% Summer 210%	ASHP Efficiency: Winter 336% Summer 210%
Heat emitter	Radiators & Underfloor	Radiators & Underfloor	Radiators & Underfloor
Hot Water Storage	Combi/Condensing	210 lts - loss 1.5 kWh\day	210 lts - loss 1.5 kWh\day
DER $kgCO_2/yr/m^2$	16.53	11.53	11.44
TER	16.69	23.84	23.84
DFEE $kWh/m^2/yr$	44.88	41.20	42.52
TFEE	45.74	45.74	45.74
DER / TER% Improvement CO_2	0.94 %	51.64 %	50.17 %
Lighting LEL	100	100	100
Renewables	None	PV 1 kW Peak	2.25 m^2 Evacuated Tube Solar
SAP Rating	84 B	90 B	90 B
Environmental Rating	86 B	91 B	91 B

The SAP Rating Energy is a measure of the overall efficiency of the dwelling. The higher the rating the more energy efficient and the lower the fuel bills will be.

Environmental Rating. This rating is a measure of a dwellings impact on the environment in terms of carbon dioxide. The higher the rating the less impact it has on the environment.

Model Fabric U values have been used within the above options to maintain a simple base level for comparison.

The introduction of PV along with ASHP option 1 achieved the required 51.64% reduction. Example has a carbon emission rate of 0.805 t/yr.

Option 2 Solar thermal 2.25m^2 with reduced air tightness to 3.00m^3 /h/m^2 and MVHR system achieved 50.17% reduction example, has carbon emission rate 0.871 t/yr.

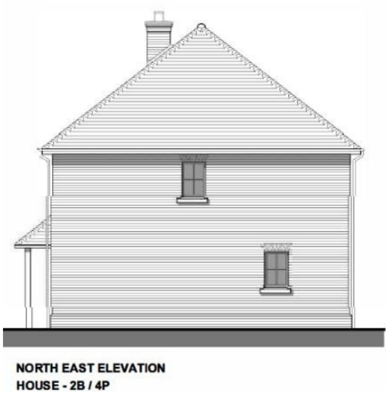
Example 2: Semi-detached 2 bedroom.

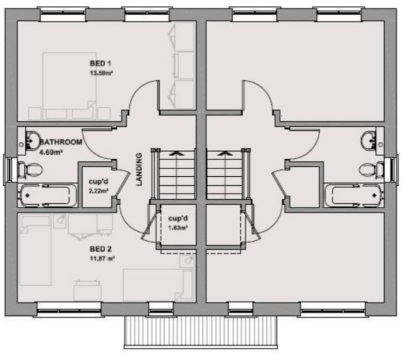
Figure 6: Elevations, sections and plans of the semi detached 2 bedroom

FRONT ELEVATION

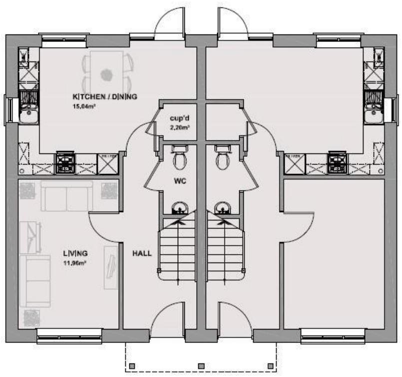
REAR ELEVATION

SIDE ELEVATION





FIRST FLOOR PLAN



GROUND FLOOR PLAN

Table 2a: Dimensions

AREA	m^2
Total internal floor area	79.80
Exposed wall Net	72.17
Semi-exposed wall	N/A
Party wall	58.85
Roof – Main Plane	39.88
Floor	39.88
Window and door openings	16.44
Orientation	South East
HEIGHT	m
Ground Floor	2.40
First Floor	2.60

Table 2b: Heat loss

Heat loss Element	Part L1A SAP Compliant specification U values W/m^2K	Option 1. Achieve 50% carbon reduction: ASHP & PV	Option 2. Achieve 50% carbon reduction: ASHP & MVHR
Walls	0.17	0.17	0.17
Ground Floor	0.11	0.11	0.11
Roofs	0.11	0.11	0.11
Front Door	1.40	1.40	1.40
Patio Door	1.60	1.60	1.60
Party Wall u Value	0	0	0
Windows	1.20	1.20	1.20
Ventilation Type	Nat – intermittent Vent	Nat - intermittent Vent	MVHR Efficiency 90%
Air Permeability $m^3/h/m^2$@50pa	5	5	3
Thermal Bridging calculated Y-value	0.05	0.05	0.05
Thermal Mass	Low	Low	Low

Table 2c: Heating, hot water supply and renewable energy

Item	Gas Boiler Efficiency: Winter 90% Summer 87%	ASHP Efficiency: Winter 336% Summer 210%	ASHP Efficiency: Winter 336% Summer 210%
Heat emitter	Radiators & Underfloor	Radiators & underfloor	Radiators & Underfloor
Hot Water Storage	Combination boiler	210 lts- loss 1.5 kWh\day	210 lts loss 1.50 kWh\day
DER $kgCO_2/yr/m^2$	18.16	12.27	13.25
TER	18.50	26.86	26.86
DFEE $kWh/m^2/yr$	47.47	47.76	45.87
TFEE	52.99	53.39	53.39
DER / TER% Improvement CO_2	1.81%	54.32%	50.67%
Lighting LEL	100%	100%	100%
Renewables	None	PV 1.00 kW Peak	2 m^2 evacuated tube
SAP Rating	83 B	90 B	89 B
Environmental Rating	86 B	91 B	90 B

Model U values have been used within the above options to maintain a simple base level for comparison.

The introduction of PV along with ASHP option 1 achieved the required 54.32% reduction. Example has a carbon emission rate of 0.75 t/yr.

Option 2 Solar thermal 2m2 with reduced air permeability to 3.00m3 /h/m2 and MVHR system achieved 50.67% reduction example, has carbon emission rate 0.89t/yr.

Example 2a. Semi-detached 2 bedroom using SAP 10 (Beta version 1.2r14).

To provide an indication of how building carbon may be assessed differently in future we have included a SAP 10 assessment of the Example dwelling 2.

Table 2d: Heat loss SAP 10

Heat loss Element	**SAP 10 Beta 10.1 ASHP & PV**	Option 1. SAP12 Achieve 50% carbon reduction: ASHP & PV.	Option 2. SAP12 Achieve 50% carbon reduction: ASHP & Solar Thermal.
Walls	0.17	0.17	0.17
Ground Floor	0.11	0.11	0.11
Roofs	0.11	0.11	0.11
Front Door	1.40	1.40	1.40
Patio Door	1.60	1.60	1.60
Party Wall U Value	0	0	0
Windows	1.20	1.20	1.20
Ventilation Type	Nat – intermittent Vent	Nat - intermittent Vent	MVHR Efficiency 90%
Air Permeability $m^3/h/m^2$@50pa	5	5	3
Thermal Bridging calculated Y-value	2.00	0.05	0.05
Thermal Mass		Low	Low
Lighting LEL	Power 10W 19 Fittings Efficacy 60 lm/W	100%	100%
Renewables	PV 1.00 kW Peak	PV 1.00kW Peak	$2m^2$ evacuated tube

Table 2e: Heating, hot water supply and renewable energy

Item	ASHP Efficiency: Winter 336% Summer 210%	ASHP Efficiency: Winter 336% Summer 210%	ASHP Efficiency Winter 336% Summer 210%
Heat emitter	Radiators & Underfloor	Radiators & underfloor	Radiators & Underfloor
Hot Water Storage	210 lts - loss 1.5 kwh\day	210 lts - loss 1.5 kwh\day	210 lts – loss 1.50 kWh\day
DER SAP 2012		12.27	13.25
TER SAP 2012		26.86	26.86
DFEE	N/A	47.76	45.87
TFEE	N/A	53.39	53.39
Fabric Efficiency replaced with primary energy.	See below		
SAP Rating	80 C	90 B	89 B
Environmental Rating	96 A	91 B	90 B

Beta 10 SAP current gives two sets of results, these fall in line with the two-option approach currently being reviewed and still to be determined.

Government proposed changes to Part L:

- Option 1. Reduction of CO_2 by 20% with a focus on Fabric efficiency. OR
- Option 2 reduction of CO_2 by 31% focus on the use of technology.

CO2 Emissions.

- Option 1: SAP rating: DER 4.82 TER1 13.05 kg/yr/m^2 63.07% improvement.
- Option 2: SAP rating: DER 4.82 TER2 11.25 kg/yr/m^2 57.16% improvement

Primary Energy.

- Option 1: DPER 53.15 TPER1 72.89 kWh/m^2/yr 27.08% improvement.
- Option 2: DPER 53.15 TPER2 58.17 kWh/m^2/yr 8.63% improvement.

The following areas of focus are the primary changes when using SAP 10:

- Fuel Prices
- Carbon Factors
- Heating Patterns
- Lighting energy
- Thermal Bridging
- Hot water demand
- Photovoltaics
- Overheating risks and
- Thermal Mass parameters.

Example 3. Detached 4 Bedroom House.

Figure 7: Elevations, sections and plans of the detached 4 bedroom

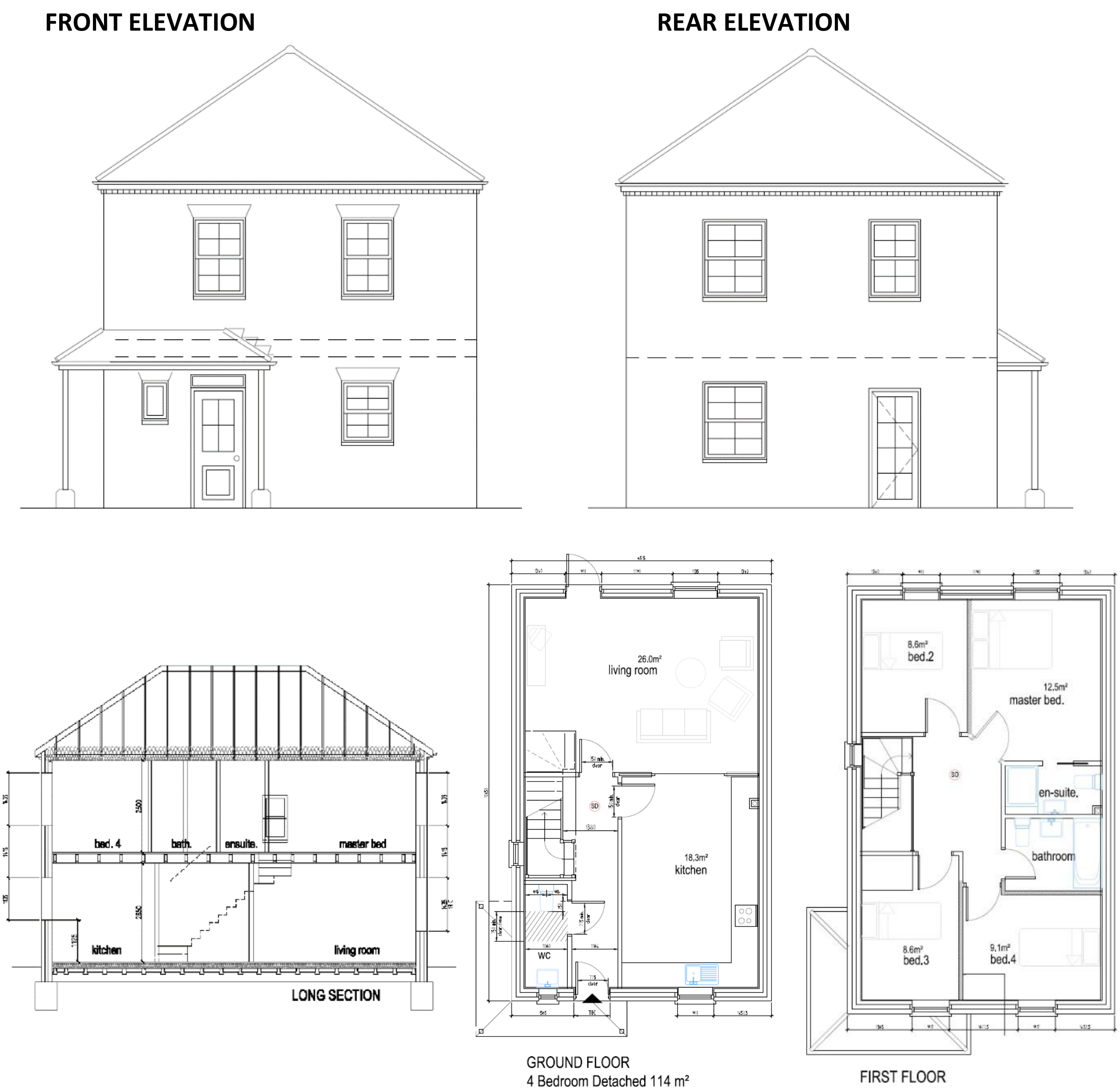


Table 3a: Dimensions

AREA	m^2
Total internal floor area	112.96
Exposed wall Net	150.59
Semi-exposed wall	N/A
Party wall	N/A
Roof – Main Plane	56.48
Floor	56.48
Window and door openings	13.21
Orientation South East	SE
HEIGHT	m
Ground Floor	2.45
First Floor	2.80

Table 3b: Heat loss

Heat loss Element.	Part L1A SAP Compliant specification U values W/m^2K	Option 1. achieve 50% carbon reduction: ASHP & PV.	Option 2. Achieve 50% carbon reduction: ASHP & Solar Thermal
Walls	0.23	0.23	0.18
Ground Floor	0.11	0.11	0.11
Roofs	0.13	0.13	0.13
Front Door	1.80	1.60	1.60
Patio Door	N/A	N/A	N/A
Party Wall u Value	N/A	N/A	N/A
Windows	1.60	1.20	1.20
Ventilation Type	Nat – intermittent Vent	Nat - intermittent Vent	
Air Permeability $m^3/h/m^2$@50pa	5	5	4
Thermal Bridging calculated Y-value	0.057	0.057	0.057
Thermal Mass	Medium	Medium	Medium

Table 3c: Heating, hot water supply and renewable energy

Item	Gas Boiler Efficiency: Winter 90.7% Summer 87.1%	ASHP Efficiency: Winter 336% Summer 210%	ASHP Efficiency: Winter 336% Summer 210%
Heat emitter	Radiators & Underfloor	Radiators & underfloor	Radiators & Underfloor
Hot Water Storage	Combination boiler	210 lts - loss 1.50 kWh\day	210 lts - loss 1.50 kWh\day
DER $kgCO_2/yr/m^2$	17.38	12.44	13.22
TER	18.07	26.11	26.56
DFEE $kWh/m^2/yr$	52.87	49.73	47.38
TFEE	57.35	57.35	59.02

DER / TER% Improvement CO_2	3.80	50.37	50.22
Lighting LEL	100%	100%	100%
Renewables	None	PV 1.00 kW Peak	2m2 evacuated tubes
SAP Rating	84 B	88 B	87 B
Environmental Rating	85 B	89 B	89 B

The introduction of PV along with ASHP option 1 achieved the required 52.36 % reduction. Example has a carbon emission rate of 1.08t/yr.

Option 2 Solar thermal 2m^2 with reduced air tightness to 4.00m^3 /h/m^2 and achieved 50.22% reduction, example has carbon emission rate 1.22t/yr.

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Guidance for complying with the climate change planning condition to reduce operational carbon of new dwellings in Swale by 50%

Part 2: Full guidance document

Introduction

This guidance has been produced for those seeking to build new dwellings in Swale, and to assist them with meeting the requirements of Swale Borough Council to reduce carbon emissions by 50% compared to current regulations (Building Regulations Part L1a 2013).

What's happening on carbon nationally and locally?

In late 2018, the Intergovernmental Panel on Climate Change (IPCC) issued a stark warning. It clearly established that achieving the ambitions of the Paris Climate Agreement, limiting warming to 1.5°C to avoid the most catastrophic impacts of climate change, will require action at an unprecedented pace and scale. Significant reductions in greenhouse gas emissions from the global economy are required by 2030, with net zero emissions by 2050.

The UK was the first major economy in the world to pass a law to end its contribution to climate change (Climate Change Act 2008, as amended). This means that the UK will aim to balance any emissions generated through emission cutting or removal efforts and achieve so-called 'Net Zero' Carbon by 2050.

According to the UK Climate Change Commmittee's UK Housing-Fit for the Future? Report (2019), "*UK homes are not fit for the future… The quality, design and use of homes across the UK must be improved now to address the challenges of climate change. Doing so will also improve health, wellbeing and comfort… New homes must be built to be low-carbon, energy and water efficient and climate resilient. The costs of building to a specification that achieves the aims (set out in this report) are not prohibitive, and getting design right from the outset is vastly cheaper than forcing retrofit late."*

Relevant UK legislation includes:

- The 2008 Climate Change Act sets a legally binding target, stating that: "*It is the duty of the Secretary of State to ensure that the net UK carbon account for the year 2050 is at least 100% lower than the 1990 baseline.*"
- The 2008 Planning and Energy Act sets out powers for local authorities to set local carbon reduction standards that go beyond national Building Regulations.
- The 2018 National Planning Policy Framework (NPPF) states that "*The purpose of the planning system is to contribute to the achievement of sustainable development*".

Energy efficiency of the existing UK housing stock

The Standard Assessment Procedure (SAP), is the methodology used by the Government to assess and compare the energy and environmental performance of dwellings. It is the basis for establishing compliance with Building Regulations, and for Energy Performance Certificates (EPCs). EPCs have two metrics, a fuel cost-based energy efficiency rating (commonly called the 'EPC' rating, in £/kWh/m^2) and a rating relating to emissions of CO2 (the Environmental Impact (EI) rating, in CO2/m^2). Ratings are banded A-G, with A being the highest performing.

The EPC rating is based on a 'SAP' score. A higher 'SAP' score indicates lower running costs, with an EPC rating of A being equivalent to a SAP score of 92 to 100 points. A score of 100 indicates that no heating or hot water costs are required for that building.

In 2016, the average SAP score of English dwellings was 62 points, up from 45 points in 1996. This increase was evident in all tenures. However, the increase appears to be slowing and there was no change in the average SAP score of homes between 2015 and 2016 (in any tenure). Source: UK Housing: fit for the future?, Committee on Climate Change 2019

Energy Performance Certificate (EPC) data indicates that D is the most common EPC rating across Great Britain. Few properties have A or B ratings (estimated to only make up 1.4% of all properties).

An introduction to carbon

Carbon dioxide (CO_2) is a naturally occurring gas that is vital for life on earth and is one of many greenhouse gases (GHGs). We must consider not only CO_2 but all greenhouse gases (GHGs), which can be converted into the same global warming potential (GWP) as carbon dioxide, known as 'carbon dioxide equivalent (CO_2e). For ease we refer to CO_2e as 'carbon'.

Concentrations of atmospheric carbon have been increasing, resulting in a warming effect on the atmosphere and oceans, and the absorption of carbon by the oceans is also causing seawater to become more acidic.

The energy, including electricity, used in homes accounts for about 20% of UK greenhouse gas emissions carbon emissions[1], a figure that significantly increases if the energy and carbon needed to produce the building materials (embodied carbon) is also included.

This section of the guidance provides more information on operational carbon, embodied carbon, whole life carbon and carbon offsetting.

Operational carbon

Operational energy consumption is often categorised into two key components; regulated and unregulated energy consumption. 'Regulated energy' consumption results from controlled, fixed building services including heating and cooling, hot water, ventilation and lighting. 'Unregulated energy' consumption results from processes that are not covered by building regulations, i.e., plug loads – cooking, and electrical equipment. The Swale Borough Council requirement is focused on regulated energy. Unregulated energy can form up to 50% of total operational energy, and

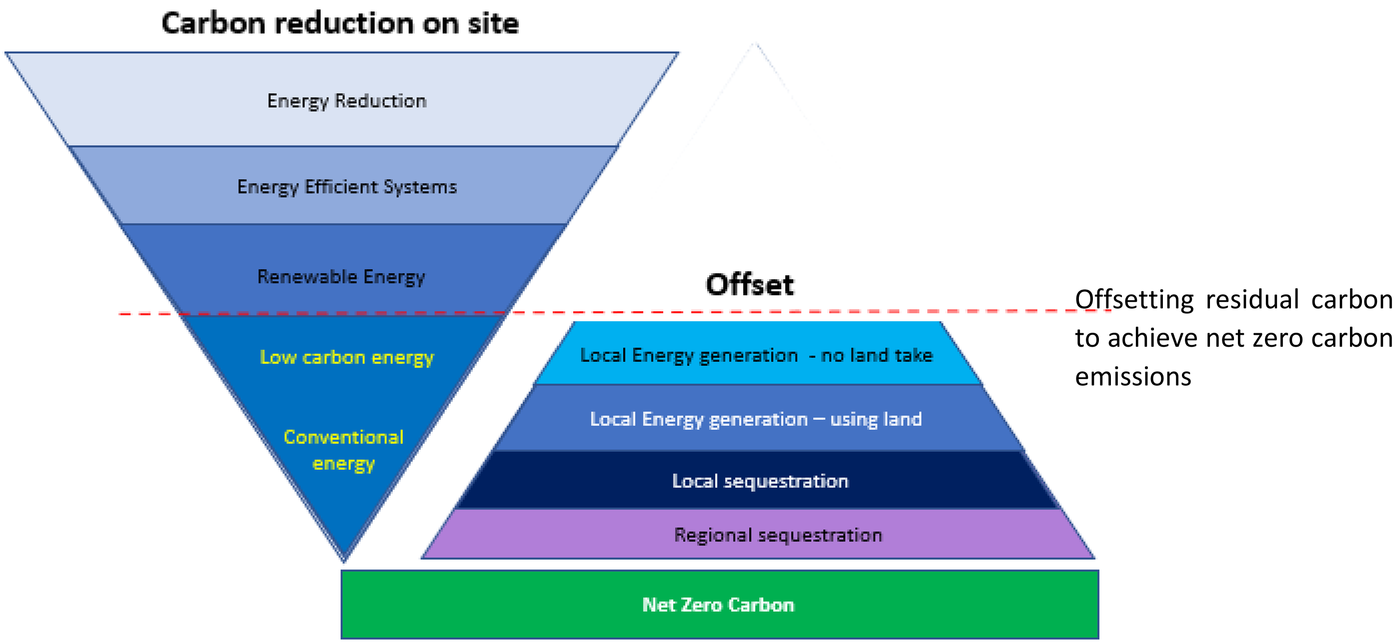
[1] UK housing: Fit for the future? Committee on Climate Change, February 2019

can also contribute to significant internal heat gains which may then need to be offset by cooling, and need to be considered to achieve a net zero carbon building.

Net zero carbon during a building's operation requires a balance between use and generation over the life of the building. It is common to use a design life of 60 years when calculating operational carbon emissions, although it is recognised that the buildings designed and built now should last longer than this.

Energy efficiency is the first consideration, and design approaches should begin with efforts to reduce building energy demand prior to the introduction of complex mechanical systems which reduce the energy required to satisfy this demand. The lower the energy demand of the building, the easier it is to achieve net zero carbon in use. Only after a thorough consideration of energy reduction steps should renewable energy generation be considered, with any energy that cannot be met by on-site generation, being offset. See Energy Hierarchy Model below.

Figure 1: Energy hierarchy and carbon offset diagram.



Useful reference documents on operational and embodied carbon have been produced recently from the London Energy Transformation Initiative (LETI)[2] and the UK Green Building Council (UKGBC)[3]. LETI suggests an operational energy intensity target of 35 kWh/m^2/yr.

Embodied carbon

Selecting the type of materials to build with, and considering those that have lower carbon emissions in their manufacture (and wider environmental issues), as well as the quantum of materials to be used, will have a significant impact on the embodied carbon of the project.

Ensuring space efficiency and reducing overall building size and material quantities will generally reduce the overall embodied carbon, as will the complexity in form, which also improves buildability and reduces the likelihood of a performance gap between the design, and actual operational energy use.

Research by LETI suggests an embodied carbon target of 500kg/CO_2/m2 GIA (gross internal area) for residential buildings.

[2] https://www.leti.london/
[3] https://www.ukgbc.org/

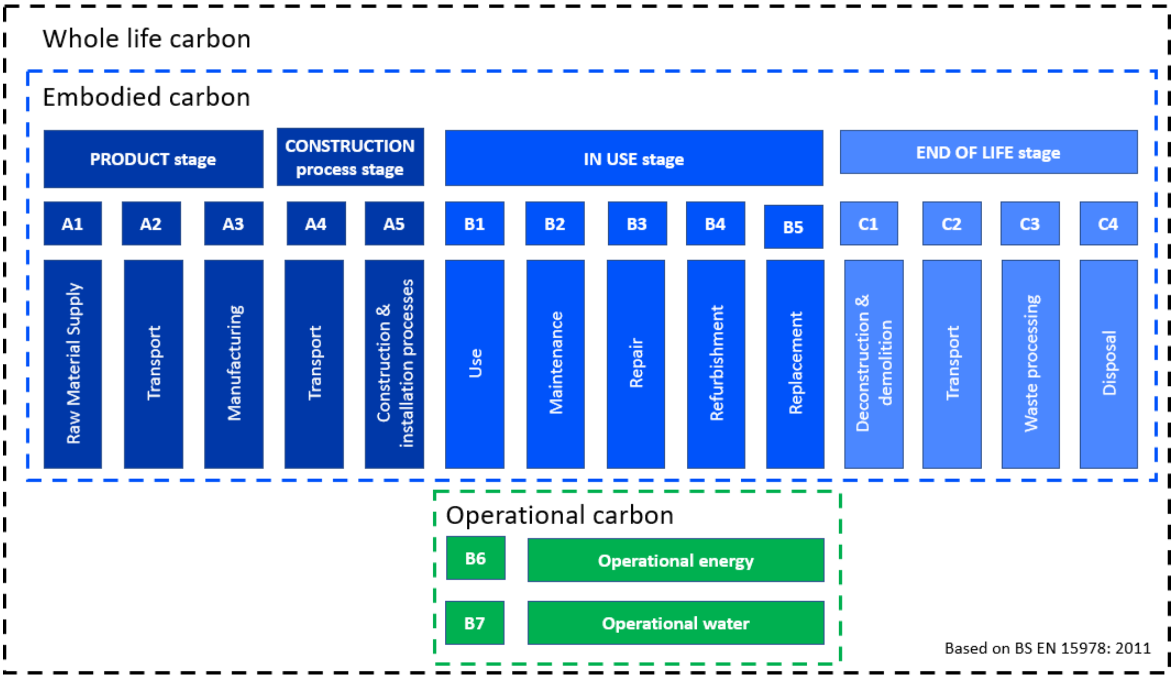
Whole life carbon

Swale Borough Council's carbon target currently focuses only on operational carbon.

When we consider both the embodied carbon of products and the carbon emissions that are generated through its operation life, we can be said to be considering the whole life carbon of a building.

The figures below show how the embodied carbon and operational carbon contribute to a building's whole life carbon (source: based on EN15978:2011 Sustainability of construction works. Assessment of environmental performance of buildings. Calculation method).

Figure 2: Whole life, embodied and operational carbon.



Offsetting carbon and Allowable solutions

Several local authorities have established a fund to offset carbon emissions. Any gap between a new building's operational performance and the local authorities' carbon requirement, must be compensated for by the developer. The local authority can then use the fund to support carbon reductions elsewhere they may not have been financially viable without this support. An example is the new London Plan, which uses a carbon price of £95/tonne.

Swale may consider establishing such a carbon offset fund prior to the requirement for 100% reduction in carbon emissions, to enable the net zero carbon (rather than true zero carbon) emissions to be achieved.

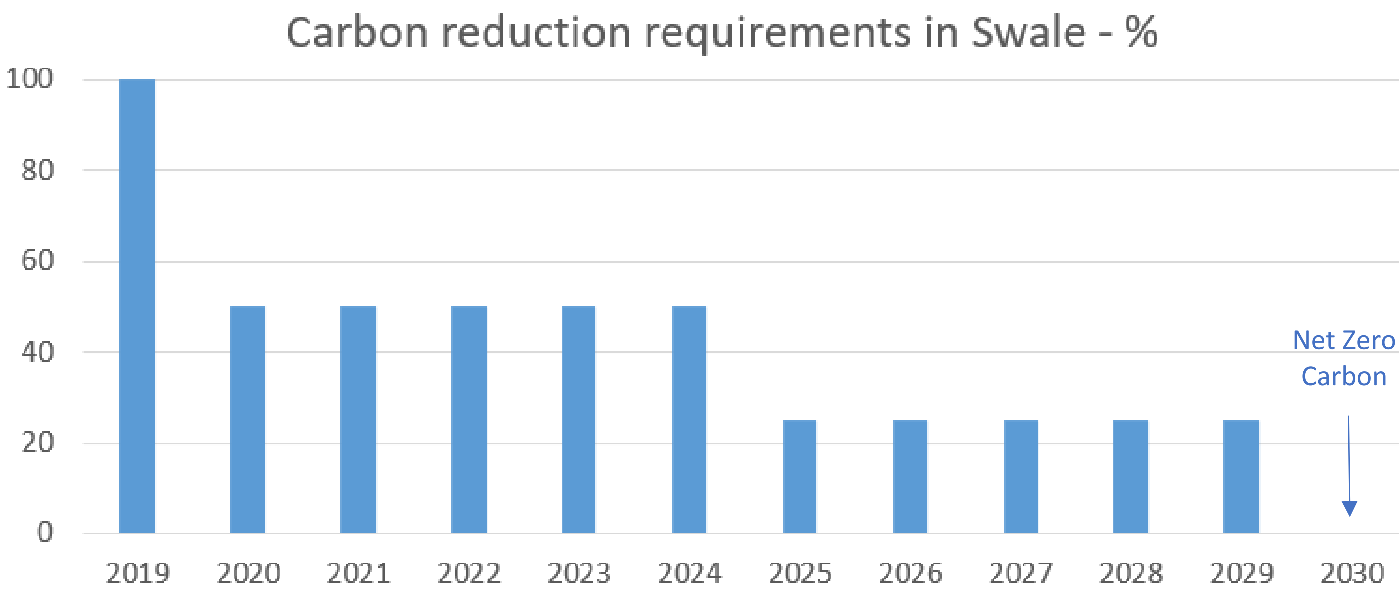
Another form of local offsetting is to use Cluster SAPs where all the houses in a terrace for example, undertake a combined SAP, and achieve the required standard collectively, albeit that individual houses may not. An example would be on a terrace of houses where the end properties could not install PV due to the gable end, and to balance this, additional PV could be installed on other properties in the terrace.

Swale Borough Council's requirements for new homes

In June 2019, Swale Borough Council made a declaration of a climate and ecological emergency and has committed to achieving net zero carbon emissions across the borough by 2030.

The Local Plan is currently being reviewed and as an interim measure, Swale Borough Council has developed a planning condition for all new homes in the borough to achieve a 50% carbon reduction compared to the current Building Regulations[4]. The improvement in the Dwelling Emission Rate (DER) should be at least a 50% improvement over the Target Emission Rate (TER). This is the first part of a phased approach to achieving zero carbon new buildings as shown on the diagram below.

Figure 3: Swale Borough Council – Net Zero Carbon Buildings Transition Plan



An 75% reduction in carbon will be required for new buildings in Swale by 2025, and a 100% reduction by 2030, to achieve zero carbon.

The scope of the Swale Borough Council requirement is:

- **Carbon emissions** resulting from **regulated energy**, in
- **New domestic buildings**.

Swale Borough Council recognises that Building Regulations use outdated carbon emission factors and that this will continue to cause uncertainty until they are updated by Government. However, developments are expected to achieve carbon reductions beyond part L from energy efficiency measures alone to reduce energy demand as far as possible.

The reduction targets relate to operational carbon of a building. Embodied carbon of building materials is also being reviewed by Swale Borough Council, which may form part of an associated target in future.

Swale Borough Council recognises the need for new homes and also that these new homes are not only resilient to climate change, but also help to mitigate against further climate impacts.

Design SAP calculations should be provided at pre-commencement, (in accordance with Building Regulations) showing that the carbon emissions of the property will be at least 50% lower than Building Regulations 2013 Part L1.

[4] Building Regulations Part L1a 2013. If these are updated, the carbon target threshold will be reviewed.

Emphasis will also be placed on checking compliance post-construction, to ensure that the new building achieves the design aspirations regarding carbon and energy.

Current challenges

The Swale Borough Council requirement aims to encourage our new homes to be low-carbon, more comfortable to live in, better for our health, and more affordable to run. The Committee on Climate Change research shows that the cost of building low-carbon, and energy efficient homes is not prohibitive. Designing in these features from the start is around one-fifth of the cost of retrofitting to the same quality and standard, and currently the health cost to the NHS of conditions exacerbated by poor housing is currently estimated to be £1.4 – 2.0 billion per year in England.

Swale Borough Council recognises the different incentivisation for planners, developers and buyers[5], and has reflected this in the Planning Condition requirement, particularly in the way in which the requirement for zero carbon buildings will be implemented in a stepped transition. It is considered that the requirement for 50% improvement on the current (and outdated) regulations is achievable, whilst maintaining a healthy development profit.

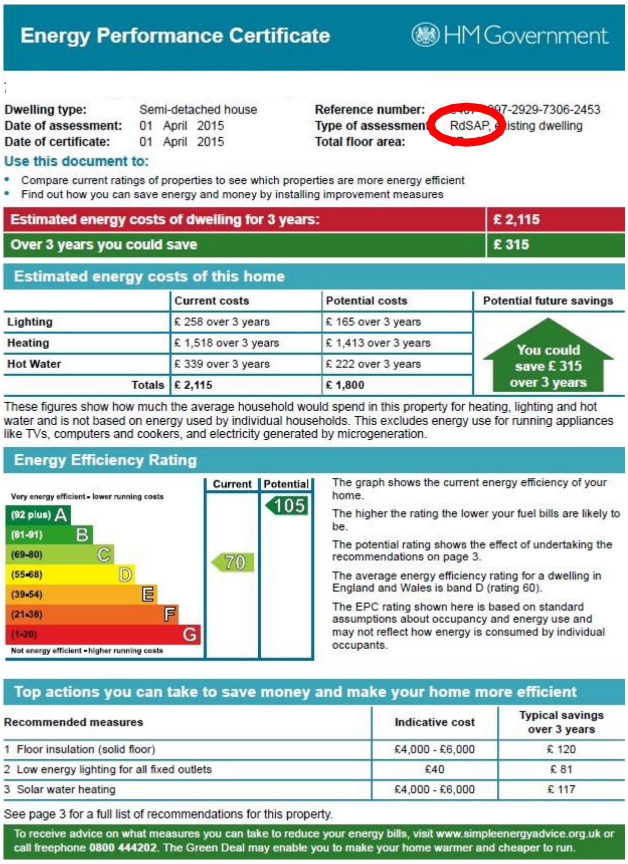
Most new homebuyers are not building industry experts, and education of the home buyers is important, using tools such as the buildings EPC. Educating buyers is particularly important when we are installing technology, which includes an Owners' Manual detailing how the equipment should be operated.

Owners should also be made aware of the requirement for a full design SAP to have been undertaken for a new home, and not the Reduced SAP (Rd SAP) that is required when buying or renting existing dwellings. The difference in the SAP certificate is not obvious, as the examples below highlight (we have circled where the Reduced SAP is used.

[5] Planners seek low carbon emissions, developers seek to maximise profits from sales, and buyers seek low energy costs.

Figure 4: Comparing Reduced SAP with Full Design SAP

Reduced SAP



Energy Performance Certificate

HM Government

Dwelling type:	Semi-detached house	**Reference number:**	[illegible]97-2929-7306-2453
Date of assessment:	01 April 2015	**Type of assessment:**	RdSAP, existing dwelling
Date of certificate:	01 April 2015	**Total floor area:**	[illegible]

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:	**£ 2,115**
Over 3 years you could save	**£ 315**

Estimated energy costs of this home

	Current costs	Potential costs	Potential future savings
Lighting	£ 258 over 3 years	£ 165 over 3 years	You could save £ 315 over 3 years
Heating	£ 1,518 over 3 years	£ 1,413 over 3 years	
Hot Water	£ 339 over 3 years	£ 222 over 3 years	
Totals	£ 2,115	£ 1,800	

These figures show how much the average household would spend in this property for heating, lighting and hot water and is not based on energy used by individual households. This excludes energy use for running appliances like TVs, computers and cookers, and electricity generated by microgeneration.

Energy Efficiency Rating

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).

The EPC rating shown here is based on standard assumptions about occupancy and energy use and may not reflect how energy is consumed by individual occupants.

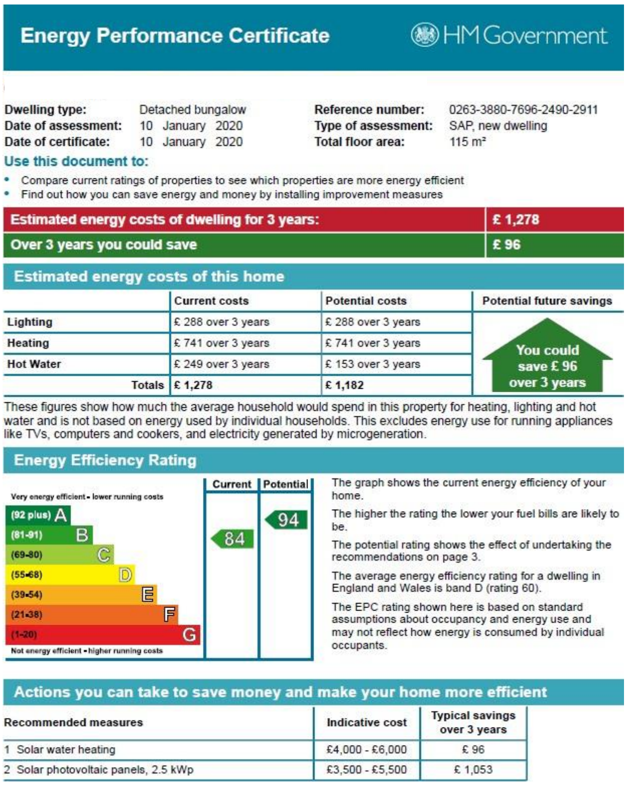
Top actions you can take to save money and make your home more efficient

Recommended measures	Indicative cost	Typical savings over 3 years
1 Floor insulation (solid floor)	£4,000 - £6,000	£ 120
2 Low energy lighting for all fixed outlets	£40	£ 81
3 Solar water heating	£4,000 - £6,000	£ 117

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

To receive advice on what measures you can take to reduce your energy bills, visit www.simpleenergyadvice.org.uk or call freephone **0800 444202**. The Green Deal may enable you to make your home warmer and cheaper to run.

Full SAP



Energy Performance Certificate

HM Government

Dwelling type:	Detached bungalow	**Reference number:**	0263-3880-7696-2490-2911
Date of assessment:	10 January 2020	**Type of assessment:**	SAP, new dwelling
Date of certificate:	10 January 2020	**Total floor area:**	115 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:	**£ 1,278**
Over 3 years you could save	**£ 96**

Estimated energy costs of this home

	Current costs	Potential costs	Potential future savings
Lighting	£ 288 over 3 years	£ 288 over 3 years	You could save £ 96 over 3 years
Heating	£ 741 over 3 years	£ 741 over 3 years	
Hot Water	£ 249 over 3 years	£ 153 over 3 years	
Totals	£ 1,278	£ 1,182	

These figures show how much the average household would spend in this property for heating, lighting and hot water and is not based on energy used by individual households. This excludes energy use for running appliances like TVs, computers and cookers, and electricity generated by microgeneration.

Energy Efficiency Rating

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).

The EPC rating shown here is based on standard assumptions about occupancy and energy use and may not reflect how energy is consumed by individual occupants.

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

Recommended measures	Indicative cost	Typical savings over 3 years
1 Solar water heating	£4,000 - £6,000	£ 96
2 Solar photovoltaic panels, 2.5 kWp	£3,500 - £5,500	£ 1,053

A further challenge that is recognised by Swale Borough Council is the fact that the current regulations have not moved on as quickly as the technology, nor how energy is delivered to the home. The current Building Regulations came into force in 2013, and use the SAP 2012 calculations. This has contributed to a disjoint between the current regulations and carbon reductions, as outdated carbon factors are used. The updated building regulations are expected in late 2020 and will use SAP 10, which moves away from fabric efficiency, towards primary energy, and this may change the resultant carbon intensity further.

It is also recognised that planning departments can be time-constrained and have little time to undertake post-construction checks, to ensure that planning conditions been robustly complied with. Swale Borough Council aims to check compliance, including the EPC, and the as-built design SAP (to show where the EPC came from).

How to achieve the goal – local worked examples

It is recognised that all buildings are different, due to their form, fabric, services, location and orientation. In order to demonstrate that a 50% reduction in carbon is achievable, we have selected three real houses located in the borough of Swale, and the following case studies illustrate how these houses could comply. There are alternative ways of complying and these examples should be seen as illustrations only. We have selected what we believe is the most cost effective ways to achieve the 50% carbon reduction target, which may involve ensuring a reasonably thermal

efficient building fabric, and the use of technologies that are well established in the mainstream market, and readily available at reasonable cost.

All properties that have been modeled by using the current regulatory compliance method SAP 12. Changes to carbon emission factors for electricity strongly favour the use of heat pumps for providing carbon reductions. The option considered in these examples are illustrative of possible solutions to achieving a 50% reduction. The potential for challenge of new standards to spur innovative new approaches should not be overlooked.

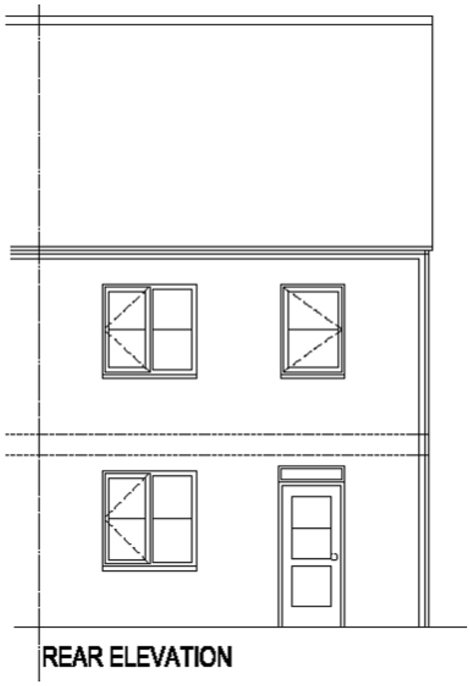
The examples have all been taken as stand alone properties, however SAP 12 will permit grouping (cluster SAPs), in particular in terraced properties and flats.

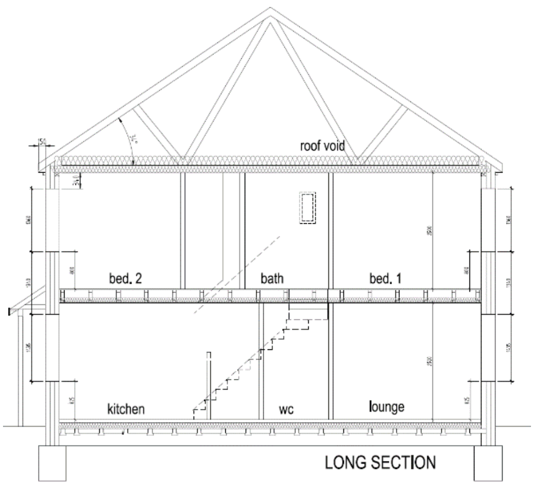
Improved energy efficiency is achieved through a combination of enhanced fabric standards and the use of low carbon heating and hot water sources.

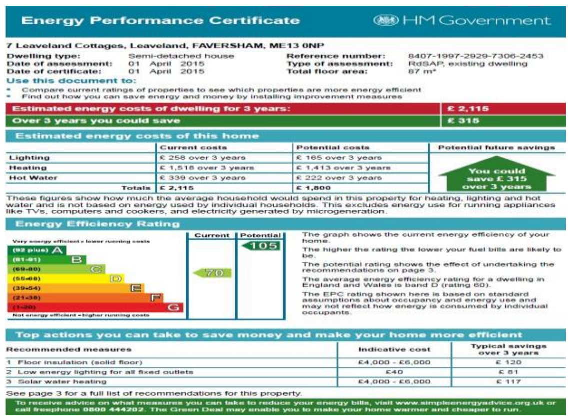
The cost of achieving these standards are likely to decrease over time due to reducing technology costs.

Example 1: Mid terrace 2 bedroom

Figure 5: Elevations, sections and plans of the mid terrace 2 bedroom







Energy Performance Certificate HM Government

7 Leaveland Cottages, Leaveland, FAVERSHAM, ME13 0NP

Dwelling type:	Semi-detached house	**Reference number:**	8407-1997-2929-7306-2453
Date of assessment:	01 April 2015	**Type of assessment:**	RdSAP, existing dwelling
Date of certificate:	01 April 2015	**Total floor area:**	87 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:	**£ 2,115**
Over 3 years you could save	**£ 315**

Estimated energy costs of this home

	Current costs	Potential costs	Potential future savings
Lighting	£ 258 over 3 years	£ 165 over 3 years	You could save £ 315 over 3 years
Heating	£ 1,518 over 3 years	£ 1,413 over 3 years	
Hot Water	£ 339 over 3 years	£ 222 over 3 years	
Totals	£ 2,115	£ 1,800	

These figures show how much the average household would spend in this property for heating, lighting and hot water and is not based on energy used by individual households. This excludes energy use for running appliances like TVs, computers and cookers, and electricity generated by microgeneration.

Energy Efficiency Rating

	Current	Potential
Very energy efficient - lower running costs		
(92 plus) A		105
(81-91) B		
(69-80) C	70	
(55-68) D		
(39-54) E		
(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).

The EPC rating shown here is based on standard assumptions about occupancy and energy use and may not reflect how energy is consumed by individual occupants.

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

Recommended measures	Indicative cost	Typical savings over 3 years
1 Floor insulation (solid floor)	£4,000 - £6,000	£ 120
2 Low energy lighting for all fixed outlets	£40	£ 81
3 Solar water heating	£4,000 - £6,000	£ 117

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

To receive advice on what measures you can take to reduce your energy bills, visit www.simpleenergyadvice.org.uk or call freephone 0800 444202. The Green Deal may enable you to make your home warmer and cheaper to run.

Table 1a: Dimensions

AREA	m^2
Total internal floor area	93.60
Exposed Net Masonry wall area.	30.41
Exposed Net Masonry Tile Hung	12.06
Semi-exposed wall	N/A
Party wall	95.40
Roof – Main Plane	46.80
Floor	46.80
Window and door openings	12.65
Orientation South East	SE
Living Area	16.60
HEIGHT	m
Ground Floor	2.50
First Floor	2.80

Table 1b: Heat loss

Heat loss Element.	Part L1A SAP Compliant specification U values W/m^2K	Option 1. Achieve 50% carbon reduction: ASHP & PV	Option 2. Achieve 50% carbon reduction: ASHP & Solar Thermal
Walls cavity masonry	0.24	0.24	0.24
Walls cavity tiled	0.23	0.18	0.18
Ground Floor	0.10*	0.11	0.11
Roofs Plane	0.13	0.11	0.11
Front Door	1.80	1.60	1.60
Party Walls U Value	0	0	0
Windows	1.60	1.20	1.20
Ventilation Type	Nat – intermittent Vent (3 fans)	Nat - intermittent Vent (3 fans)	MVHR Efficiency 90%
Air Permeability $m^3/h/m^2$@50pa	5	4	3
Thermal Bridging calculated Y-value	0.118- 17.55 W/mk	0.118- 17.55 W/mk	0.118- 17.55 W/mk
Thermal Mass	Low	Low	Low

*A ground floor U value of 0.10 W/m^2k was used to in obtaining a SAP pass in the original design SAP. This figure is not taken from regulations as they could use the 'backstop' value of 0.22 W/m2k in accordance with Part L1A. However, using backstop values would not achieve a Fabric pass even if lots of smart technology were used.

Table 1c: Heating, hot water supply and renewable energy

Item	Gas Boiler Efficiency: Winter 90.7% Summer 87.1%	ASHP Efficiency: Winter 336% Summer 210%	ASHP Efficiency: Winter 336% Summer 210%
Heat emitter	Radiators & Underfloor	Radiators & Underfloor	Radiators & Underfloor
Hot Water Storage	Combi/Condensing	210 lts - loss 1.5 kWh\day	210 lts - loss 1.5 kWh\day
DER $kgCO_2/yr/m^2$	16.53	11.53	11.44
TER	16.69	23.84	23.84
DFEE $kWh/m^2/yr$	44.88	41.20	42.52
TFEE	45.74	45.74	45.74
DER / TER% Improvement CO_2	0.94 %	51.64 %	50.17 %
Lighting LEL	100	100	100
Renewables	None	PV 1 kW Peak	2.25 m^2 Evacuated Tube Solar
SAP Rating	84 B	90 B	90 B
Environmental Rating	86 B	91 B	91 B

The SAP Rating Energy is a measure of the overall efficiency of the dwelling. The higher the rating the more energy efficient and the lower the fuel bills will be.

Environmental Rating. This rating is a measure of a dwellings impact on the environment in terms of carbon dioxide. The higher the rating the less impact it has on the environment.

Model Fabric U values have been used within the above options to maintain a simple base level for comparison.

The introduction of PV along with ASHP option 1 achieved the required 51.64% reduction. Example has a carbon emission rate of 0.805 t/yr.

Option 2 Solar thermal 2.25m^2 with reduced air tightness to 3.00m^3 /h/m^2 and MVHR system achieved 50.17% reduction example, has carbon emission rate 0.871 t/yr.

Example 2: Semi-detached 2 bedroom.

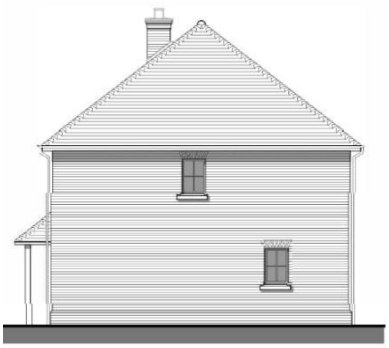
Figure 6: Elevations, sections and plans of the semi detached 2 bedroom

FRONT ELEVATION

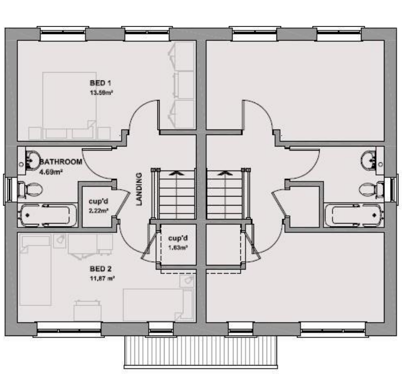
REAR ELEVATION

NORTH WEST ELEVATION
HOUSE - 2B / 4P

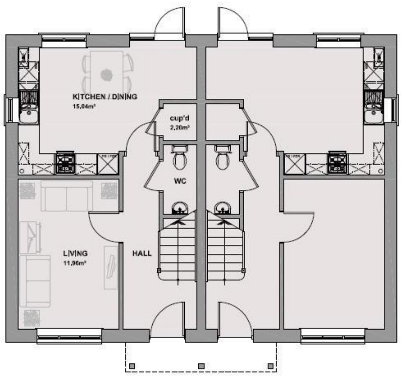
SIDE ELEVATION



NORTH EAST ELEVATION
HOUSE - 2B / 4P



FIRST FLOOR PLAN



GROUND FLOOR PLAN

Table 2a: Dimensions

AREA	m^2
Total internal floor area	79.80
Exposed wall Net	72.17
Semi-exposed wall	N/A
Party wall	58.85
Roof – Main Plane	39.88
Floor	39.88
Window and door openings	16.44
Orientation	South East
HEIGHT	m
Ground Floor	2.40
First Floor	2.60

Table 2b: Heat loss

Heat loss Element	Part L1A SAP Compliant specification U values W/m^2K	Option 1. Achieve 50% carbon reduction: ASHP & PV	Option 2. Achieve 50% carbon reduction: ASHP & MVHR
Walls	0.17	0.17	0.17
Ground Floor	0.11	0.11	0.11
Roofs	0.11	0.11	0.11
Front Door	1.40	1.40	1.40
Patio Door	1.60	1.60	1.60
Party Wall u Value	0	0	0
Windows	1.20	1.20	1.20
Ventilation Type	Nat – intermittent Vent	Nat - intermittent Vent	MVHR Efficiency 90%
Air Permeability $m^3/h/m^2$@50pa	5	5	3
Thermal Bridging calculated Y-value	0.05	0.05	0.05
Thermal Mass	Low	Low	Low

Table 2c: Heating, hot water supply and renewable energy

Item	Gas Boiler Efficiency: Winter 90% Summer 87%	ASHP Efficiency: Winter 336% Summer 210%	ASHP Efficiency: Winter 336% Summer 210%
Heat emitter	Radiators & Underfloor	Radiators & underfloor	Radiators & Underfloor
Hot Water Storage	Combination boiler	210 lts- loss 1.5 kWh\day	210 lts loss 1.50 kWh\day
DER $kgCO_2/yr/m^2$	18.16	12.27	13.25
TER	18.50	26.86	26.86
DFEE $kWh/m^2/yr$	47.47	47.76	45.87
TFEE	52.99	53.39	53.39
DER / TER% Improvement CO_2	1.81%	54.32%	50.67%
Lighting LEL	100%	100%	100%
Renewables	None	PV 1.00 kW Peak	2 m^2 evacuated tube
SAP Rating	83 B	90 B	89 B
Environmental Rating	86 B	91 B	90 B

Model U values have been used within the above options to maintain a simple base level for comparison.

The introduction of PV along with ASHP option 1 achieved the required 54.32% reduction. Example has a carbon emission rate of 0.75 t/yr.

Option 2 Solar thermal 2m2 with reduced air permeability to 3.00m3 /h/m2 and MVHR system achieved 50.67% reduction example, has carbon emission rate 0.89t/yr.

Example 2a. Semi-detached 2 bedroom using SAP 10 (Beta version 1.2r14).

To provide an indication of how building carbon may be assessed differently in future we have included a SAP 10 assessment of the Example dwelling 2.

Table 2d: Heat loss SAP 10

Heat loss Element	**SAP 10 Beta 10.1 ASHP & PV**	Option 1. SAP12 Achieve 50% carbon reduction: ASHP & PV.	Option 2. SAP12 Achieve 50% carbon reduction: ASHP & Solar Thermal.
Walls	0.17	0.17	0.17
Ground Floor	0.11	0.11	0.11
Roofs	0.11	0.11	0.11
Front Door	1.40	1.40	1.40
Patio Door	1.60	1.60	1.60
Party Wall U Value	0	0	0
Windows	1.20	1.20	1.20
Ventilation Type	Nat – intermittent Vent	Nat - intermittent Vent	MVHR Efficiency 90%
Air Permeability $m^3/h/m^2$@50pa	5	5	3
Thermal Bridging calculated Y-value	2.00	0.05	0.05
Thermal Mass		Low	Low
Lighting LEL	Power 10W 19 Fittings Efficacy 60 lm/W	100%	100%
Renewables	PV 1.00 kW Peak	PV 1.00kW Peak	$2m^2$ evacuated tube

Table 2e: Heating, hot water supply and renewable energy

Item	ASHP Efficiency: Winter 336% Summer 210%	ASHP Efficiency: Winter 336% Summer 210%	ASHP Efficiency Winter 336% Summer 210%
Heat emitter	Radiators & Underfloor	Radiators & underfloor	Radiators & Underfloor
Hot Water Storage	210 lts - loss 1.5 kwh\day	210 lts - loss 1.5 kwh\day	210 lts – loss 1.50 kWh\day
DER SAP 2012		12.27	13.25
TER SAP 2012		26.86	26.86
DFEE	N/A	47.76	45.87
TFEE	N/A	53.39	53.39
Fabric Efficiency replaced with primary energy.	See below		
SAP Rating	80 C	90 B	89 B
Environmental Rating	96 A	91 B	90 B

Beta 10 SAP current gives two sets of results, these fall in line with the two-option approach currently being reviewed and still to be determined.

Government proposed changes to Part L:

- Option 1. Reduction of CO_2 by 20% with a focus on Fabric efficiency. OR
- Option 2 reduction of CO_2 by 31% focus on the use of technology.

CO2 Emissions.

- Option 1: SAP rating: DER 4.82 TER1 13.05 kg/yr/m^2 63.07% improvement.
- Option 2: SAP rating: DER 4.82 TER2 11.25 kg/yr/m^2 57.16% improvement

Primary Energy.

- Option 1: DPER 53.15 TPER1 72.89 kWh/m^2/yr 27.08% improvement.
- Option 2: DPER 53.15 TPER2 58.17 kWh/m^2/yr 8.63% improvement.

The following areas of focus are the primary changes when using SAP 10:

- Fuel Prices
- Carbon Factors
- Heating Patterns
- Lighting energy
- Thermal Bridging
- Hot water demand
- Photovoltaics
- Overheating risks and
- Thermal Mass parameters.

Example 3. Detached 4 Bedroom House.

Figure 7: Elevations, sections and plans of the detached 4 bedroom

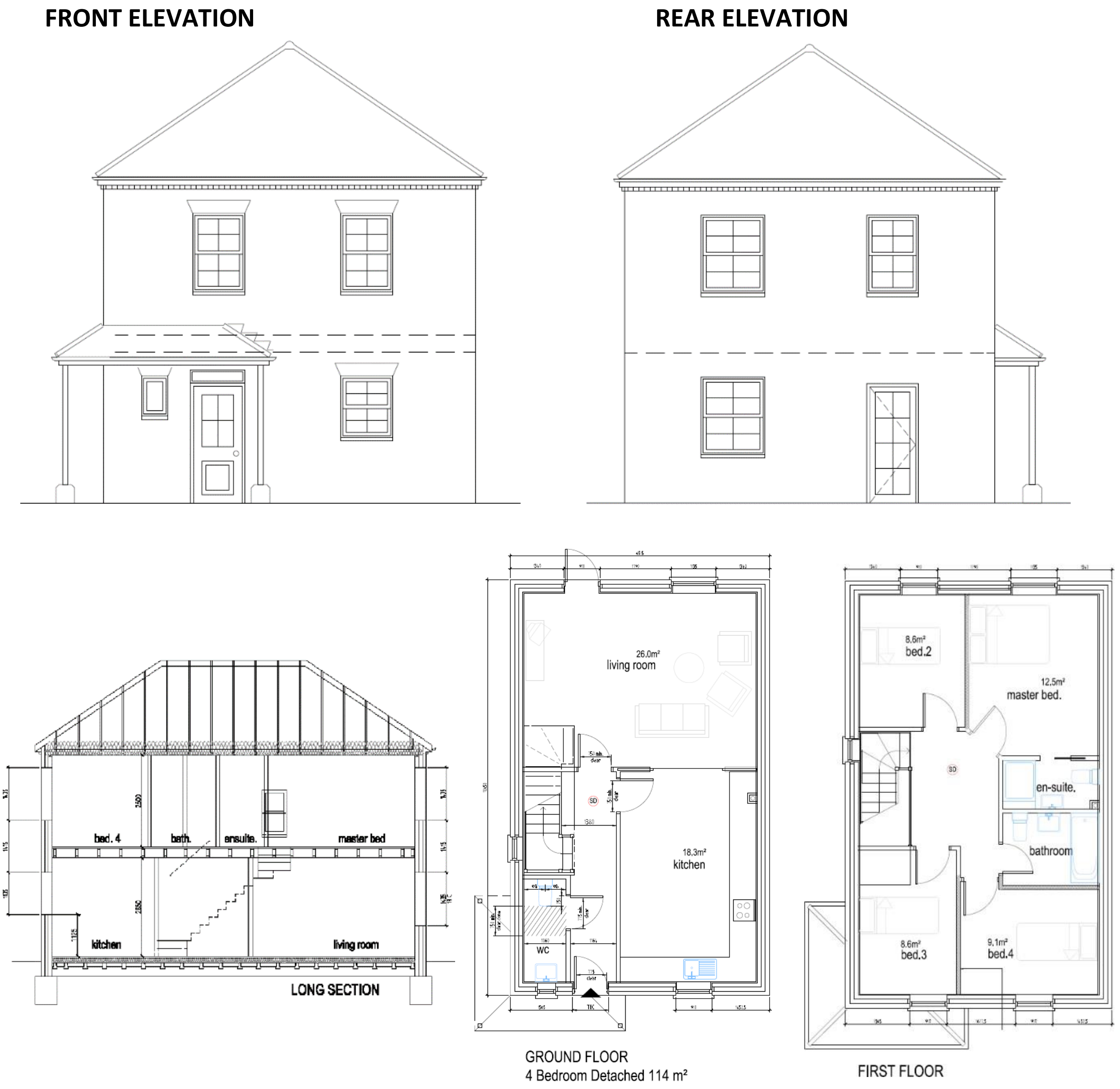


Table 3a: Dimensions

AREA	m^2
Total internal floor area	112.96
Exposed wall Net	150.59
Semi-exposed wall	N/A
Party wall	N/A
Roof – Main Plane	56.48
Floor	56.48
Window and door openings	13.21
Orientation South East	SE
HEIGHT	m
Ground Floor	2.45
First Floor	2.80

Table 3b: Heat loss

Heat loss Element.	Part L1A SAP Compliant specification U values W/m^2K	Option 1. achieve 50% carbon reduction: ASHP & PV.	Option 2. Achieve 50% carbon reduction: ASHP & Solar Thermal
Walls	0.23	0.23	0.18
Ground Floor	0.11	0.11	0.11
Roofs	0.13	0.13	0.13
Front Door	1.80	1.60	1.60
Patio Door	N/A	N/A	N/A
Party Wall u Value	N/A	N/A	N/A
Windows	1.60	1.20	1.20
Ventilation Type	Nat – intermittent Vent	Nat - intermittent Vent	
Air Permeability $m^3/h/m^2$@50pa	5	5	4
Thermal Bridging calculated Y-value	0.057	0.057	0.057
Thermal Mass	Medium	Medium	Medium

Table 3c: Heating, hot water supply and renewable energy

Item	Gas Boiler Efficiency: Winter 90.7% Summer 87.1%	ASHP Efficiency: Winter 336% Summer 210%	ASHP Efficiency: Winter 336% Summer 210%
Heat emitter	Radiators & Underfloor	Radiators & underfloor	Radiators & Underfloor
Hot Water Storage	Combination boiler	210 lts - loss 1.50 kWh\day	210 lts - loss 1.50 kWh\day
DER $kgCO_2/yr/m^2$	17.38	12.44	13.22
TER	18.07	26.11	26.56
DFEE $kWh/m^2/yr$	52.87	49.73	47.38
TFEE	57.35	57.35	59.02

DER / TER% Improvement CO_2	3.80	50.37	50.22
Lighting LEL	100%	100%	100%
Renewables	None	PV 1.00 kW Peak	2m2 evacuated tubes
SAP Rating	84 B	88 B	87 B
Environmental Rating	85 B	89 B	89 B

The introduction of PV along with ASHP option 1 achieved the required 52.36 % reduction. Example has a carbon emission rate of 1.08t/yr.

Option 2 Solar thermal 2m^2 with reduced air tightness to 4.00m^3 /h/m^2 and achieved 50.22% reduction, example has carbon emission rate 1.22t/yr.

Costs and returns for developers

It is likely that many developers will chose to meet the Swale carbon target by using an ASHP, as opposed to a conventional gas boiler. The Future Homes Standard outlines that from 2025, no gas boilers will be allowed in new homes. An ASHP costs approximately £6,000 - £9,000 to purchase and install, and they achieve their greatest efficiency when running at low temperature. Therefore larger radiators are also required. Low temperature radiators add around £150-500 to the upfront cost of building a home (depending on the size of the home). The savings resulting from not having to install a traditional radiator can be offset against these additional savings to provide an extra overall cost.

When it comes to selling these energy efficient houses, in addition to traditional financial products, green mortgages are a relatively new suite of products to have entered the financial markets. Green mortgages and green loans have been designed to encourage uptake and support financing of any additional upfront costs incurred through low energy, low carbon homes. Lenders incorporate energy costs in mortgage affordability calculations, allowing buyers toborrow more when purchasing homes with low energy bills. Green mortgages combined with in-use savings are likely to make energy efficient homes more attractive to buyers. In turn this should result in an increased value on efficient homes, allowing developers of these homes to recoup any initial investment and potentially more.

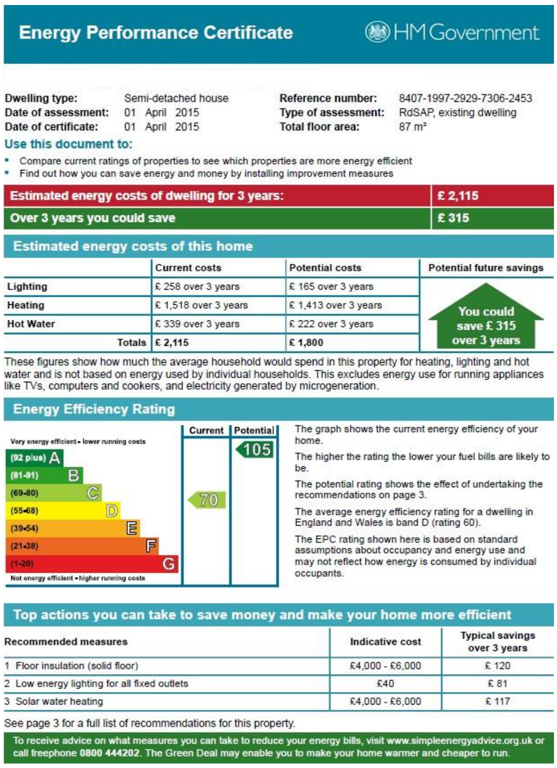
Costs for residents – energy bills

The transition to zero carbon (100% carbon reduction), results in lower operational costs for residents, which has been demonstrated to attract increased sales values of more than 9%[6] of property value. The below example uses these figures and applies this to the Swale Borough Council requirement for 50% carbon reduction (50% of 9% = 4.5%).

If a traditional (Building Regulation compliant) house were to be valued at £250,000 with traditional energy usage, the same house with 50% energy reduction would be valued at 4.5% higher, or £261,250

This additional £11,000 can be used by developers to more than cover the additional capital expenditure required to achieve the 50% carbon reduction.

The potential savings in energy use (and carbon) are shown on the dwellings EPC, a local example of which is shown here.



Energy Performance Certificate HM Government

Dwelling type: Semi-detached house
Date of assessment: 01 April 2015
Date of certificate: 01 April 2015
Reference number: 8407-1997-2929-7306-2453
Type of assessment: RdSAP, existing dwelling
Total floor area: 87 m²

Use this document to:

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- Find out how you can save energy and money by installing improvement measures

Estimated energy costs of dwelling for 3 years:	£ 2,115
Over 3 years you could save	£ 315

Estimated energy costs of this home

	Current costs	Potential costs	Potential future savings
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Heating	£ 1,518 over 3 years	£ 1,413 over 3 years	
Hot Water	£ 339 over 3 years	£ 222 over 3 years	
Totals	£ 2,115	£ 1,800	

These figures show how much the average household would spend in this property for heating, lighting and hot water and is not based on energy used by individual households. This excludes energy use for running appliances like TVs, computers and cookers, and electricity generated by microgeneration.

Energy Efficiency Rating

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).

The EPC rating shown here is based on standard assumptions about occupancy and energy use and may not reflect how energy is consumed by individual occupants.

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

Recommended measures	Indicative cost	Typical savings over 3 years
1 Floor insulation (solid floor)	£4,000 - £6,000	£ 120
2 Low energy lighting for all fixed outlets	£40	£ 81
3 Solar water heating	£4,000 - £6,000	£ 117

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

To receive advice on what measures you can take to reduce your energy bills, visit www.simpleenergyadvice.org.uk or call freephone 0800 444202. The Green Deal may enable you to make your home warmer and cheaper to run.

The future cost of carbon is likely to be higher. Over 190 countries have recognised that carbon emissions are causing climate change and have committed to significantly reduce carbon emissions. In future, the price of carbon is likely to increase in the near future, either through market forces, or through taxation. A precedent has been set for this in the past with the introduction of the Landfill Tax, when the government wished to reduce landfill waste. The Landfill Tax was introduced in 1996 at £6/tonne and currently stands at over £94/tonne.

[6] ZEB 1, Priors Hall Park, Corby

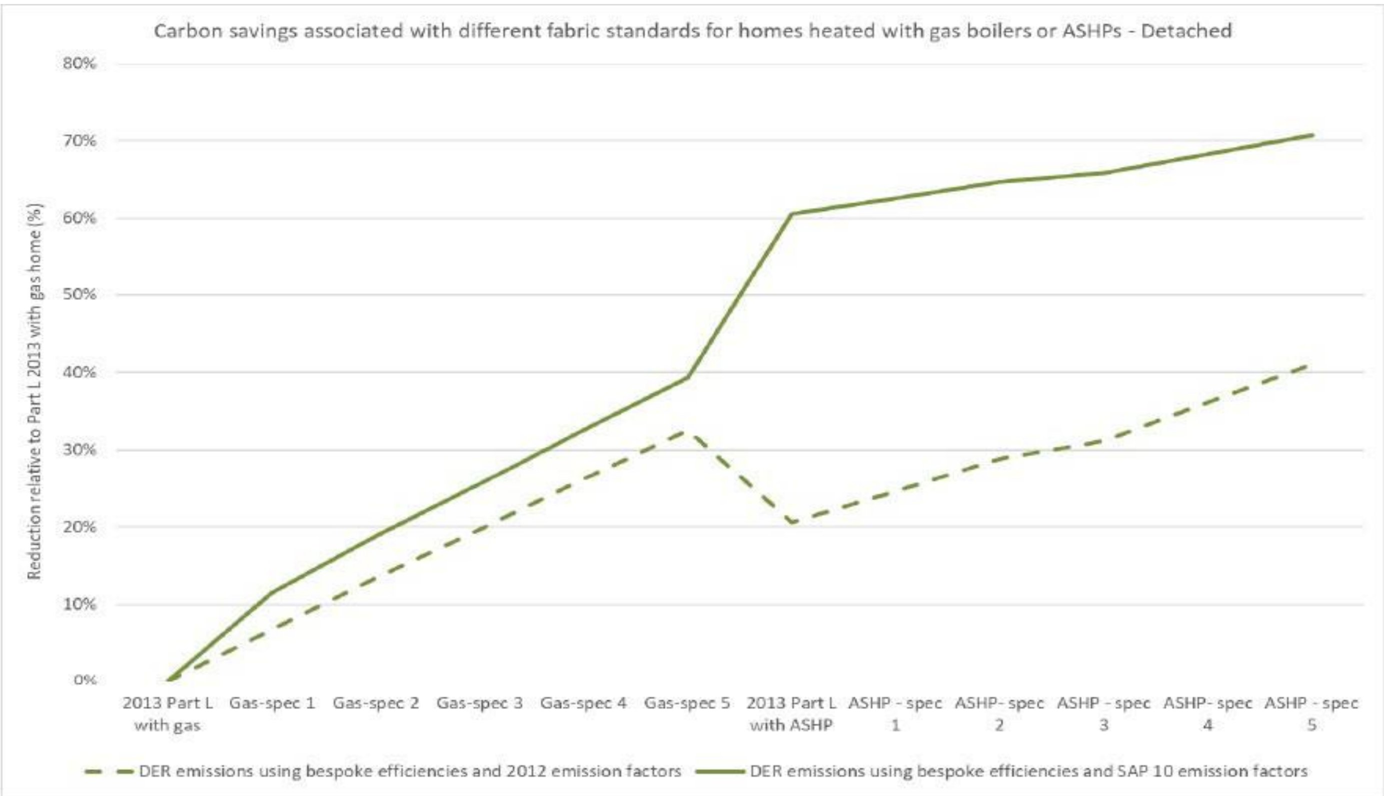
When carbon costs are higher, the relative savings for residents in low carbon homes will be greater. It follows that an increased premium for such savings is likely to be attracted on the sale values of such homes.

Looking forward

Ultra-low energy and carbon houses already exist which significantly surpass the current Swale Borough Council requirement for a 50% reduction in carbon emissions. Many of these homes are certified to third party standards, which rigerously focus on the construction details and build quality. For example over 65,000 buildings have been designed, built and tested to the Passivhaus standard. Swale Borough Council's approach recognises that although such schemes may hold significant merit, they may not be affordable for all, using today's technologies and pricing. Therefore a phased approach to carbon reduction has been determined. This provides mainstream developers years to ensure they have the skills to meet today's leaders such as Passivhaus.

The Building Regulations are expected to be amended in late 2020 and introduce a new SAP (SAP10). SAP10 focuses on primary energy, rather than fabric efficiency, and will use updated carbon factors for both the supply of gas and electricity from the grid. Compared with the old carbon factors (used by SAP 2012), the SAP10 factors reduce the carbon intensity of gas slightly, and reduce the carbon intensity of electricity by almost five fold. It is therefore likely that new homes will be predominantly electrically heated, and the Future Homes Standard (on which the consultation completed in late 2019) is expected to ban gas boilers in all new homes from 2025.

Figure 8: The difference to carbon emissions, comparing SAP 2012 and the new SAP10, for a suite of homes with gas boilers or ASHPs.



Source: The costs and benefits of tighter standards for new buildings, Currie & Brown, 2019

Glossary

ASHP	Air Source Heat Pump
CO_2	Carbon Dioxide, referred in the report as ‘carbon’
DER	Dwelling Emission Rate
DFEE	Dwelling Fabric Energy Efficiency Rate
DPER	Design Primary Energy Rating
EPC	Energy Performance Certificate
kWh	Kilowatt hour
LEL	Low energy lighting
Lm	Lumines per Watt
MVHR	Mechanical Ventilation with Heat Recovery
Part L1a	Part L1A (of the Building Regulations) deals with the conservation of fuel and power in new dwellings.
PV	Photovoltaic panels, used to convert sunlight into electricity
SAP	Standard Assessment Procedure. A SAP rating is the calculation that is required in order to produce a predicted energy assessment on an Energy Performance Certificate (EPC). A full design SAP is required prior to selling a new dwelling.
Rd SAP	Reduced SAP
TER	Target Emission Rate
TFEE	Target Fabric Energy Efficiency Rate
TPER	Target Primary Energy Rating

References

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