Sustainability Study for:

Future Homes Sustainability Report for Spring Ville/ Brock Lane, East Sleekburn

Carried out by:

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Introduction

This is a Sustainability Assessment, it is a consultation provided by Richmond Thermal Solutions for Spring Ville/ Brock Lane, East Sleekburn

The proposal is to construct newly efficiently designed houses.

New Dwellings
at
Spring Ville/ Brock Lane, East Sleekburn

Feasability Study

Thermal Elements

This property achieves well below the target U-values as in Approved Document L1A, please see below :

Walls	To achieve 0.18
Floor	To achieve 0.10
Insulated Ceilings	To achieve 0.10
Slope	To achieve 0.13
Windows	To achieve 1.20
Doors	To achieve 1.00

Air Leakage 5 m3/m2/hr

Below in Table 1, this shows the key features for each house type and the reductions they are achieving in CO_2 emissions.

There is also a breakdown of each house type showing using SAP methodology the Dwelling Emission Rate against the Target Emission Rate and the reduction.

Table 1

Dwelling	Status	Built Form	DER	TER	DFEE	TFEE	% Reduction	FEE	Total CO2 (SAP)
Plot 1	New dwelling design stage	Detached	16.8	17.76	51	59.6	5.41	50.95	1587.57
Plot 2	New dwelling design stage	Detached	15.26	16.26	45.1	54.5	6.15	45.13	1616.27
Plot 3	New dwelling design stage	Semi-detached	16.72	17.48	39.4	48.4	4.35	39.37	1137.71
Plot 4	New dwelling design stage	Semi-detached	16.72	17.48	39.4	48.4	4.35	39.37	1137.71
Plot 5	New dwelling design stage	Detached	15.26	16.26	45.1	54.5	6.15	45.13	1616.27
Plot 6	New dwelling design stage	Detached	15.26	16.26	45.1	54.5	6.15	45.13	1616.27
Plot 7	New dwelling design stage	End-terrace	16.72	17.48	39.4	48.4	4.35	39.37	1137.71
Plot 8	New dwelling design stage	Mid-terrace	15.62	16.32	34.3	42.3	4.29	34.28	1061.08
Plot 9	New dwelling design stage	End-terrace	16.72	17.48	39.4	48.4	4.35	39.37	1137.71
Plot 10	New dwelling design stage	End-terrace	16.72	17.48	39.4	48.4	4.35	39.37	1137.71

Plot 11	New dwelling design stage	Mid-terrace	15.62	16.32	34.3	42.3	4.29	34.28	1061.08
Plot 12	New dwelling design stage	End-terrace	16.72	17.48	39.4	48.4	4.35	39.37	1137.71
Plot 13	New dwelling design stage	End-terrace	16.72	17.48	39.4	48.4	4.35	39.37	1137.71
Plot 14	New dwelling design stage	Mid-terrace	15.62	16.32	34.3	42.3	4.29	34.28	1061.08
Plot 15	New dwelling design stage	End-terrace	16.72	17.48	39.4	48.4	4.35	39.37	1137.71
Plot 16	New dwelling design stage	Detached	16.08	17.08	46.7	56.7	5.85	46.67	1561.03
Plot 17	New dwelling design stage	Detached	16.08	17.08	46.7	56.7	5.85	46.67	1561.03
Plot 18	New dwelling design stage	Semi-detached	16.72	17.48	39.4	48.4	4.35	39.37	1137.71
Plot 19	New dwelling design stage	Semi-detached	16.72	17.48	39.4	48.4	4.35	39.37	1137.71
Plot 20	New dwelling design stage	End-terrace	16	16.85	47.4	56.9	5.04	47.43	1666.39
Plot 21	New dwelling design stage	End-terrace	16	16.85	47.4	56.9	5.04	47.43	1666.39
Plot 22	New dwelling design stage	Detached	16.08	17.08	46.7	56.7	5.85	46.67	1561.03
Plot 23	New dwelling design stage	Semi-detached	16.72	17.48	39.4	48.4	4.35	39.37	1137.71
Plot 24	New dwelling design stage	Semi-detached	16.72	17.48	39.4	48.4	4.35	39.37	1137.71
Plot 25	New dwelling design stage	Detached	15.26	16.26	45.1	54.5	6.15	45.13	1616.27
Plot 26	New dwelling design stage	End-terrace	16	16.85	47.4	56.9	5.04	47.43	1666.39
Plot 27	New dwelling design stage	Detached	15.26	16.26	45.1	54.5	6.15	45.13	1616.27
Plot 28	New dwelling design stage	Semi-detached	16.72	17.48	39.4	48.4	4.35	39.37	1137.71
Plot 29	New dwelling design stage	Mid-terrace	15.62	16.32	34.3	42.3	4.29	34.28	1061.08
Plot 30	New dwelling design stage	End-terrace	16.72	17.48	39.4	48.4	4.35	39.37	1137.71
Plot 31	New dwelling design stage	End-terrace	16	16.85	47.4	56.9	5.04	47.43	1666.39
Plot 32	New dwelling design stage	End-terrace	14.31	15.16	36.8	45.3	5.61	36.78	1339.92
Plot 33	New dwelling design stage	End-terrace	14.31	15.16	36.8	45.3	5.61	36.78	1339.92
Plot 34	New dwelling design stage	End-terrace	14.31	15.16	36.8	45.3	5.61	36.78	1339.92
Plot 35	New dwelling design stage	End-terrace	16	16.85	47.4	56.9	5.04	47.43	1666.39
Plot 36	New dwelling design stage	Detached	15.26	16.26	45.1	54.5	6.15	45.13	1616.27
Plot 37	New dwelling design stage	End-terrace	16	16.85	47.4	56.9	5.04	47.43	1666.39
Plot 38	New dwelling design stage	End-terrace	16	16.85	47.4	56.9	5.04	47.43	1666.39
Plot 39	New dwelling design stage	Detached	16.08	17.08	46.7	56.7	5.85	46.67	1561.03
Plot 40	New dwelling design stage	Detached	16.08	17.08	46.7	56.7	5.85	46.67	1561.03
Plot 41	New dwelling design stage	Detached	16.08	17.08	46.7	56.7	5.85	46.67	1561.03
Plot 42	New dwelling design stage	Semi-detached	16.72	17.48	39.4	48.4	4.35	39.37	1137.71
Plot 43	New dwelling design stage	Semi-detached	16.72	17.48	39.4	48.4	4.35	39.37	1137.71
Plot 44	New dwelling design stage	Semi-detached	16.72	17.48	39.4	48.4	4.35	39.37	1137.71
Plot 45	New dwelling design stage	Semi-detached	16.72	17.48	39.4	48.4	4.35	39.37	1137.71

Plot 46	New dwelling design stage	End-terrace	17.32	18.21	41.3	49.9	4.89	41.28	1064.62
Plot 47	New dwelling design stage	Mid-terrace	16.11	16.94	35.7	43.2	4.96	35.72	989.27
Plot 48	New dwelling design stage	End-terrace	17.32	18.21	41.3	49.9	4.89	41.28	1064.62

Assessor and House Details

Assessor Name: John Young **Assessor Number:** STRO034821
Property Address: House Type A - End Terrace

Buiding regulation assessment

	kg/m²/year
TER	18.21
DER	17.32

ENE 1 Assessment - Dwelling Emission Rate

Total Energy Type CO_2 Emissions for Codes Levels 1 - 5

	%	kg/m²/year	
DER from SAP 2012 DER Worksheet		17.32	(ZC1)
TER		18.21	
Residual CO2 emissions offset from biofuel CHP		0	(ZC5)
CO2 emissions offset from additional allowable electricty generation		0	(ZC7)
Total CO2 emissions offset from SAP Section 16 allowances		0	
DER accounting for SAP Section 16 allowances		17.32	
% improvement DER/TER	4.9		

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Assessor and House Details

Assessor Name: John Young **Assessor Number:** STRO034821
Property Address: House Type A - MidTerrace

Buiding regulation assessment

	kg/m²/year
TER	16.94
DER	16.11

ENE 1 Assessment - Dwelling Emission Rate

Total Energy Type CO_2 Emissions for Codes Levels 1 - 5

	%	kg/m²/year	
DER from SAP 2012 DER Worksheet		16.11	(ZC1)
TER		16.94	
Residual CO2 emissions offset from biofuel CHP		0	(ZC5)
CO2 emissions offset from additional allowable electricty generation		0	(ZC7)
Total CO2 emissions offset from SAP Section 16 allowances		0	
DER accounting for SAP Section 16 allowances		16.11	
% improvement DER/TER	4.9		

Assessor and House Details

Assessor Name: **John Young** | Assessor Number: **STRO034821**
Property Address: **House Type B - End Terrace**

Buiding regulation assessment

	kg/m²/year
TER	**17.48**
DER	**16.72**

ENE 1 Assessment - Dwelling Emission Rate

Total Energy Type CO_2 Emissions for Codes Levels 1 - 5

	%	kg/m²/year	
DER from SAP 2012 DER Worksheet		**16.72**	*(ZC1)*
TER		**17.48**	
Residual CO2 emissions offset from biofuel CHP		**0**	*(ZC5)*
CO2 emissions offset from additional allowable electricty generation		**0**	*(ZC7)*
Total CO2 emissions offset from SAP Section 16 allowances		**0**	
DER accounting for SAP Section 16 allowances		**16.72**	
% improvement DER/TER	**4.3**		

Assessor and House Details

Assessor Name: **John Young** | Assessor Number: **STRO034821**
Property Address: **House Type B - Mid Terrace**

Buiding regulation assessment

	kg/m²/year
TER	**16.32**
DER	**15.62**

ENE 1 Assessment - Dwelling Emission Rate

Total Energy Type CO_2 Emissions for Codes Levels 1 - 5

	%	kg/m²/year	
DER from SAP 2012 DER Worksheet		**15.62**	*(ZC1)*
TER		**16.32**	
Residual CO2 emissions offset from biofuel CHP		**0**	*(ZC5)*
CO2 emissions offset from additional allowable electricty generation		**0**	*(ZC7)*
Total CO2 emissions offset from SAP Section 16 allowances		**0**	
DER accounting for SAP Section 16 allowances		**15.62**	
% improvement DER/TER	**4.3**		

Assessor and House Details

Assessor Name: **John Young** | Assessor Number: **STRO034821**
Property Address: **House Type C - End Terrace**

Buiding regulation assessment

	kg/m²/year
TER	**15.16**
DER	**14.31**

ENE 1 Assessment - Dwelling Emission Rate

Total Energy Type CO_2 Emissions for Codes Levels 1 - 5

	%	kg/m²/year	
DER from SAP 2012 DER Worksheet		**14.31**	*(ZC1)*
TER		**15.16**	
Residual CO2 emissions offset from biofuel CHP		**0**	*(ZC5)*
CO2 emissions offset from additional allowable electricty generation		**0**	*(ZC7)*
Total CO2 emissions offset from SAP Section 16 allowances		**0**	
DER accounting for SAP Section 16 allowances		**14.31**	
% improvement DER/TER	**5.6**		

Assessor and House Details

Assessor Name:	**John Young**	**Assessor Number:**	**STRO034821**
Property Address:	**House Type D**		

Buiding regulation assessment

	kg/m²/year
TER	**17.08**
DER	**16.08**

ENE 1 Assessment - Dwelling Emission Rate

Total Energy Type CO_2 Emissions for Codes Levels 1 - 5

	%	kg/m²/year	
DER from SAP 2012 DER Worksheet		**16.08**	*(ZC1)*
TER		**17.08**	
Residual CO2 emissions offset from biofuel CHP		**0**	*(ZC5)*
CO2 emissions offset from additional allowable electricty generation		**0**	*(ZC7)*
Total CO2 emissions offset from SAP Section 16 allowances		**0**	
DER accounting for SAP Section 16 allowances		**16.08**	
% improvement DER/TER	**5.9**		

Assessor and House Details

Assessor Name:	**John Young**	**Assessor Number:**	**STRO034821**
Property Address:	**House Type E**		

Buiding regulation assessment

	kg/m²/year
TER	**16.85**
DER	**16**

ENE 1 Assessment - Dwelling Emission Rate

Total Energy Type CO_2 Emissions for Codes Levels 1 - 5

	%	kg/m²/year	
DER from SAP 2012 DER Worksheet		**16**	*(ZC1)*
TER		**16.85**	
Residual CO2 emissions offset from biofuel CHP		**0**	*(ZC5)*
CO2 emissions offset from additional allowable electricty generation		**0**	*(ZC7)*
Total CO2 emissions offset from SAP Section 16 allowances		**0**	
DER accounting for SAP Section 16 allowances		**16**	
% improvement DER/TER	**5**		

Assessor and House Details

Assessor Name:	**John Young**	**Assessor Number:**	**STRO034821**
Property Address:	**House Type G**		

Buiding regulation assessment

	kg/m²/year
TER	**16.26**
DER	**15.26**

ENE 1 Assessment - Dwelling Emission Rate

Total Energy Type CO_2 Emissions for Codes Levels 1 - 5

	%	kg/m²/year	
DER from SAP 2012 DER Worksheet		**15.26**	*(ZC1)*
TER		**16.26**	
Residual CO2 emissions offset from biofuel CHP		**0**	*(ZC5)*
CO2 emissions offset from additional allowable electricty generation		**0**	*(ZC7)*
Total CO2 emissions offset from SAP Section 16 allowances		**0**	
DER accounting for SAP Section 16 allowances		**15.26**	
% improvement DER/TER	**6.2**		

Assessor and House Details			
Assessor Name:	John Young	Assessor Number:	STRO034821
Property Address:	House Type N		

Buiding regulation assessment	
	kg/m²/year
TER	17.76
DER	16.8

ENE 1 Assessment - Dwelling Emission Rate

Total Energy Type CO_2 Emissions for Codes Levels 1 - 5

	%	kg/m²/year	
DER from SAP 2012 DER Worksheet		16.8	(ZC1)
TER		17.76	
Residual CO2 emissions offset from biofuel CHP		0	(ZC5)
CO2 emissions offset from additional allowable electricty generation		0	(ZC7)
Total CO2 emissions offset from SAP Section 16 allowances		0	
DER accounting for SAP Section 16 allowances		16.8	
% improvement DER/TER	5.4		

Passive design features

The proportion of glazing on each elevation allows solar gains through all orientations of the proposed dwelling

Water Efficiency Useage

Water usage will be within the permitted usage of 110 litres of water per person per day.

Building Materials

These will be locally sourced where possible, and to be sympathetic to the area.

Healthy Enviroment

Consideration has been taken into account for natural daylight where possible.

Space has been allocated for private parking and adequate drying space.

Environmental Standards

This assessment has been carried out by an OCDEA using Stroma Technology software as approved by the BRE.

The Development (Standard case minimum specification)

Information for the feasibility study has been provided by standard case SAP calculations and entered onto the spreadsheet using the following information:

The “Standard” case includes the minimum space and water heating services as set out in the Domestic Heating Compliance Guide and are as follows:

- Primary heating fuel (space and water) – Mains gas
- Boiler SEDBUK 88 per cent room sealed fanned flue
- Secondary space heating Electric heater assumed
- Heat loss of cylinder 2.62
- Cylinder Volume 150 litres
- Primary pipe work : Insulated
- Space heating control Programmer, Room Thermostat and TRV's
- Hot water Control Boiler interlock, cylinder thermostat separate water control

From these initial SAP calculations a base line emission rate has been used.

Electric car charging Point

With a third of the UK's carbon emissions generated by transport, reducing CO2 from cars is at the heart of the government's ambitious net zero targets. And electric cars are poised to keep Britain moving while reducing emissions.

In the UK there is a high level of ultra-low emission vehicles on the roads, which is consistent with consumers wanting a cleaner and greener transport, and the convenience of being able to charge your car overnight is a benefit and cost savings EV v's Petrol/Diesel is approximately 50%.

In addition to the introduction of domestic charge points, the government has also been consulting on the incorporation of 'smart' charging which would allow electric vehicle owners to charge their cars at different points in the day in response to signals such as tariff information to encourage off-peak charging and thus keep costs down.

Costs for installing a EV point start from £449 upwards depending on the type of car and charging type to be installed, however there is currently a grant available for up to 75% of the cost under the EVHS scheme per household, that is if customer fits the criteria set out under this scheme – this may mean if this scheme is to be used that the applicant will need to liase with the prospective buyer to ensure these criteria's are met. It may be that communal EV bays are more feasible dependant on site restrictions.

EV will be considered to be installed as part of the build.

Upgraded specification

To enable this pass, the development will use high performance insulation and will have extremely low u-values to the floor, walls roof, windows and doors, inline with Future Homes Standard u-values which is the governments commitment to reduce CO2 emissions. They will also have highly efficient A rated gas boilers will be installed with enhanced heating controls to ensure there will be a CO2 reduction. Lastly to ensure low air leakage an Air Leakage Pressure Test will be required and all leakages will be identified and rectified if necessary this should enable minimal usage of the heating/boiler therefore reducing CO2 emissions.

Excluded technologies

See the table below as to technologies looked at to increase the Code Level and why they are discounted:

TECHNOLOGY	REASON
Ground/ Air Source Heat Pump	Site size restrictions makes this not a viable option
Wood Pellet Boiler	Site size restrictions makes this not a viable option
Solar Water/solar photovoltaic	Cost implications would restrict the sites viablity
Wind	Site size and location would not make this a viable option

Conclusion

The Applicants strategy has been developed to comply with the requirements of the emerging Northumberland Local Plan, and specifically Policy STP 4, by delivering a reduction in energy demand from the baseline scenario.

This report also demonstrates that consideration has been given to how the proposed development could incorporate decentralised, renewable and low carbon technologies to help mitigate climate change and contribute towards meeting national targets to reduce greenhouse gas emissions. Even though the size of the development site, its location and cost implications excluded several different types of technologies, installation of charging infrastructure for electric vehicles may be considered further in accordance with Policy TRA 1 of the Northumberland Local Plan.

Low or Zero Carbon technologies available in the UK

Zero Carbon Technologies

- Solar Hot Water
- Solar Photovoltaic
- Small scale hydro power
- Wind turbines

Low Carbon Technologies

- Biomass
- Combined Heat and Power (CHP) and micro CHP
- Community heating, including utilising waste heat from processes such as large scale power generation where the majority of heating comes from waste heat
- Heat Pumps, Ground Source Heat Pumps (GSHP) Geothermic heating systems, Air Source.
- Other technologies, Fuel cells using hydrogen from any of the above renewable sources
- Flue Gas Heat Recovery Systems (FGHRS)

Low or Zero Carbon Overview

There are effective alternatives to fossil fuels that can meet your energy requirements and reduce carbon dioxide emissions. They will either never run out - like wind, the sun and flowing water - or are continually replaceable - like waste products and crops. These can help reduce our dependence on non-renewable sources like fossil fuels.

Types of renewables

RENEWABLE ENERGYS

Renewable energy refers to power generated by a renewable source. When the energy is generated , the resource is not depleted or used up They are naturally replenished and can either be managed so they last forever or their supply is so enormous humans can never meaningfully deplete them. Unlike fossil fuels renewable energy sources do not release C02 as a by-product into the atmosphere. As the amount of fossil fuel resources on Earth decreases it is becoming increasingly important to find and utilize alternative fuels.

There are effective alternatives to fossil fuels that can meet your energy requirements and reduce carbon dioxide emissions. They will either never run out - like wind, the sun and flowing water - or are continually replaceable - like waste products and crops. These can help reduce our dependence on non-renewable sources like fossil fuels.

Renewable energy opportunities

Renewable energy describes energy flows that occur naturally and repeatedly in the environment, eg from the sun, wind and the oceans and from plants and the fall of water. It also includes energy available from wastes and the emerging clean technologies eg fuel cells. There are a wide range of renewable energy sources/technologies, varying in technical and commercial viability.

These include:

- Wind power
- Hydroelectric
- Wave and tidal power
- Photovoltaics
- Active solar heating
- Passive solar design
- Municipal and general wastes
- Landfill gas
- Geothermal energy
- Agricultural and forestry wastes
- Energy crops

Renewable energy produces few, if any, harmful emissions. Exploiting renewables also reduces the rate at which other energy resources are consumed. Renewables therefore promise to play an increasingly significant role in the future.

Renewable energy technologies in the UK are now establishing themselves as viable credible contributors to energy supplies. An assessment of renewable energy opportunities in the UK in the early 1990s indicated limited opportunities for exploiting geothermal power but considerable resources for wind, wave and tidal power. In 2000, the UK produced 2.8% of its electricity from renewable sources, of which just under half was by large scale hydroelectricity. The remainder came largely from combustion of bio-fuels, led by landfill gas and refuse combustion. Wind power was the largest contributor, other than large-scale hydro and bio-fuels, but amounted to only 0.26% of total electricity produced. Although the contribution from renewables is still relatively small, renewable generating capacity doubled between 1996 and 2000.

The Government has set a target that 5% of UK electricity needs should be met from renewables by the end of 2003 and 10% by 2010 as long as the cost to consumers is acceptable however this has increased to 2025. This has led to the introduction of a new Renewables Obligation (RO), to succeed the Non Fossil Fuel Obligation (NFFO), which includes exemption of renewable electricity and heat from the Climate Change Levy and an expanded support programme for renewable energy. The new RO requires power suppliers to derive a specified proportion of the electricity they supply from renewables, with the cost to consumers limited by a price cap. In the short term much of the expansion in renewables is expected to come from wind and land-fill gas.

The use of naturally renewable energy resources is becoming more common in buildings. Waste incineration, bio-fuels, wind, bio-gas and hydroelectric schemes should all be considered at the design stage, depending upon local conditions and availability. Active and passive solar energy systems are becoming more common in buildings although the economics still require careful assessment. Photovoltaic cells to produce electricity are becoming cheaper and the beginning to have applications in buildings, particularly when integrated into the building fabric. Simple solar systems for heating domestic hot water have been used extensively in hot climates although they have not generally provided a good return on investment in the UK.

The main constraints on the use of renewables are the costs of the energy they produce and the local environmental impact. Currently the cost of energy from renewables is generally higher than that produced by conventional energy sources. However as renewables become more established and the benefit of mass production take effect, the gap will reduce. Indeed, in the case of wind power and some other technologies, this is already happening.

There are a number of key issues not specific to any individual renewable energy technology that affect both the uptake of renewables and the development of the industry. These cross-technology issues include:

- Planning
- Financing
- Devlopment of the UK electricity market

No renewable scheme can proceed without planning permission. A range of guidance aimed at the planning community is available (eg ODPM Planning Policy Guidance 22: Renewable energy) to ensure the planning authorities make informed decisions when faced with applications for renewable projects. The government has recently introduced a regional strategic approach to planning with regional targets for renewable energy. Local authorities also play a key role in stimulating renewable energy under their Local Agenda 21 UK and post Kyoto activities.

Obtaining finance can represent a major barrier to the progress of a renewables project. In 1990, very few renewables projects existed (beyond large scale hydro electricity) and the technologies were largely untried in a commercial sense. Now, through the mechanism of the NFFO, hundreds of schemes are generating power. The Department of Trade and Industry's New and Renewable Energy Programme in the financial sector has encouraged investors into a new market and allayed financiers concerns about what they originally perceived as a risky industry.

The integration of renewables into, and their acceptance by, the electricity supply industry will play a key role in ensuring that they make an increasingly significant contribution to UK energy supplies. The market for 'green' electricity is growing, with an expanding number of electricity companies now offering 'green' tariffs. The industry is also addressing barriers that might prevent significant increases in renewables-based generating capacity by working with the renewables and wider small generator community to define and implement the New Electricity Trading Arrangement (NETA).

CHP

For many buildings, combined heat and power (CHP) offers a highly economic method of providing heat and power which is less environmentally harmful than conventional methods. Where applicable CHP is the single most effective means of reducing building related emissions and running costs. Building designers, specifiers and operators should always consider the option of CHP as an althernative means of supplying energy. If this was chosen investigations into initiatives and exemptions with using this technology, such as Carbon Trusts Action energy, enhanced carbon allowances and the climate change levy. The CHP Quality Assurance Scheme (CHPQA) sets out what is meant by 'good quality' CHP

Building Regulations Approved Document suggest minimum efficiencies (based on maximum carbon intensities) for heating systems at full load and 30% load, based on the overall output of the system, as a means of compliance with the Building Regulation 2000. Where CHP is included then special adjustments can be made to take into account the benefit of the on-site electricity generation in reducing emissions from power stations. Including CHP is therefore a simple way of meeting these regulations, particularly the requirement at 30% load. These regulations apply when replacing boilers or a heating system as well as in new and refurbished buildings.

Financing Options

Whilst the capital and installation costs of CHP plant are significantly higher than conventional boiler plant, CHP can yield very considerable savings in running costs. Any economic appraisal should only consider the marginal capital cost of CHP plant over and above any avoided costs of boiler or standby generation plant. A range of alternative financial arrangements exist including:

- Capital Purchase – in this case the host organization bears all the capital cost, and realizes all the subsequent savings.
- Equipment supplier finance (ESF) – where the CHP supplier offers an arrangement whereby they supply and maintain the equipment free of charge in exchange for a proportion of the savings achieved. This is typically for the site that does not have funds available and is looking for a straight-forward 'one-stop' approach to CHP.
- Energy services companies (ESCo) – formerly known as contract energy management (CEM) companies, whereby an organization contracts out its energy services. Contracts can be based on a fixed fee, an agreed unit price for energy (energy supply) or a shared savings approach.

Maintenance

CHP requires more maintenance than conventional boiler plant. Good maintenance underpins economic outcome, maximizing availability and minimizing downtime. Percentage availability and reliability are key factors that represent the success of the maintenance regime. Maintenance is nearly always contracted out to a specialist company usually the CHP supplier itself. Contracts are usually based on performance typically guaranteeing an availability well above 90% .

CHP – Summary

- CHP provides on-site electricity generation with heat recovery
- CHP is typically over 80% efficient
- The most appropriate applications are those with a year round heat demand
- In general CHP will be economic if it runs for more than 4500 hours per year
- An independent feasibility study is essential based on reliable demand profiles
- CHP should always be the lead 'boiler'
- The economics of CHP improve if standby generation or boiler replacement is considered
- Sizing CHP somewhat above the base heat load usually provides the best economics
- Oversizing CHP leads to excessive heat dumping which undermines the ecomomics

Biomass

Biomass is produced from organic materials, either directly from plants or indirectly from industrial, commercial, domestic or agricultural products. It is often called 'bioenergy' or 'biofuels'. It doesn't include fossil fuels, which have taken millions of years to be created.

Biomass fall into two main categories:

- Woody biomass includes forest products, untreated wood products, energy crops and short rotation coppice (SRC), which are quick-growing trees like willow.
- Non-woody biomass includes animal waste, industrial and biodegradable municipal products from food processing and high energy crops. Examples are rape, sugar cane, maize.

For small-scale domestic applications of biomass the fuel usually takes the form of wood pellets, wood chips or wood logs

The benefits

Producing energy from biomass has both environmental and economic advantages.

Although biomass produces CO_2 it only releases the same amount that it absorbed whilst growing, which is why it is considered to be **carbon neutral**. Furthermore, biomass can contribute to waste management by harnessing energy from products that are often disposed of at landfill sites.

It is most cost effective and sustainable when a local fuel source is used, which results in local investment and employment and also minimises transport miles to your home.

How it works

There are two main ways of using biomass to heat a domestic property:

- Stand alone stoves providing space heating for a single room. These can be fuelled by logs or pellets but only pellets are suitable for automatic feed. Generally they are 5-7 kW in output, and some models can be fitted with a back boiler to provide water heating.
- Boilers connected to central heating and hot water systems. These are suitable for pellets, logs or chips, and are generally larger than 15 kW.

There are many domestic log, wood chip and wood pellet burning central heating boilers available. Log boilers must be loaded by hand and may be unsuitable for some situations. Automatic pellet and wood chip systems can be more expensive. Many boilers will dual fire both wood chips and pellets, although the wood chip boilers need larger hoppers to provide the same time interval between refuelling.

Is it suitable for my home?

You should consider the following issues if you're thinking about a biomass boiler or stove. An accredited installer will be able to provide more detailed advice.

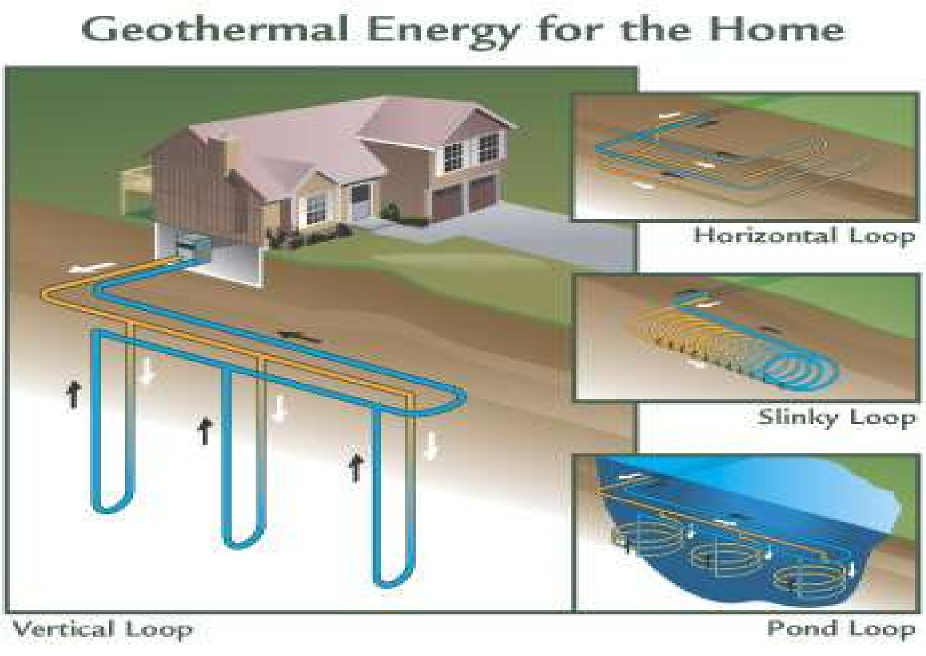
Wood pellets

- **Fuel**
  It's important to have storage space for the fuel, appropriate access to the boiler for loading and a local fuel supplier.
- **Flue**
  The vent material must be specifically designed for wood fuel appliances and there must be sufficient air movement for proper operation of the stove. Chimneys can be fitted with a lined flue.
- **Regulations**
  The installation must comply with all safety and building regulations.
- See Part L of the Building Regulations, Northern Ireland
- See Section 3 of the Technical Handbooks, Scotland
- **Smokeless zones**
  Wood can only be burnt in exempted appliances, under the Clean Air Act.
- **Planning**
  If the building is listed or in an area of outstanding natural beauty (AONB), then you will need to check with your Local Authority Planning Department before a flue is fitted.

Costs and savings

Stand alone room heaters generally cost £2,000 to £4,000 installed. Savings will depend on how much they are used and which fuel you are replacing. A biomass stove which provides a detached home with 10% of annual space heating requirements could save around 840kg of carbon dioxide when installed in an electrcially heated home. Due to the higher cost of biomass pellets compared with other traditional heating fuels, and the relatively low efficiency of the stove compared to a central heating system it will cost more to run. The cost for boilers varies depending on the system choice; a typical 15kW (average size required for a three-bedroom semi detached house) pellet boiler would cost around £5,000 - £14,000 installed, including the cost of the flue and commissioning. A manual log feed system of the same size would be slightly cheaper. A wood pellet boiler could save you around £470 a year in energy bills and around 6 tonnes of $C0_2$ per year when installed in an electrcially heated home.

Ground Source Heat Pump



Ground source heat pumps use a buried ground loop which transfers heat from the ground into a building to provide space heating and, in some cases, to pre-heat domestic hot water. As well as ground source heat pumps, air source and water source heat pumps are also available.

The benefits

The efficiency of a ground source heat pump system is measured by the coefficient of performance (CoP). This is the ratio of units of heat output for each unit of electricity used to drive the compressor and pump for the ground loop. Average CoP over the year, known as seasonal efficiency, is around 3-4 although some systems may produce a greater rate of efficiency. This means that for every unit of electricity used to pump the heat, 3-4 units of heat are produced, making it an efficient way of heating a building. If grid electricity is used for the compressor and pump, then you should consult a range of energy suppliers to benefit from the lowest running costs, for example by choosing an economy 10 or economy 7 tariff.

How it works

There are three important elements to a ground source heat pump:

1. **The ground loop**
   This is comprised of lengths of pipe buried in the ground, either in a borehole or a horizontal trench. The pipe is usually a closed circuit and is filled with a mixture of water and antifreeze, which is pumped around the pipe absorbing heat from the ground.The ground loop can be:
   - Vertical, for use in boreholes
   - Horizontal, for use in trenches
   - Spiral, coil or 'slinky', also for use in trenches
2. **A heat pump**
   In the same way that your fridge uses refrigerant to extract heat from the inside, keeping your food cool, a ground source heat pump extracts heat from the ground, and uses it to heat your home. A ground source heat pump has three main parts:
   - The evaporator, (e.g. the squiggly thing in the cold part of your fridge) absorbs the heat using the liquid in the ground loop;
   - The compressor, (this is what makes the noise in a fridge) moves the refrigerant round the heat pump and compresses the gaseous refrigerant to the temperature needed for the heat distribution circuit;
   - The condenser, (the hot part at the back of your fridge) gives up heat to a hot water tank which feeds the distribution system.
3. **Heat distribution system**
   This consists of under floor heating or radiators for space heating and in some cases water storage for hot water supply.

Is it suitable for a home?

You should consider the following issues if you're thinking about installing a ground source heat pump. An accredited installer will be able to provide more detailed advice.

- You will need space outside your house for the ground loop.
- The ground will need to be suitable for digging a trench or borehole.
- What fuel is being replaced? If it's electricity, oil, LPG or coal the savings will be more favourable than gas. Heat pumps are a good option where gas is unavailable.
- The type of heat distribution system. Ground source heat pumps can be combined with radiators but these will normally be larger than with standard boiler systems. Under floor heating is better as it works at a lower temperature.
- Want to further reduce your home's carbon dioxide emissions? Install solar PV or some other form of renewable electricity generating system to power the compressor and pump.
- Is the system for a new building development? Combining the installation with other building works can reduce costs.
- Have you installed insulation measures? Wall, floor and loft insulation will lower your heat demand and make the system more effective.

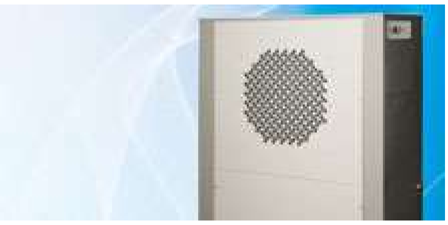
Air and water source heat pumps

Air and water source heat pumps use air or water respectively. They do not rely on a collection system and simply extract the heat from the source at the point of use.

Air source heat pumps can be fitted outside a house or in the roof space and generally perform better at slightly warmer air temperatures. Water source heat pumps can be used to provide heating in homes near to rivers, streams, lakes and lochs for example.

Air Source Heat Pump

Air source heat pumps absorb heat from the outside to heat buildings. There are two types of air-source heating systems. Air-to-air systems provide warm air, which is circulated to heat the building. The other type, air-to-water, heat water to provide heating to a building through radiators or an underfloor system.



Benefits

The benefits of air source heat pumps are similar to ground-source heat systems. Firstly, neither type of system requires the use or storage of external fuel. The systems instead run on electricity, which eliminates the need for a gas connection or storage of oil/solid fuel. Air source heat pumps present an advantage over ground source heat pumps because they require less space to install. Instead of requiring the installation of buried underground coils, air source systems can be fitted using much less space and are therefore, more suited for an urban home.

How it works

In the same way that a fridge uses refrigerant to extract heat from the inside, keeping your food cool, and air source heat pump extracts heat from the outside air, and uses it to heat your home and hot water. An air-source heat pump has three main parts:

- The **evaporator coil** absorbs heat from the outside air;
- The **compressor** pumps the refridgerant through the heat pump and compresses the gaseous refridgerant to the temperature needed for the heat distribution circuit;
- The **heat exchanger** transfers the heat from the refridgerant to air or water.

In an air-to-water system, the heat produced is used to heat water, which can be used to pre-heat water in a storage tank or circulate through underfloor heating or radiators. Heat pumps produce hot water that is a lower temperature (typically 35-45C) than standard boiler systems, which makes underfloor heating the most effective option. In an air-to-air system, this heat is used to produce warm air, which is circulated by fans to heat a building.

The efficiency of air source systems is measured by a coefficient of performance (CoP). CoPs for air source systems are almost comparable with ground-source heat pumps, and generally range between 2 and 3. This means that for every unit of electricity used to power the pump, 2-3 units of heat are produced, making it an efficient way of heating a building.

It is even possible for air source heat pumps to extract useful heat from air at temperatures as low as minus 15 ^{o}C.

Is it suitable for a home?

You should consider the following issues if you're thinking about installing an air source heat pump.

- You will need space on an external wall outside your house to fit the evaporator coil.
- An air source heat pump should cover the heating requirements of a well insulated property. Due to the lower temperature compared with traditional boilers, it is essential that your home is insulated and draught proofed. These measures will lower your heat demand and make the system more effective.
- Consider what fuel is being replaced: if it's electricity, oil, Liquid Petroleum Gas (LPG) or coal, the payback will be more favourable than gas. Heat pumps are a good option where gas is unavailable.
- The type of heat distribution system. Air source heat pumps can be used to heat water that is circulated through radiators but under floor heating is more effective due to the lower temperature of the air/water produced.
- Is the system for a new building development? combining the installation with other building works can reduce costs.
- If you want to further reduce your home's CO_2 emissions you can purchase a green electricity tariff or install solar PV or some other form of renewable electricity generating system to power the compressor and pump.

. **Solar Water Heating**

Solar water heating systems use heat from the sun to work alongside your conventional water heater. The technology is well developed with a large choice of equipment to suit many applications.

How does it work?

For domestic hot water there are three main components

- Solar panels or collectors - are fitted to your roof. They collect heat from the sun's radiation. There are 2 main types of collector:

- Flat plate systems - which are comprised of an absorber plate with a transparent cover to collect the sun's heat, or
- Evacuated tube systems - which are comprised of a row of glass tubes that each contain an absorber plate feeding into a mainfold which transports the heated fluid.

- A heat transfer system - uses the collected heat to heat water;
- Hot water cylinder - stores the hot water that is heated during the day and supplies it for use later.

The benefits

Solar water heating can provide you with about a third of your hot water needs. The average domestic system reduces $C0_2$ by around 325kg per year and about £65 a year of your hot water bills, when installed in a gas heated home.

Fuel Displaced	**£ Saving per year**	**CO_2 saving per year**
Gas	£65	325 kg
Electricity	£95	635 kg
Oil	£85	365 kg
Solid	£55	645 kg

All savings are approximate and are based on the hot water heating requirements of a 3 bed semi detached home.

Is it suitable for a home?

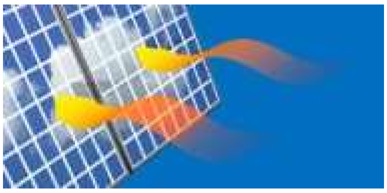
Solar water heating can be used in the home or for larger applications, such as swimming pools. For a domestic system you will need 3-4 square metres of southeast to southwest facing roof receiving direct sunlight for the main part of the day. You'll also need space to locate an additional water cylinder if required.

Choosing a system suitable to your needs requires consideration of a range of factors, including the area of south facing roof, the existing water heating system (e.g. some combi boilers aren't suitable) and your budget. A competent accredited installer will be able to assess your situation and discuss with you the best configuration to meet your needs.

In England, changes to permitted development rights for microgeneration technologies introduced on 6th April 2008 have lifted the requirements for planning permission for most solar water heating installations. Roof mounted and stand-alone systems can now be installed in most dwellings, as long as they respect certain size criteria. See planning permission for renewable energy technologies for more information. Exceptions apply for Listed Buildings, and buildings in Conservation Areas and World Heritage Sites.

In Wales, Scotland and Northern Ireland, the devolved governments are currently all considering changes to their legislation on permitted developments, to facilitate installations of microgeneration technologies, including solar water heating. Legislation is expected in all three countries later this year. Until then, householders in Wales, Scotland and Northern Ireland must consult with their local authority regarding planning permission.

Solar water heating systems tend to require little maintenance



Installation and maintenance costs

The typical installation cost for a domestic system is £3,000 - £5,000. Evacuated tube systems are more advanced in design than flat plate, and so tend to be more expensive.

Solar water heating systems generally come with a 5-10 year warranty and require little maintenance. A yearly check by the householder and a more detailed check by a professional installer every 3-5 years should be sufficient (consult your system supplier for exact maintenance requirements & costs).

Solar Electricity

Solar PV (photovoltaic) uses energy from the sun to create electricity to run appliances and lighting. PV requires only daylight, not direct sunlight to generate electricity and so can still generate some power on a cloudy day.

How does it work?

Photovoltaic systems use cells to convert sunlight into electricity. The PV cell consists of one or two layers of a semi conducting material, usually silicon. When light shines on the cell it creates an electric field across the layers causing electricity to flow. The greater the intensity of the light, the greater the flow of electricity.

PV cells are referred to in terms of the amount of energy they generate in full sunlight, know as kilowatt peak or kWp.

The benefits

PV systems produce no greenhouse gases. A typical domestic system can save approximately 1.2 tonnes of carbon dioxide per year, adding up to almost 30 tonnes over a system's lifetime.

Is it suitable for a home?

You can use PV systems for a building with a roof or wall that faces within 90 degrees of south, as long as no other buildings or large trees overshadow it. If the roof surface is in shadow for parts of the day, the output of the system decreases.

Solar panels are not light and your roof must be strong enough

PV arrays now come in a variety of shapes and colours, ranging from grey 'solar tiles' that look like roof tiles to panels and transparent cells that you can use on conservatories and glass to provide shading as well as generating electricity.

Solar panels are not light and the roof must be strong enough to take their weight, especially if the panel is placed on top of existing tiles.

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Costs and savings

Prices for PV systems vary depending on the size of the system to be installed, type of PV cell used and the nature of the actual building on which the PV is mounted. The size of the system is dictated by the amount of electricity required.

For the average domestic system, costs can be around £5,000- £7,500 per kWp (check costs with suppliers) installed with most domestic systems usually between 1.5 and 3 kWp. Solar tiles cost more than conventional panels and panels that are integrated into a roof are more expensive than those that sit on top.

If you intend to have major roof repairs carried out it may be worth exploring PV tiles as they can offset the cost of roof tiles.

You could be saving up to 1.2 tonnes of CO_2 a year and this could mean around £250 off your electricity bill*. A 2.5kWp system could provide enough electricity to meet around half a household's electrcity needs each year (to be confirmed with supplier costs and paybacks)

Grid connected systems require very little maintenance, generally limited to ensuring that the panels are kept relatively clean and that shade from trees has not become a problem. The wiring and components of the system should however be checked regularly by a qualified technician.

Stand-alone systems, i.e. those not connected to the grid, need maintenance on other system components, such as batteries.

* Savings are dependent on the level of on-site consumption and/or value of export tariff. Assumes a 2.5kWp system with 50% - 100% on-site consumption with excess exported to grid on a typical export tariff.

Microwind

Wind turbines use the wind's lift forces to rotate aerodynamic blades that turn a rotor which creates electricity. In the UK we have 40% of Europe's total wind energy. But it's still largely untapped and only 0.5% of our electricity requirements are currently generated by wind power.

How does it work?

Most small wind turbines generate direct current (DC) electricity. Systems that are not connected to the national grid require battery storage and an inverter to convert DC electricity to AC (alternating current - mains electricity)..

Wind systems can also be connected to the national electricity grid. A special inverter and controller converts DC electricity to AC at a quality and standard acceptable to the grid. No battery storage is required. Any unused or excess electricity may be able to be exported to the grid and sold to the local electricity supply company.

There are two types of wind turbines:

- Mast mounted - which are free standing and located near the building(s) that will be using the electricity.
- Roof mounted - which can be installed on house roofs and other buildings.

Benefits

Wind power is a clean, renewable source of energy which produces no carbon dioxide emissions or waste products.

In the UK we have 40% of Europe's total wind energy

Is it suitable for a home?

Individual turbines vary in size and power output from a few hundred watts to two or three megawatts (as a guide, a typical domestic system would be 1 - 6 kilowatts). Uses range from very small turbines supplying energy for battery charging systems (e.g. on boats or in homes), to turbines on wind farms supplying electricity to the grid.

You should consider the following issues if you're thinking about small scale wind. An accredited installer will be able to provide more detailed advice.

- Wind speed increases with height so it's best to have the turbine high on a mast or tower.
- Generally speaking the ideal site is a smooth top hill with a flat, clear exposure, free from excessive turbulence and obstructions such as large trees, houses or other buildings.
- Small scale wind power is particularly suitable for remote off grid locations where conventional methods of supply are expensive or impractical.

Please note that the electricity generated at any one time by a wind turbine is highly dependent on the speed and direction of the wind. The windspeed itself is dependent on a number of factors, such as location within the UK, height of the turbine above ground level and nearby obstructions. Ideally, you should undertake a professional assessment of the local windspeed for a full year at the exact location where you plan to install a turbine before proceeding. In practice, this may be difficult, expensive and time consuming to undertake. Therefore we recommend that, if you are considering a domestic building mounted installation and electricity generation is your main motivation, then you only consider a wind turbine under the following circumstances:

- The local annual average windspeed is 6 m/s or more. An approximate figure for your location can be checked on the BERR website
- There are no significant nearby obstacles such as buildings, trees or hills that are likely to reduce the windspeed or increase turbulence

If you are in any doubt, please consult a suitably qualified professional.
Planning issues such as visual impact, noise and conservation issues also have to be considered. System installation normally requires permission from the local authority, so it's important to always check with your local authority about planning issues before you have a system installed.

Hydroelectricity

Hydro power systems use running water turning a turbine to produce electricity. A micro hydro plant is one that generates less than 100kW. Improvements in small turbine and generator technology mean that micro hydro schemes are an attractive means of producing electricity. Useful power may be produced from even a small stream.

Benefits

For houses with no mains connection but with access to a micro hydro site, a good hydro system can generate a steady, more reliable electricity supply than other renewable technologies at a lower cost. Total system costs can be high but often less than the cost of a grid connection and with no electricity bills to follow.

It should be noted that in off grid applications the power is used for lighting and electrical appliances. However, space and water heating can be supplied when available power exceeds demand.

Hydro power systems convert potential energy stored in water held at height to kinetic energy.

How it works

Hydro power systems convert potential energy stored in water held at height to kinetic energy (or the energy used in movement) to turn a turbine to produce electricity.

Energy available in a body of water depends on the water's flow rate and the height (or head) that the water falls. These are divided into low head, medium head and high head, where the height drop is greater. The scheme's actual output will depend on how efficiently it converts the power of the water into electrical power (maximum efficiencies of over 90% are possible but for small systems 60 - 80% is more realistic).

Is it suitable for a home?

Hydro power requires the source to be relatively close to where the power will be used or to a suitable grid connection. Hydro systems can be connected to the main electricity grid or as a part of a stand alone (off grid) power system. In a grid connected system, any electricity generated but not used can be sold to electricity companies.

In an off grid hydro system, electricity can be supplied directly to the devices powered or through a battery bank and inverter set up. A back up power system may be needed to compensate for seasonal variations in water flow.