DRAFT

RENEWABLE ENERGY STRATEGY

for

STOCKTON-ON-TEES BOROUGH COUNCIL

Executive Summary

Gas and electricity prices are showing significant volatility against a longer term upward trend as fossil fuel supplies become more difficult to exploit or are sourced from distant lands as the home supply declines.

There is also a requirement to reduce carbon emissions substantially with the Stockton-on-Tees Borough Council Carbon Management programme requiring a 25% reduction by 2013 and government targets of a reduction of 34% by 2020 and 80% by 2050 requiring strong action beyond energy efficiency improvements.

Means of supplying low and zero carbon energy to the Council buildings are therefore required and these sources may be grouped under the heading of renewable energy supply. Such supply would not be confined to technologies mounted on or adjacent to buildings but could include provision of renewable electricity from a remote source (ie beyond Stockton-on-Tees Borough Council boundaries, through a 'Power Purchase Agreement'.

This strategy provides information on available and practicable renewable energy technologies and maps out the means of Stockton-on-Tees Borough Council achieving an increase in proportion of its energy requirement from these renewable and sustainable sources that as well as reducing carbon emissions will provide greater price stability and in the long term lower cost to the Council than conventional energy supplies.

The table below summarises the benefits and consequences of adopting renewable energy supplies:

Performance Measure	Renewable Energy Consequences
Carbon Management Programme	Renewable electricity and heat reduces Council carbon emissions thus aiding the achievement of targets
NI 185 Council CO_2	On site renewables not claiming Renewables Obligation Certificates provide carbon saving thus improving NI 185 position.
Carbon Reduction Commitment (CRC)	Carbon reduction only counts for building mounted renewables that reduce conventional consumption but do not secure other financial benefits such as Feed In Tariffs
Power Purchase Agreement	Long term electricity supply contract enabling large scale renewable source (eg wind farm or hydro scheme) to be financed in another part of the UK. Provides price stability and long term lower prices than fossil fuels but can't count against CRC carbon allowances. Avoids need for Council investment.
Finance	Price stability, long term lower prices than fossil fuels. Feed In Tariffs aid payback but can't count against CRC carbon allowances

DRAFT

The recommended hierarchy of renewable energy technologies for consideration by the Council is as follows:

1. Wind Turbines – utilising council land including school grounds these provide an immediate renewable electricity supply subject to suitable locations and planning permission but will only provide a small proportion of current electricity demand.
2. Solar PV – in terms of available roof space has the potential to meet up to 20% of current electricity demand but is currently a very costly technology. However the introduction of Feed In Tariffs from April 2010 does change the economics of this technology with a predicted 8% return on investment from the resultant income.
3. Renewable Heat – encompassing biomass boilers, solar hot water, ground source and air source heat pumps to displace natural gas as the space heating and domestic hot water supply.
4. Power Purchase Agreement – This is a long term contract securing a fixed (plus inflation) price for energy supply that in this case is applied to renewable energy (electricity) supply. This long term, contractual arrangement, typically 20 to 40 years enables the development of large scale renewables to be funded from capital raised against the guaranteed earnings from the supply contract. Such an arrangement could therefore be linked to a renewable energy supply remote from the Stockton-on-Tees Borough Council area thus removing limits on supply capacity arising from a lack of suitable sites.
5. Solar electricity – although costly this does provide an alternative renewable energy supply to those buildings with south facing roofs.

The Stockton-on-Tees Borough Council goals for renewable energy supply need to take the Council beyond the 25% carbon reduction planned for 2013 towards an effective zero carbon energy supply by 2040. This would be achieved by targeting the high energy use buildings first and seeking to introduce increasing levels of renewable electricity and renewable heat.

DRAFT

CONTENTS

DRAFT

1. Background and Context

Energy costs have substantially increased in recent years and although there has been a fall from the highs of 2008 the long term trend will be upwards as the UK becomes increasingly dependent on imported energy and global energy supply comes under pressure from increasing demand, particularly due to the growing economies of China and India. In the UK the carbon intensity of centrally generated electricity has increased (ie the amount of carbon released per kWh generated) due to a reduction in nuclear capacity and a move back to coal as gas prices increased. It is therefore in the interests of Stockton-on-Tees Borough Council to find ways of reducing energy costs both by energy efficiency measures and through a move to local and sustainable energy supply, in particular large scale renewable energy technologies. This approach would also reduce the carbon emissions related to Council activities.

Stockton-on-Tees Borough Council closely monitors energy consumption and carbon emissions related directly to its operations both as a key part of the Local Authority Carbon Management Programme and for National Indicator reporting (NI185: Percentage CO_2 reduction from local authority operations) for council emissions. This covers the gas and electricity used in buildings and fuel used for transport, both the Council fleet and the business mileage.

Energy and emissions data is gathered for all Council controlled buildings, for street lighting, for Council fleet transport and for business mileage. This data is currently gathered and entered into a Defra supplied tool to determine the carbon dioxide emissions (for NI185) and also air quality data as required by NI194 (National Indicator for Air quality – % reduction in NOx and primary PM10 emissions through local authority's estate and operations). The data will also be used for the forthcoming Carbon Reduction Commitment to determine the Council's requirements for purchase of carbon allowances from 2011 (see below).

The current energy consumption and associated carbon emissions of the Council are discussed in the next section.

The Local Authority Carbon Management Plan was implemented from 2008/09 with a target of 25% carbon dioxide emission reduction by 2013. A detailed Strategy and Implementation plan has been developed and implemented with annual reviews to ensure that continuous reduction towards the target is maintained. The focus for the Carbon Management Programme is rightly on improvements to energy efficiency including raising awareness amongst council employees to ensure lights, computers and other electrical equipment are switched off when not in use but also running a number of projects that to date have included:

- Automatic switch off of PCs at 7pm each evening using in house developed software and applied to all Council offices and schools;
- Insulation improvements to council buildings through cavity wall and loft insulation where practicable;
- Draught proofing of some council buildings;
- Reduction in room temperature settings in Council buildings to 19C;
- Improved photocell control of street lighting to switch on thirty minutes later and switch off thirty minutes earlier than the previous technology;
- Dimming of streetlights on main routes to reduce lighting levels and hence electricity consumption between midnight and an hour before sunrise;
- Use of voltage regulation to optimise the mains supply voltage;
- Programme of insulation improvements to a number of schools;

- Adoption of a bio-diesel blend for the Council transport fleet and consideration of higher proportions of bio-diesel for older vehicles;
- Procurement of electric vehicles for road sweeping and local rubbish collection, street cleaning etc;

Other opportunities for energy efficiency improvement will be identified and pursued to drive towards the Local Authority Carbon Management programme 25% reduction target.

Drivers for carbon reduction are also being generated at national government level as part of the UK approach to tackling climate change and countering global warming. The Climate Change Act 2008 requires the setting of rolling 5 year carbon reduction budgets that are mandatory and will be devolved to local government.

The first of these carbon budgets formed part of the 2009 budget and requires a 22% reduction in carbon emissions compared to 1990 levels by 2012 and 32% reduction by 2020. The long term target is for an 80% reduction by 2050.

National greenhouse gas emissions in 1990 were 773 $MtCO_2e$ (million tonnes of carbon dioxide equivalent) and this forms the base line for reduction measurement for international treaties such as Kyoto and the 2009 Copenhagen treaty. By 2007 Government data shows a reduction to 636 $MtCO_2e$.

The Government set five yearly target budgets look to achieve a total of 3,018 $MtCO_2e$ over the period 2008-12, or an average of 604 $MtCO_2e$. For 2013 to 2017 this reduces to 2,782 $MtCO_2e$ or 556 $MtCO_2e$ average per annum and for 2018 to 2022 to 2,544 $MtCO_2e$ or 509 $MtCO_2e$ average per annum. In order to meet the long term Government target of 80% reduction from 1990 levels the annual national greenhouse gas emissions need to reduce to less than 155 $MtCO_2e$ per annum, a huge reduction and only achievable by decarbonising energy supply and achieving a much more sustainable lifestyle.

From this it can be seen that energy efficiency measures alone cannot achieve the total changes need. It is therefore essential that efforts are made to rapidly increase renewable and sustainable energy supply for all sectors of the economy.

A further driver arises from the forthcoming Carbon Reduction Commitment (CRC), a ‘cap and trade’ scheme for high energy users intended to increase energy efficiency and reduce carbon dioxide emissions. Registration to the scheme will take place between April and October 2010 with trading commencing in April 2011. Carbon Allowances will have to be purchased to cover predicted carbon emissions in the year ahead and these currently will have a cost of £12 per tonne of emitted carbon. On this basis it is currently estimated that the annual cost to the Council will be around £380k in terms of cash flow. It is therefore in the financial interest of the Council to reduce carbon emissions beyond the planned 25% reduction under the Carbon Management programme. Also because of the uncertainty of the CRC league table and the increased carbon burden from mains electricity there should be a long term objective to reduce electricity consumption and displace carbon based energy sources to come out of the CRC.

The Council building stock is varied and ageing. Rationalisation of accommodation would reduce energy consumption but disposal of redundant buildings would be difficult during the current economic recession. However, this does need to be a long term objective.

DRAFT

The Building Schools for the Future (BSF) programme offers an opportunity to provide much more energy efficient buildings although this will be countered to some extent by the increased use modern school buildings with the facilities they house will experience. This is already showing up as a year on year increase in electricity consumption as more electrical devices come into use along with extended operating hours.

Across all buildings, Council and schools, there is an upward trend in energy consumption due to increased use of IT equipment in particular and this has an adverse impact on carbon emissions due to the carbon content of the prime fuels used in the UK for electricity generation, ie coal and gas.

By targeting the identified high energy buildings listed in Tables 1,2 and 3 at the end of this document and progressively introducing renewable electricity and renewable heat the goal is to achieve an effective zero carbon energy supply by 2040 thus exceeding current Government targets which are for an 80% reduction in carbon emissions by 2050.

DRAFT

Baseline

Energy data gathered from the 2008/09 financial year provides the NI185 and NI194 baselines so it would be logical to also use this as the baseline for this issue of the Renewable Energy Strategy. This would enable targets to be set as a percentage of council energy demand to be met by renewable energy supplies.

From the 2008/09 energy data the baseline figures for this strategy are as follows:

Electricity consumption	34,391,683 kWh	17,986 tonnes CO_2
Gas consumption	56,788,330 kWh	10,504 tonnes CO_2

Transport also adds significantly to overall council carbon emissions and is reported in both the Local Authority Carbon Management (LACM) programme and under National Indicator NI185. Data is collected both for fleet fuel consumption and business mileage with total emissions for 2008/09 of 3,292 tonnes CO_2.

The LACM data set of buildings is a subset of those included for NI185 baseline data. The reason for this is that LACM used data readily available in 2007 when the Carbon Management programme was set up. This data set has been agreed with the Carbon Trust and forms the basis of reported carbon savings consistent with the stated objective of achieving a 25% reduction in carbon emissions by 2013. However, it may be that with the introduction of CRC and ongoing NI185 reporting that discussion is opened with the Carbon Trust regarding bringing LACM data into line with the other reports.

Despite an intensive carbon management programme and the introduction of measures to reduce carbon emissions there is a persistent upward demand for energy. Within Stockton-on-Tees Borough Council this is due to:

- increase in office hours through flexi extension to 12 hour daily availability;
- increase in use of IT equipment, particularly in schools;
- increase in use of school facilities, particularly new build and refurbished schools;

Efforts therefore need to continue to reduce the demand for electricity and gas supply by continuing to improve building insulation where possible, extending the use of voltage regulators, improving office lighting controls and procuring low energy IT equipment.

For this Renewable Energy Strategy there needs to be a clear understanding of what constitutes a renewable energy supply. The Regional Spatial Strategy and Low Carbon Buildings Programme along with other funding streams accept heat pumps (ground and air source) as a renewable supply regardless of the source of the electricity these devices use. Also biomass qualifies as a renewable energy source provided the fuel is from a sustainable source. This means that the carbon emitted through burning is taken up by the growing replacement biomass. High quality combined heat and power is also beneficial but must be considered as energy efficiency improvement unless the fuel source is renewable such as biomass. These ‘definitions’ are used within this strategy.

Stockton-on-Tees Borough Council contributes to the local generation of renewable energy by providing solid municipal waste to the Haverton Hill energy from waste plant which generates 30MW per hour of operation.

In considering the approach to renewable energy supply is interesting to consider the highest energy consumers amongst Council buildings:

DRAFT

Table 1 provides data on the top fifty consumers of gas; this is used principally for space heating and heating swimming pools in leisure facilities and some of the schools.

Table 2 provides data on the top fifty consumers of electricity where there is an overall upward driver from increased IT and other new technologies.

Table 3 provides data on the top fifty consumers of total energy

These tables show the role of schools in the use of energy, and therefore contribution to carbon emissions, which is now being addressed by a real time energy monitoring project that will come into full effect in at least the twelve climate change schools by early 2010. This will enable greater local control of day to day energy consumption along with a better focus on introducing energy efficiency measures where they can have the greatest impact.

DRAFT

2. Key Drivers

Quite apart from the Council's commitment to reducing carbon emissions, as evidenced by the Carbon Management Programme, there are a number of key drivers that need to be taken account of. These comprise Government targets for carbon reduction or 'carbon budgets', National Indicators, particularly where these form part of Local Area Agreement, the forthcoming Carbon Reduction Commitment and the longer term financial impact from increases in fossil fuel energy prices.

3.1 Government Targets

Through the Climate Change Bill the UK Government has a statutory duty to set rolling five year carbon reduction budgets and longer term targets. These are intended to fulfil the UK's international obligations to combat climate change arising from global warming through the level of greenhouse gas emissions.

The first of carbon budget formed part of the 2009 Budget Statement delivered to parliament by the Chancellor of the Exchequer on 22 April 2009. This yields the following:

2008-12	22% reduction in emissions compared to the 1990 baseline
2013-17	28% reduction in emissions compared to the 1990 baseline
2018-22	34% reduction in emissions compared to the 1990 baseline

with a legally binding commitment to an 80% reduction in emissions compared to the 1990 baseline by 2050.

The effort needed to achieve these targets should not be underestimated, particularly since carbon emissions associated with the generation of grid electricity have increased substantially over the past five years resulting in increased carbon even where electricity consumption has not increased.

3.2 National Indicators

With respect to Stockton-on-Tees Borough Council carbon emissions there are two National Indicators of direct relevance. These are NI 185, Percentage CO_2 reduction from Local Authority operations and NI 194, Air quality – Percentage reduction in NOx and primary PM_{10} emissions through a Local Authority's operations. NI185 lies within the Stockton-on-Tees Borough Council Local Area Agreement as a Community priority requiring the council to show and achieve year on year reductions.

The 2008/09 baseline has been established in agreement with Defra at the following emission levels:

Carbon dioxide	31,783 tonnes
NOx	47.8 tonnes
PM_{10}	1.5 tonnes

Targets have been submitted to reduce these emissions by 10.4 % for CO_2 and 10.3% for NOx and PM_{10} in 2010/11 financial year.

3.3 Carbon Reduction Commitment

The Government are in the process of introducing the Carbon Reduction Commitment (CRC), a 'cap and trade' scheme for high energy users which is intended to increase energy efficiency and reduce carbon dioxide emissions.

Participation in the scheme is decided by the electricity consumption measured by half hourly meters during the calendar year 2008. On this basis Stockton-on-Tees Borough Council qualify and will be full participants in the scheme.

Registration to the scheme will take place between April and October 2010 with trading commencing in April 2011. Further information is expected to become available before January 2010.

CRC requires organisations in the scheme to purchase carbon emission 'allowances' from Government. These are to cover emissions associated with electricity consumption, gas consumption and any other fuel used but specifically excludes transport. The allowances will be available at the start of the scheme at a price of £12 per tonne of carbon dioxide. On the current carbon dioxide emission figures for Stockton-on-Tees Borough Council determined for NI185 reporting a figure of 28,490,919 kg of carbon dioxide excluding transport has been determined and agreed with Defra. This results in a purchase cost of carbon credits of £341,891. On the basis that NI185 carbon reduction targets for 2009/10 are achieved then the emissions fall to 26,069,191, reducing the cost to £312,830. These figures are subject to the detailed requirements for CRC reporting that are not yet available.

According to the government the CRC scheme is 'fiscally neutral' in that the payments received will be recycled back to participants on the basis of their performance in reducing emissions each October. Determination of the repayment is made according to the organisation's position in a league table of all participants. At the top of the league table a 'bonus' of 10% is paid whilst at the bottom a 'penalty' of 10% applies. Over a period of five years this bonus (or penalty) rises to 50%. The actual bonus or penalty payable for a given league table position is on a linear scale from top to bottom.

However there are also other related costs for entry to the scheme, most significant of which has been accreditation to the Carbon Trust Standard at a cost of £12,000 for the first two years

It is currently estimated that around 5,000 organisations will be participating in the scheme and these will include supermarkets, other large stores, manufacturing and commercial business as well as local authorities.

Part of the process requires the establishment of a 'carbon footprint report' and this will cover the actual emissions in 2010/11 financial year. After five years operation of the scheme the 'cap' will be introduced to set a limit on the number of allowances available and this will be progressively reduced over time to push towards Government carbon reduction targets.

Whilst initial pricing of allowances will be £12 per tonne of carbon dioxide, after the initial purchase period these will be traded on the open market with values set by supply and demand. In the event that an organisation has not purchased sufficient allowances to cover the year's emissions more must be bought to cover the total and these will have to be sourced from the market. Their cost may be higher but they are

also subject to brokerage fees and tax which the original purchase is not. It is therefore important that sufficient allowances are purchased. Surplus allowances may be sold.

CRC will be administered by the Environment Agency which also acts as the regulator. There are both civil and criminal penalties for various aspects of non-compliance with the scheme.

DRAFT

4 Energy Efficiency

Whilst the adoption of increasing renewable energy capacity is seen as the means of reducing carbon emissions by Stockton-on-Tees Borough Council this does not mean that continual improvements in energy efficiency should be set aside. Far from it; renewable energy supply needs to be treated as a precious resource therefore efforts need to be made to ensure maximum energy efficiency in all areas. The work started under the Local Authority Carbon Management Programme (LACM) therefore needs to continue whilst specifications for any new build such as BSF should be demanding the highest levels of thermal efficiency and efforts to minimise electrical demand.

To this end further efforts are needed wherever practicable to improve building insulation, draught proof and install higher efficiency double glazing. Boiler plant should be upgraded or replaced with low carbon (eg ground or air sourced heat pumps) or renewable (eg biomass boilers, solar hot water) sources of space and water heating. Voltage regulation also provides significant savings in appropriate buildings as has been shown in the trial at Queensway House and will be further monitored through the Conyers School installation.

For new build there needs to be very close attention to building orientation to make the most of solar gain whilst natural ventilation methods ensure there is no demand for carbon costly air conditioning in the warmer summers we can expect through global warming. Built in thermal mass is also beneficial to minimise diurnal temperature variations and to smooth the transition of temperature changes through the seasons. The planning approval process is the key to success in this area with a need for stringent requirements on 'U' values, acceptable carbon emissions and both on and off site renewable energy supply. The Council should be requiring developers, BSF and the Primary Capital grants programme to deliver carbon neutral buildings ahead of current government aspirations for 2016 to ensure that the Council is not burdened with the costs and penalties associated with carbon emissions into the long term future.

As fossil fuel supply diminishes or becomes more reliant on imports the prices will increase substantially. This will alter financial payback periods to the benefit of what are currently seen as more costly measures to both improve energy efficiency and provide renewable energy supply. For example, external insulated cladding of many Council buildings may therefore become a viable next step to improve energy efficiency beyond currently achieved levels.

An area of particular concern regarding carbon management is the apparently constant upward pressure on electricity demand, particularly noticeable in schools with increased use of IT, electronic whiteboards and other equipment but also in many Council buildings. Plans have been made to introduce real time displays of electricity (and gas) consumption into the Climate Change schools initially. These displays will include energy targets and provide an alarm to the school site manager or bursar responsible for energy use if consumption varies from predicted demands enabling quick action to be taken to restore control. The displays will also enable the monitoring of water use, recycling and waste providing a comprehensive tool to encourage 'green' thinking amongst staff and students. The installation of the initial units is financed by grant from the Regional Improvement & Efficiency Partnership and these will be operational early in 2010. There is a possibility of similar displays being introduced to key council buildings.

Continuous monitoring will produce energy savings. Research has shown that this can amount to 10-15% simply due to increased user awareness whilst the alarm function will alert to failures to switch off equipment after use or to faults in control systems enabling early rectification.

5 Renewable Energy Resources

This section introduces the various sources of renewable energy supply that may be considered by Stockton-on-Tees Borough Council and covers the pros and cons of these technologies. This is an area in which a significant effort into the development of the various devices is focussed which means that costs are likely to reduce and efficiency of energy conversion increase over time. It is important that this changing picture is taken into account as the Renewable Energy Strategy is implemented and reviewed.

5.1 Onshore Wind – This provides the quickest current route to significant generation of electricity. Wind turbines have increased in capacity substantially over the years such that large machines are now available rated at between 1 and 4 MW with developments up to 10MW in the pipeline. These machines are likely to be around 100m in height and therefore need to be sited in areas of relatively open ground since a 'topple' distance must be allowed for.

A range of planning issues also needs to be considered. These include visual impact including light 'flicker' from the rotating blades, potential interference with airport and MOD radar systems, impact on migrating birds and proximity to major road and rail routes. The North East Regional Renewable Energy Strategy, the Regional Spatial Strategy and PPS25 contain guidance and supporting information on wind energy developments and need to be taken into account when identifying potential sites.

Questions are often raised concerning the output of wind turbines since both low and very high wind speeds provide periods without generation. Data gathered from the wind turbines operating in the North East has resulted in an availability figure of 27% reported in the north East Renewable Energy Strategy. This means that a 3MW wind turbine would generate an average of 0.84 MW across the year. This needs to be considered when looking at wind energy as a source of renewable electricity and its impact on carbon emissions.

Small scale wind, typically of sizes up to 250kw, are more appropriate for smaller sites including schools, council depots and other buildings. Once again their maximum availability would be 27% but could be much less, particularly in urban environments where the impact of adjacent buildings can result in wide variations in wind speed and direction at the Wind turbine.

The really small machines of less than 5kW should only be considered for educational purposes at schools as these will only give a consistent output in areas away from buildings and at a height well above building lines. It is very unlikely that the costs associated with such an installation would be justified for these low output machines.

Two locations have been considered in some detail for wind turbines of 250kW capacity. These are Northfield School and Bishopsgarth School. On the basis of the latest energy data such installations would have the following impact:

DRAFT

	Electricity 2008/09 KwH	Gas 2008/09 kWh	Carbon dioxide Emissions 2008/09 tonnes	Potential Wind Energy Supply	New Total Energy kWh	Carbon Dioxide Savings tonnes	New Carbon Dioxide Emissions tonnes
Bishopsgarth School	325,465	1,102,894	374.2	589,680	838,679	308.4	65.8
Northfield School	608,972	1,323,598	563.4	589,680	1,342,890	308.4	255.0

This example shows the opportunity for carbon savings, even from an 'intermittent' renewable like wind energy.

Ove Arup conducted a review of wind energy potential for the Stockton-on-Tees Borough Council area to determine the potential for larger (at least 100m) wind turbines to determine a theoretical maximum energy generation capacity. This study has shown that the area is generally heavily constrained by a number of factors. The study suggested a theoretical maximum capacity of 52MW though whilst the study didn't take this further, it is likely that the actual maximum would be ¼ to ½ of this.

Should the Council adopt a power purchase agreement (see 6.3 below) to provide, say 60% of 2008/09 electricity requirements (on the basis that the LACM 25% reduction by 2013 target is met and that there are other sources of renewable electricity such as solar PV below), and assuming the 27% availability prevalent in the north east, this would require a wind farm of around 25MW which is not unreasonable being around 10 of the current larger 2.75MW wind turbines.

Since energy from the wind is not consistent, there are times when there is no generation due to low or high wind speeds, access to 'conventional' electricity supply would need to be maintained but this would be part of the power purchase agreement. However, it does mean that some carbon emissions would remain.

5.2 Offshore wind – This is more effective than onshore since winds are more consistent and for longer periods thus increasing availability but is more costly due to the difficulties of installing structures in the sea. There are plans for an offshore wind farm off the coast at Redcar.

5.3 Biomass – This provides the most readily available source of renewable heat. There is scope for the introduction of biomass boilers to replace natural gas boilers whilst Combined Heat and Power, whereby electricity is generated as well as space and domestic water heating, even using natural gas provides substantial energy savings for the right applications. However, the truly renewable supply is biomass in various forms and this needs serious consideration as the source of heating for Stockton-on-Tees Borough Council buildings.

Biomass feedstock includes the following potential sources of fuel:

- Small round wood: an output from managed woodland and forestry which because of its size is unsuitable for other purposes and which has been increasingly priced out of the chip board making supply chain. There is spare capacity available within the region from this resource providing that an economic price can be realised.

- Low Value Forestry Products: including sawdust, slabwood and bark. These products have a low value and it is uneconomic to transport them more than short distances to customers.
- Forest residues: generally left on the ground after clear felling and thinning of managed forests and sometimes burnt on site before replanting. This resource is currently more difficult and expensive to process than other potential fuel sources.
- Energy crops: these include short rotation coppice, single stem trees and other dedicated energy crops such as miscanthus grass; and as a feedstock for biodiesel a wide range of oil seed crops.
- Wood recovered from the waste stream: this includes both clean and contaminated wood, which includes post consumer waste such as old pallets and packaging. Both clean and contaminated wood can be used, given the correct circumstances, and represent a potentially large resource.
- Output from Unmanaged small woodlands: also offer an important resource, referred to in RRES in the context of small round wood. Current low timber prices mean that it is more difficult to extract this resource economically than that from the larger forests managed for example by the Forestry Commission.

Wood fuel from these sources can be used in the following ways:

- As logs, for use in traditional wood burning stoves providing individual room heating, central heating and hot water. This traditional way of using wood fuel is widely used in rural areas. The extent to which log based systems are used and growth in the use of this fuel is not known.
- As off cuts etc used to heat industrial premises that generate significant quantities of waste wood. Again the extent of use of this source is not fully known, as it does not enter any supply chain.
- As chips for use in larger boilers serving public and commercial buildings, and in district heating systems.
- As fuel pellets and briquettes made by compressing sawdust and small wood fragments, currently there are two pellet manufacturers in the region and a further two suppliers.

In addition to wood based biomass there are other potential resources

- Straw: It is considered that only a small proportion of the region's straw production would be surplus to requirements and therefore available as a potential fuel source. In fact there is a shortage of straw for higher value markets such as animal bedding.
- Litter: Intensive poultry and pig farming is not significant in the region. There is no scope for utlising this as a fuel source.
- Farm and Food Waste: The renewable energy potential of farm and food waste has been recognised with gasification and anaerobic digestion technologies used to process animal, biomass and food wastes to produce gas and electricity.

The table below (from the Biomass Energy Centre owned and managed by the Forestry Commission) shows the energy density in terms of land required for the various biomass energy crops.

DRAFT

Fuel	Net calorific value (MJ/kg)	Output per hectare p.a. (t/ha.a)	Energy per ha p.a.	
			GJ/ha	MWh/ha
Wood (forestry residues, SRW, thinnings, etc.) @ 30% MC	13	2.9 (2 odt)	37	10.3
Wood (SRC Willow) @ 30% MC	13	12.9 (9 odt)	167	46
Miscanthus @ 25% MC	13	17.3 (13 odt)	225	63
Wheat straw @ 20% MC	13.5	4.6 (3.7 odt)	62	17
Biodiesel (from rapeseed oil)	37	1.1	41	11.3
Bioethanol (from sugar beet)	27	4.4	119	33
Bioethanol (from wheat)	27	2.3	62	17
Biogas (from cattle slurry)	20	0.88	18	4.9
Biogas (from sugar beet)	20	5.3	106	29

On the basis of 2008/09 energy consumption data Stockton-on-Tees Borough Council require around 56,000 MWh of heat per annum which would equate to over 1,200 ha of SRC willow per annum, about 6% of the area of Stockton-on-Tees Borough Council. As SRC is harvested on a three year cycle this would need 3,600 ha equivalent to 90 Preston Parks! There would also be a requirement for fuel storage and associated delivery at the various boiler plant locations. This is not easy to achieve in town centre locations with restricted sites and access.

5.4 Biodiesel and other biofuels – Biodiesels is already being used at a 10% blend for the diesel engine vehicles in the Stockton-on-Tees Borough Council fleet. Higher proportions are under consideration where these would not affect vehicle warranties. A further possibility is the production of bio-methane from anaerobic digestion of waste streams and this could particularly be applied to food waste. A trial project using this technology is currently under consideration with support from Renew at CPI.

5.5 Hydro power – The upgrade of the Tees Barrage white-water course includes provision of Archimedes screw pumps that will be operated in reverse to generate electricity. It is expected that overall this arrangement will result in a net export of renewable electricity. There is little prospect of other viable hydro power schemes in the Stockton-on-Tees Borough Council area.

DRAFT

5.6 Solar electricity – photo-voltaic cells and panels are currently an expensive technology but the results of current research are likely to result in substantial cost savings in the near future. Current technology is competitively priced if utilised as an alternative architectural cladding material on commercial and public buildings.

The other viable option for PV is for items such as car park ticket machines, lighting and other items where the cost of laying and connecting mains cables can be avoided.

A preliminary assessment of available south facing roof capacity on council buildings and schools suggests that it would be feasible to install a total area of around 33,000 m^2 of photo-voltaic panels, subject to roof construction being able to support the weight of the panels. On the basis of 1kW of output per 7m^2 of panels this would yield a capacity of solar electricity for Stockton-on-Tees borough Council of 4.7 MW. Meteorological Office data suggests and average of around 1,450 hours of sunshine per annum which would result in these panels providing 6,835 MWh of electricity per annum or 20% of 2008/09 electricity consumption.

Currently provision of photovoltaic panels on this scale would be prohibitively expensive, potentially in excess of £12m. But current research into alternative methods of producing PV cells may ultimately reduce costs to around 10% of current levels and this would clearly improve the prospects of justifying the investment.

At a smaller scale there is potential for up to 5,500 m^2 of PV to be installed on Queensway House, Kingsway house, Municipal Buildings and Library and Gloucester House. This could provide around 750kW of electricity, up to 1.2MWh across the year. This would provide just over half the current electricity demand of these buildings.

Municipal Buildings Example

1-5kw	£5500 per kW installed
5.1-10kw	£5250 per kW installed
10.1-17.5kw	£5000 per KW installed
17.6kw-30kw	£4750 per kW installed

Each KW installed will provide around 850 kWh/unit per annum. Costs exclude VAT and are estimated. So for 20kw system on Municipal Buildings: £90,000 + vat estimated. This would generate around 16672kWh per year (SAP) and avoid 9467kg/CO2 per year. On the basis of Feed in Tariff (see section 7 below) revenue at 26p/kWh this would give a payback of 21 years.

5.7 Solar Hot Water – this is used to provide domestic hot water or preheat space heating water for buildings. South facing roofs are required and a careful assessment of hot water requirements but this technology can provide around 60% of annual domestic hot water demand. The majority of council buildings would accommodate solar hot water panels to provide domestic hot water supply

5.8 Geo-thermal – for Stockton-on-Tees Borough Council this is most likely to take the form of ground source heat pumps for space heating using underfloor systems. This is best suited to new build (eg Rosebrook school) and should be seriously considered for all BSF schools.

5.9 Marine (Wave & Tidal) – This is likely to be the long term provider of substantial quantities of renewable energy and is currently subject of a number of research and development projects.

In terms of providing effective renewable energy supply to the Stockton-on-Tees Borough Council buildings a mix of the technologies described above will be required. The most appropriate mix will be dependant on the energy demand profile of each building but must be properly considered.

In addition the availability of renewable electricity to recharge electric vehicles would enable these to be clearly identified as ‘zero carbon’ transport.

6 Opportunities

6.1 Buildings, opportunities for building mounted renewable energy supply

Practical renewable energy supply for buildings comprises solar electricity and hot water that would be roof mounted, replacement of natural gas boilers with biomass fuelled heating systems most likely using wood chip and the possible use of anaerobic digestion to produce biomethane from waste streams, particularly food waste.

The majority of Stockton-on-Tees Borough Council buildings and schools have, subject to roof loading capacity, the potential to accommodate solar photo-voltaic panels and solar hot water that collectively could furnish around 25% of current energy demand. Conversion of boilers to biomass would be dependant on fuel storage space and vehicle access and sufficient sustainable supply of wood chip fuel.

6.2 Land, Council owned land with opportunities for renewable energy installations to serve Council properties

Bishopsgarth and Northfield Schools have been identified as potential wind turbine sites, current consideration is for around 250kW capacity but in principle this could be increased to around 1MW, in all cases subject to planning permission.

6.3 3rd Party Agreements with renewable energy generators for supply to Council.

Power Purchase Agreements for electricity may be set up between local authorities and energy suppliers to secure both long term stability in electricity prices and to enable access to renewable electricity supply on a scale that may not be available locally. This enables an agreement to be set up whereby renewable electricity, typically wind generated, is provided through the existing grid connections to the customer.

Preliminary discussions have been held between Stockton-on-Tees Borough Council and two organisations, Utilyx and Banks Developments regarding the potential use of this route to a substantial supply of renewable electricity on a long term arrangement.

6.4 New build including BSF

All new build related to Council operations provides the opportunity to insist on increased levels of renewable energy supply. It is not unreasonable to demand 20% on site renewables for BSF and Primary Capital Grant schools for example with additional requirements for the maximum use of ground source heat and under-floor heating, particularly where biomass boilers are considered impractical due to fuel store and delivery requirements.

In addition new build will be required to comply with the Sustainable Construction Policy which will provide another driver for renewable energy supply to be included.

DRAFT

7 Financial

In general renewable energy supply is still seen as expensive. A recently published summary of the various technologies is included at the end of this document. However, a means of financing the implementation of renewables is required. An opportunity to revisit the financing of renewable electricity supply through solar and wind generated power arises from the planned introduction of Feed in Tariffs (FiTs) from April 2010. Whilst this was referred to in the Renewable Energy Strategy this document examines the use of FiTs for schemes that have been looked at in the recent or more distant past.

The currently published table of feed in tariffs is:

Technology	Scale	Proposed Initial Tariff (p/kWh)
Anaerobic Digestion	Electricity only	9
Anaerobic Digestion	CHP	11.5
Biomass	<50kW	9
Biomass	50kW – 5MW	4.5
Biomass	CHP	9
Hydro	<10kW	17
Hydro	10 – 100kW	12
Hydro	100kW – 1MW	8.5
Hydro	1 – 5MW	4.5
PV	<4kW (new build)	31
PV	<4kW (retrofit)	36.5
PV	4 – 10kW	31
PV	10 – 100kW	28
PV	100kW – 5MW	26
PV	Stand alone system	26
Wind	<1.5kW	30.5
Wind	1.5 – 15kW	23
Wind	15 – 50kW	20.5
Wind	50 – 250kW	18
Wind	250 – 500kW	16
Wind	500 – 5MW	4.5

The following paragraphs look at the implications of adopting certain technologies to show the role of FiTs in the financial case for renewable energy supply.

7.1 Wind Turbine

In June 2008 North Energy undertook a study into the feasibility of erecting a wind turbine at Northfield School. Three recommendations were made, two for 330kW machines and one for a larger, 800kW wind turbine. Taking the smaller option a predicted annual total output of 976,500kWh has been stated. An alternative calculation is to apply the typical availability figure of 27% for wind turbines in the North East across the year. This would result in an electrical output of 330x365x24x0.27=780,516kWh. Capital cost for this device on 2008 figures was £563,520.

Electricity consumption at Northfield School for 2008/09 was 608,972 kWh and this taken with school opening hours and wind conditions will mean that there will be surplus electricity to sell back to the Grid from a wind turbine of this size.

On the basis of the lower electrical out put figure and applying the FiT of 16p/kWh for a turbine in the size range 250kw to 500kW an annual income of £124,883 would result. Assuming 50% of the output were sold to the grid at say 5p/kWh then an additional income of £39,026 would result giving a total annual income of £163,909 enabling the capital cost of installation to be paid back in under 3½ years. After this time there would be a continuing income to the school.

7.2 Solar PV

A similar approach may also be applied to the installation of solar photo-voltaic panels that generate electricity from the sun. An initial estimated price of £90,000 for 20kW of PV for Municipal Buildings has been received from Access Renewables. The annual output from this installation would be 16,672kWh. This would attract a FiT of 28p/kWh yielding an annual income of £4668 resulting in a payback period of 19 years.

The much longer payback period reflects the high cost of solar PV technology but advances are expected to see this reduce substantially over the next decade or so, some predictions are to 10% of current costs which would bring payback to less than that of a wind turbine. Time will tell if this becomes a reality.

7.3 Financial Summary

Wind generated electricity provides an excellent opportunity to kick start a move towards increased renewable energy supply for Stockton-on-Tees Borough Council activities. There are a number of school sites that could readily host wind turbines, subject to planning permission. Feasibility studies have been conducted fro Northfield and Bishopsgarth schools and there are other candidate open areas across the Borough. The introduction of Feed in Tariffs from April 2010 provides an opportunity to look carefully at how the Council could support the development of renewable energy supply with prudential borrowing over a five year period appearing viable.

The numbers used in support of this argument are provisional and would need to be revisited by the appropriate energy supply developers in more detail as well as being brought up to date but the quoted payback periods will be typical of those that could be achieved. Additional examples are shown in the table below.

Location	Renewable	kW	kWh	Capital cost	Revenue from FiTs/annum	Payback
Northfield School	Enercon E33 Wind Turbiine	330	780,516	£563,520.00	£124,882.56	4.51
	Enercon E48 Wind Turbine	800	1,892,160	£827,840.00	£302,745.60	2.73
Bishposgarth School	Seewind 132 Wind Turbine	132	312,206	£139,125.00	£49,953.02	2.79
St Patricks Primary, Thornaby	Mitsubishi PV	3.7	3,084	£18,802.00	£956.04	19.67
Municipal Buildings	PV	20	16,672	£90,000.00	£4,668.16	19.28

It is however important to be clear that even though Feed in Tariffs can transform the economic argument for renewables and would reduce the Council's carbon consumption, at least in terms of NI 185, it does not count for the Carbon Reduction Commitment where electricity benefiting from feed in tariffs must be treated as grid electricity with its associated carbon burden. Until CRC is underway it is difficult to cost the impact of this as the recorded carbon emissions set our position on the league table and therefore determine whether the Council achieves a net gain or loss against the cost of the carbon allowances. To quote from the latest guidance on CRC:

DRAFT

"As an energy efficiency mechanism, CRC will not provide additional incentives for renewable generation."

However, the published league table will show renewable energy supply for organisations allowing at least a reputational benefit.

Grant support for renewable energy supply is available through the Government's Low Carbon Buildings Programme that provides up to 50% support to a range of technologies. The available funding and priorities for various technologies vary with time requiring careful checking of status at the time of considering a grant application. Other grant opportunities arise from time to time including from the utilities, particularly for educational establishments.

DRAFT

8 Action plan

Despite the rather negative view of renewable energy supply that comes from the CRC approach, somewhat surprising given the Government's requirement to meet a renewable energy supply target of 15% including heat by 2020, the council should proceed to include renewable energy as part of the carbon management programme.

The following priorities are advised:

1. It is essential to maintain a downward pressure on energy demand by adopting effective energy efficiency measures including:
    i. Continued insulation improvements
    ii. Upgrade of office lighting including light level and motion detectors
    iii. Voltage regulation
    iv. IT moving to thin client servers
    v. Reduce use of air conditioning
    vi. Higher efficiency heating systems and controls

2. Phased introduction of renewable energy supplies
    i. PV panels on key buildings using feed in tariff for return on investment
    ii. Solar hot water for buildings with suitable domestic hot water load
    iii. Ground source heat pumps on all new builds where practicable
    iv. Wind turbine installations at key sites such as secondary schools, Northfield, Bishopsgarth initially, possibly St Michaels.
    v. Power purchase agreement for off site, out of borough renewable energy supply
    vi. Biomass heat linked to CHP where practicable

3. Building priorities

    The approach for determining the application of renewable energy supply will be to target the high energy use buildings presented in Tables 1,2 and 3 at the end of this document.

    Refurbishment of the Billingham Forum will include provision of Combined Heat and Power along with other energy efficiency measures to reduce its carbon impact on reopening. Other buildings will be considered such as the installation of solar electricity supply on Municipal Buildings whilst wind turbines and solar energy are applicable to many of the school premises.

Driver	Criteria	Influence
Building regulations part L	Increased energy efficiency and reduction in carbon emissions	Encourages the use of building integrated renewables to reduce carbon footprint
BSF Policy	Ideally should be setting high standards at BREEAM Excellent with high energy score	Establishes future carbon emissions burden to the Council from the new build schools

DRAFT

Government Policy	Setting rolling 5 yearly carbon reduction budgets plus 34% reduction by 2020 and 80% reduction by 2050	Additional pressure on local authorities through National Indicators including NI185 that falls within the Stockton-on-Tees Borough Council Local Area Agreement
Stockton-on-Tees Borough Council Policy	25% reduction in carbon emissions by 2013 under LA Carbon Management	Requires continuous improvement in energy efficiency across all activities and reduction in use of carbon emitting fuels so pushes renewable energy supply
Funding/grants	Feed in tariffs from April 2010 predicted 8% return on investment for renewable electricity generation. Low Carbon Buildings Programme grants of up to 50% of installed cost	Improves financial justification for renewable energy projects.
Carbon Reduction Commitment	Requires carbon allowances to be purchased in advance against predicted annual emissions with payback dependant on comparative performance	Additional incentive to reduce carbon emissions and to improve monitoring and predicting enabling early action to be taken to meet predictions.

DRAFT

9 Recommendations

This section presents a hierarchy of renewable energy technologies for consideration by the Council.

9.1 Wind Turbines – utilising council land including school grounds these provide an immediate renewable electricity supply subject to suitable locations and planning permission but will only provide a small proportion of current electricity demand.

9.2 Solar PV – in terms of available roof space has the potential to meet up to 20% of current electricity demand but is currently a very costly technology. However the introduction of Feed In Tariffs from April 2010 does change the economics of this technology with a predicted 8% return on investment from the resultant income.

9.3 Renewable Heat – encompassing biomass boilers, solar hot water, ground source and air source heat pumps to displace natural gas as the space heating and domestic hot water supply.

9.4 Power Purchase Agreement – This is a long term contract securing a fixed (plus inflation) price for energy supply that in this case is applied to renewable energy (electricity) supply. This long term, contractual arrangement, typically 20 to 40 years enables the development of large scale renewables to be funded from capital raised against the guaranteed earnings from the supply contract. Such an arrangement could therefore be linked to a renewable energy supply remote from the Stockton-on-Tees Borough Council area thus removing limits on supply capacity arising from a lack of suitable sites.

9.5 Solar electricity – although costly this does provide an alternative renewable energy supply to those buildings with south facing roofs.

DRAFT

10 Conclusions

Carbon reduction in line with the national targets of a 34% reduction by 2020 and at least 80% by 2050 will only be achieved by a progressive move towards renewable and sustainable energy supply for heat and electricity in Council buildings.

Efforts on the reduction of energy demand must take priority over the introduction of renewable energy supplies so that these achieve the best match with the building energy consumption.

Building mounted sustainable energy supplies are limited to solar, heat pumps and possibly biomass heating though there are implications related to the delivery and storage of fuel for the latter, particular in the urban environment.

For large scale renewable energy supply a power purchase agreement providing renewable electricity from a remote wind farm is currently the best option.

Renewable heat presents a real challenge but is important to meet the higher carbon reduction targets from 2020 onwards. Biomass is unlikely to be practical for urban centre locations other than for larger scale CHP should appropriate sites and investment becomes available. There may also be opportunities for anaerobic digestion if sufficient feedstock such as food waste be available.

Feed in Tariffs provide for a different financial model for smaller scale renewable electricity supply. Installations such as solar PV take advantage of this and can provide a strong message of commitment and leadership from the Council. However, as currently configured they will not impact on the CRC financial commitment as such electricity has to be considered as grid sourced to avoid double counting, but would feature alongside the league tables to the benefit of the Council's reputation.

DRAFT

TABLE 1 Top 50 Consumers of Gas

	Building	Gas kWh
1	BILLINGHAM FORUM (TEES ACTIVE)	4,870,836
2	IAN RAMSEY CE COMPREHENSIVE SCHOOL	2,056,693
3	OUR LADY & ST. BEDE'S RC COMPREHENSIVE SCHOOL	2,028,909
4	STOCKTON SWIMMING POOL (SPLASH) (TEES ACTIVE)	1,934,036
5	BILLINGHAM CAMPUS COMPREHENSIVE SCHOOL	1,746,739
6	GRANGEFIELD COMPREHENSIVE SCHOOL	1,585,508
7	THORNABY SWIMMING BATHS (TEES ACTIVE)	1,444,495
8	BLAKESTON COMPREHENSIVE SCHOOL	1,439,649
9	EGGLESCLIFFE COMPREHENSIVE SCHOOL & ALLENS WEST PA	1,365,687
10	NORTHFIELD COMPREHENSIVE SCHOOL	1,323,958
11	THORNABY PAVILION (TEES ACTIVE)	1,298,445
12	THORNABY COMMUNITY SCHOOL	1,153,686
13	BISHOPSGARTH COMPREHENSIVE SCHOOL	1,102,894
14	PRESTON HALL MUSEUM	1,050,172
15	ST. MICHAEL'S RC COMPREHENSIVE SCHOOL	1,008,950
16	THE NORTON COMPREHENSIVE SCHOOL	859,486
17	CONYERS COMPREHENSIVE SCHOOL	835,778
18	MUNICIPAL BUILDINGS	725,778
19	ABBEY HILL SPECIAL SCHOOL	685,634
20	HARDWICK Y&CC - ABBEY HILL POOL	630,214
21	STOCKTON SPORTS CENTRE (TEES ACTIVE)	626,490
22	WHITEHOUSE PRIMARY SCHOOL	587,432
23	WILLIAM NEWTON ADULT EDUCATION CENTRE	521,346
24	ROPNER PARK	485,876
25	ST. PATRICK'S RC COMPREHENSIVE SCHOOL	448,990
26	RIEVAULX AVENUE RESOURCE CENTRE	436,467
27	BARLEY FIELDS PRIMARY SCHOOL	433,184
28	COWPEN LANE DEPOT	412,934
29	PENTLAND PRIMARY SCHOOL	407,554
30	MANDALE MILL PRIMARY SCHOOL	401,202
31	WESTLANDS SPECIAL SCHOOL	391,492
32	BILLINGHAM SOUTH PRIMARY SCHOOL	371,567
33	THE OAK TREE PRIMARY SCHOOL	371,167
34	16 CHURCH ROAD	367,304
35	SURE START HIGH FLYERS CENTRE	366,012
36	SURE START REDHILL CHILDRENS CENTRE	364,736
37	NORTON PRIMARY SCHOOL	348,120
38	TILERY PRIMARY SCHOOL	340,124
39	STOCKTON CENTRAL LIBRARY	338,921
40	HARTBURN PRIMARY SCHOOL	322,841
41	YARM PRIMARY SCHOOL	322,017
42	OXBRIDGE LANE PRIMARY SCHOOL	321,174
43	ASH TREES SPECIAL SCHOOL	318,868
44	HARROW GATE PRIMARY SCHOOL	316,509
45	BADER PRIMARY SCHOOL	312,626
46	HARDWICK PRIMARY SCHOOL	312,191
47	ALMA CENTRE	310,070
48	BILLINGHAM ADULT EDUCATION CENTRE	309,897
49	TITHEBARN HOUSE RESOURCE CENTRE	301,756
50	WHINSTONE PRIMARY SCHOOL	300,855

DRAFT

Table 2 Top 50 Consumers of Electricity

	Building	Electricity kWh
1	BILLINGHAM FORUM (TEES ACTIVE)	2,617,119
2	MUNICIPAL BUILDINGS	1,296,968
3	STOCKTON SWIMMING POOL (SPLASH) (TEES ACTIVE)	1,009,526
4	EGGLESCLIFFE COMPREHENSIVE SCHOOL & ALLENS WEST PA	639,889
5	NORTHFIELD COMPREHENSIVE SCHOOL	608,972
6	CONYERS COMPREHENSIVE SCHOOL	553,979
7	GRANGEFIELD COMPREHENSIVE SCHOOL	540,832
8	BILLINGHAM CAMPUS COMPREHENSIVE SCHOOL	496,692
9	IAN RAMSEY CE COMPREHENSIVE SCHOOL	474,017
10	THORNABY COMMUNITY SCHOOL	415,143
11	THORNABY PAVILION (TEES ACTIVE)	412,390
12	OUR LADY & ST. BEDE'S RC COMPREHENSIVE SCHOOL	368,453
13	BISHOPSGARTH COMPREHENSIVE SCHOOL	325,465
14	ABBEY HILL SPECIAL SCHOOL	319,921
15	ST. MICHAEL'S RC COMPREHENSIVE SCHOOL	319,554
16	BLAKESTON COMPREHENSIVE SCHOOL	318,635
17	SECURITY & SURVEILLANCE CENTRE	301,117
18	THE NORTON COMPREHENSIVE SCHOOL	280,832
19	WILLIAM NEWTON ADULT EDUCATION CENTRE	231,882
20	QUEENSWAY HOUSE	213,097
21	16 CHURCH ROAD	208,604
22	THORNABY SWIMMING BATHS (TEES ACTIVE)	206,830
23	COWPEN LANE DEPOT	206,347
24	STOCKTON CENTRAL LIBRARY	202,687
25	PRESTON HALL MUSEUM	195,858
26	KINGSWAY HOUSE	188,400
27	ST. PATRICK'S RC COMPREHENSIVE SCHOOL	184,708
28	STOCKTON SPORTS CENTRE (TEES ACTIVE)	179,082
29	BAYHEATH HOUSE	170,687
30	BOWESFIELD LANE GYPSY SITE	163,101
31	PRIOR'S MILL CE PRIMARY SCHOOL	141,692
32	STIRLING HOUSE	137,115
33	WHITEHOUSE PRIMARY SCHOOL	136,595
34	WHINSTONE PRIMARY SCHOOL	132,777
35	YARM PRIMARY SCHOOL	131,134
36	HAREWOOD PRIMARY SCHOOL	123,975
37	WYNYARD WOODLAND PARK	123,360
38	GLOUCESTER HOUSE	120,999
39	THE OAK TREE PRIMARY SCHOOL	119,945
40	THE BISHOPTON CENTRE	118,225
41	BILLINGHAM COUNCIL OFFICES	116,706
42	COWPEN BEWLEY WOODLAND PARK	113,661
43	WESTLANDS SPECIAL SCHOOL	113,606
44	RAGWORTH NEIGHBOURHOOD CENTRE	111,671
45	HARTBURN PRIMARY SCHOOL	108,820
46	HARDWICK Y&CC - ABBEY HILL POOL	108,124
47	BILLINGHAM SOUTH PRIMARY SCHOOL	108,046
48	SURE START HIGH FLYERS CENTRE	106,451
49	INGLEBY MILL PRIMARY SCHOOL	104,263
50	ASH TREES SPECIAL SCHOOL	102,465

DRAFT

Table 3 Top 50 Consumers of Total Energy

	Building	Electricity kWh	Gas kWh	Total Energy kWh
1	BILLINGHAM FORUM (TEES ACTIVE)	2,617,119	4,870,836	7,487,955
2	STOCKTON SWIMMING POOL (SPLASH) (TEES ACTI	1,009,526	1,934,036	2,943,562
3	IAN RAMSEY CE COMPREHENSIVE SCHOOL	474,017	2,056,693	2,530,710
4	OUR LADY & ST. BEDE'S RC COMPREHENSIVE SCH	368,453	2,028,909	2,397,362
5	BILLINGHAM CAMPUS COMPREHENSIVE SCHOOL	496,692	1,746,739	2,243,431
6	GRANGEFIELD COMPREHENSIVE SCHOOL	540,832	1,585,508	2,126,340
7	MUNICIPAL BUILDINGS	1,296,968	725,778	2,022,746
8	EGGLESCLIFFE COMPREHENSIVE SCHOOL & ALLE	639,889	1,365,687	2,005,576
9	NORTHFIELD COMPREHENSIVE SCHOOL	608,972	1,323,958	1,932,930
10	BLAKESTON COMPREHENSIVE SCHOOL	318,635	1,439,649	1,758,284
11	THORNABY PAVILION (TEES ACTIVE)	412,390	1,298,445	1,710,835
12	THORNABY SWIMMING BATHS (TEES ACTIVE)	206,830	1,444,495	1,651,325
13	THORNABY COMMUNITY SCHOOL	415,143	1,153,686	1,568,829
14	BISHOPSGARTH COMPREHENSIVE SCHOOL	325,465	1,102,894	1,428,359
15	CONYERS COMPREHENSIVE SCHOOL	553,979	835,778	1,389,757
16	ST. MICHAEL'S RC COMPREHENSIVE SCHOOL	319,554	1,008,950	1,328,504
17	PRESTON HALL MUSEUM	195,858	1,050,172	1,246,030
18	THE NORTON COMPREHENSIVE SCHOOL	280,832	859,486	1,140,318
19	ABBEY HILL SPECIAL SCHOOL	319,921	685,634	1,005,555
20	STOCKTON SPORTS CENTRE (TEES ACTIVE)	179,082	626,490	805,572
21	WILLIAM NEWTON ADULT EDUCATION CENTRE	231,882	521,346	753,228
22	HARDWICK Y&CC - ABBEY HILL POOL	108,124	630,214	738,338
23	WHITEHOUSE PRIMARY SCHOOL	136,595	587,432	724,027
24	ST. PATRICK'S RC COMPREHENSIVE SCHOOL	184,708	448,990	633,698
25	COWPEN LANE DEPOT	206,347	412,934	619,281
26	16 CHURCH ROAD	208,604	367,304	575,908
27	ROPNER PARK	88,572	485,876	574,448
28	STOCKTON CENTRAL LIBRARY	202,687	338,921	541,608
29	BARLEY FIELDS PRIMARY SCHOOL	97,550	433,184	530,734
30	RIEVAULX AVENUE RESOURCE CENTRE	92,618	436,467	529,085
31	WESTLANDS SPECIAL SCHOOL	113,606	391,492	505,098
32	THE OAK TREE PRIMARY SCHOOL	119,945	371,167	491,112
33	PENTLAND PRIMARY SCHOOL	79,274	407,554	486,828
34	MANDALE MILL PRIMARY SCHOOL	78,507	401,202	479,709
35	BILLINGHAM SOUTH PRIMARY SCHOOL	108,046	371,567	479,613
36	KINGSWAY HOUSE	188,400	287,689	476,089
37	SURE START HIGH FLYERS CENTRE	106,451	366,012	472,463
38	YARM PRIMARY SCHOOL	131,134	322,017	453,151
39	WHINSTONE PRIMARY SCHOOL	132,777	300,855	433,632
40	HARTBURN PRIMARY SCHOOL	108,820	322,841	431,661
41	SURE START REDHILL CHILDRENS CENTRE	66,519	364,736	431,255
42	BAYHEATH HOUSE	170,687	254,630	425,317
43	NORTON PRIMARY SCHOOL	76,799	348,120	424,919
44	HAREWOOD PRIMARY SCHOOL	123,975	299,189	423,164
45	ASH TREES SPECIAL SCHOOL	102,465	318,868	421,333
46	STIRLING HOUSE	137,115	280,559	417,674
47	TILERY PRIMARY SCHOOL	76,668	340,124	416,792
48	SECURITY & SURVEILLANCE CENTRE	301,117	114,516	415,633
49	INGLEBY MILL PRIMARY SCHOOL	104,263	294,689	398,952
50	HARROW GATE PRIMARY SCHOOL	82,304	316,509	398,813

DRAFT

Fuel	About	Pros	Cons	Viability
Clean coal 	Range of technologies to pre-treat coal to reduce emissions, burn it more efficiently, or capture carbon emissions at source.	Most abundant and widely distributed fossil fuel. Preserves existing industry and makes use of existing infrastructure.	Uses more coal per kWh than normal coal power. Produces some pollutants, such as heavy metals. Coal is a finite resource.	Small-scale trials under way. Huge investment(c $3trn) needed by 2050. Estimated cost: 5-13 cents/kWh (double normal coal).
Geothermal 	Uses naturally hot rocks, or temperature differences, beneath Earth's surface to heat water directly or drive turbines.	Constant renewable energy source in some locations. Highly efficient for heating living spaces. Long hardware lifetime.	Underground heat only available in some locations. Energy can "dry up" for years. Can in some locations release toxic gases.	Currently less than 1% of global capacity. US and Australia investing in new technologies. Estimated cost: 5-11 cents/kWh.
Nuclear 	Harnesses energy from the controlled splitting of atoms, releasing heat that is harvested to drive turbines.	Significant historical experience and technology developed. Can provide heat and electricity. Plentiful fuel supplies.	Perceived as risky. Strong opposition from green campaigners. Creates radioactive waste. Fuel can be weapons security risk.	Set for a comeback after years in shadow. New reactors behind schedule. Disputed cost. One estimate: 4-8 cents/kWh.
Marine 	Exploits energy of shifting tides, underwater currents, or shoreline and offshore waves.	Large and infinitely renewable resource. Tidal energy very regular. Can be exploited on small or large scale.	No consensus on best means to capture energy. Large projects may disrupt natural water flow, tides and ecosystems.	Little expected before 2030. Technology uncertain, so wide cost range: 15-30 cents/KWh (double or triple coal)
Wind 	Using the wind, on land or at sea, to drive turbines.	Significant experience and mature industry and infrastructure. Infinitely renewable resource. Can be deployed in range of project sizes.	Intermittent resource. Not efficient for all locations. Windfarms interrupt radar signals, can be noisy and regarded by some as unsightly.	Currently about 1% of global supply. Onshore cheaper than offshore. High energy storage costs are handicap. Quite low cost: 7-14 cents/kWh.
Solar 	Gathers energy from sunlight, using light to generate electricity directly (photovoltaic) or to heat liquids to drive a turbine.	Infinitely renewable and most abundant zero-carbon resource. Silent and no effects on local environment.	Like wind and marine, intermittent. Current photovoltaic designs complex; if widely used, chemicals could become scarce.	US investing heavily, EU planning plant in Africa. Cost still high (13-35 cents/kWh) but expected to fall. Price of solar panels falling.

DRAFT

Fuel	About	Pros	Cons	Viability
Hydroelectric 	Generates electricity by damming water and constraining flow through turbines. Most widely deployed renewable strategy.	Well-established as a large-scale energy source. Can also be used for energy storage if run in reverse.	Dams disrupt ecosystems and are a public health risk if they burst. Can trap decaying matter that creates pollution.	One of the cheapest forms of electricity. Development focusing on small hydro-electric power. Estimated cost: 2-6 cents/kWh.

Source: Costings from IEA, Table from BBC, November 2009