Northumberland County Council

Renewable, Low-Carbon Energy Generation and Energy Efficiency Study

Final Report

February 2011

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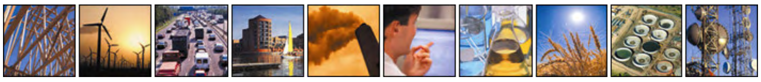

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Entec UK Limited

Report for

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Executive Summary

A. Introduction

This report has been produced by Entec UK Ltd (Entec) to support the development of planning policies in Northumberland County Council's (NCC) Local Development Framework (LDF) which will help support the reduction of carbon dioxide (CO_2) emissions. As the statutory planning authority NCC is required to develop such policies to meet national targets and Council-wide commitments in response to climate change and in order to reduce the reliance on fossil fuels.

This Executive Summary provides an overview of the purpose of the report, the context and challenges associated with planning for CO_2 reduction in Northumberland and presents 'key priorities' for action in the LDF in response to the study findings. The main report and supporting appendices should be referred to for further detail. A glossary is also provided at the end of the main report with definitions of key terminology to assist the reader.

B. Purpose of this Report

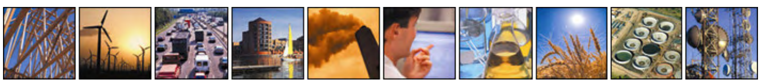
The fundamental purpose of this report is to provide NCC with a robust evidence base to support the development and implementation of policies in the LDF. Covering all land within the administrative boundary of NCC, this desktop study concentrates solely on the opportunities for reducing CO_2 emissions associated with energy use from the built environment - i.e. emissions associated with heating and powering the Northumberland's homes, schools, places of work and other buildings.

Specifically focussing on the role of planning policy in reducing emissions, the study also considers the crucial and complementary links with building regulations as part of an overall package of measures. What is outside the scope of this study is consideration of the other factors which will also be essential in reducing the County's overall CO_2 emissions, including social, environmental and transport policy.

It is important to note that although this study has been specifically commissioned by and written for NCC, the findings will be relevant to a wider audience including local communities, commercial and residential developers, energy companies and landowners. All of these stakeholders will be fundamental to the delivery of a 'low carbon' Northumberland.

C. Context, Challenges and Opportunities

Northumberland's potential for renewable energy is already well known with a number of schemes operational or in the pipeline: wind most significantly, as well as biomass, solar, hydro and other schemes. For major new developments developers are already actively considering the use of on-site renewable or low carbon technologies. Alongside this, the Council has its own corporate commitments to deliver a low carbon Northumberland, including



those commitments set out in their Sustainable Energy Action Plan (SEAP). This study therefore draws on the valuable progress that has already been made, but looks to the future in terms of what opportunities exist and how key challenges can be overcome.

A summary of the overall context for the study is provided in Box i.

Box i. Context, challenges and opportunities: delivering a 'Low Carbon Northumberland'

Responding to national planning policies for tackling climate change: national planning policy in the **Climate Change PPS**[1] is clear that local planning authorities should develop policies in their LDFs to reduce CO_2 emissions supported by a robust local evidence base. The PPS sets the context for encouraging the take-up of strategic scale renewable energy schemes as well as requiring new developments to be connected to locally supplied renewable and low carbon energy. The recently published **Planning for Climate Change: Guidance and Model Policies for Local Authorities**[2] provides further details on best practice in planning policy setting.

Local commitments: NCC is already committed to reducing CO_2 emissions in response to climate change demonstrated by its signing of the Covenant of Mayors, a voluntary commitment to go beyond EU objectives in reducing CO_2 emissions. As part of this commitment the Council plans to achieve a 34% reduction in emissions over 1990 levels by 2020 rather than the 20% which other authorities are working towards; this is set out in their Sustainable Energy Action Plan (SEAP). The Council is also covered by other commitments such as the CRC Energy Efficiency Scheme (formerly Carbon Reduction Commitment) and becoming a 'low carbon economy' by 2020 is one of the key priorities set out in the Northumberland Economic Strategy.

Building on current achievements: significant progress has already been made in the County with respect to renewable and low carbon energy projects. A number of wind and biomass schemes already operational or with planning consent granted. In addition, the Council - through its Carbon Management Board - is leading on a number of initiatives, such as the Blyth Valley Low Carbon Energy Project where options for an Energy Service Company (ESCO) to deliver a low carbon heating network are being considered.

Providing a framework for low and zero carbon growth: the Council anticipates the need to plan for around **10,000 new homes over the next ten years** together with related employment growth and supporting community infrastructure. A significant proportion of this new development will be centred on the **South East Northumberland Growth Point** which covers settlements including Blyth, Morpeth, Ellington, Cramlington and Ashington. This presents a number of challenges for the Council and developers to respond to:

- Promoting 'sustainable' patterns of growth which support the delivery of low carbon communities served by renewable energy.
- Future proofing developments to ensure that they take account of the government's timetable for 'zero carbon' homes from 2016 and non-residential developments from 2019 given the implications for emerging masterplans (i.e. need to plan for and test the feasibility and viability on-site renewable and low carbon technologies **at the outset**, given likely land-take and cost implications).
- The ambition for "***South East Northumberland* (Growth Point) *to become an exemplar for sustainable development***"[3].
- Balancing the need for higher sustainability standards against the need to ensure development viability and not constrain overall delivery.

National/global priorities vs. local impacts: Northumberland is a predominantly rural area, characterised by high quality landscapes, countryside and towns and villages with valued cultural heritage. One of the central conflicts that the Council will need to balance through the planning process (plan-making and via development control) will be how renewable technologies - fundamental in the global response to climate change and reducing the dependency on fossil fuels - can be delivered in a way which is sensitive to local impacts.

In response to the context, challenges and opportunities identified in Box i the report is presented in three key parts: **Part A** considers the opportunities to reduce emissions from the built environment via efficiency measures, **Part B**

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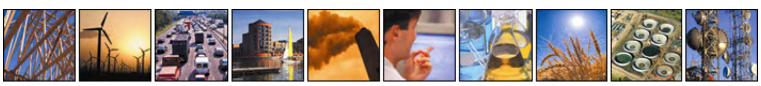
[1] *Planning Policy Statement: Planning and Climate Change*, *Supplement to Planning Policy Statement 1*, DCLG, December 2007

[2] *Planning for Climate Change, Guidance and Model Policies for Local Authorities*, Planning and Climate Change Coalition, November 2010

[3] *South East Northumberland New Growth Point Programme of Development*, October 2008



assesses the renewable and low carbon resource and **Part C** brings the findings together to inform policy development for the LDF.

D. Overview of Main Findings

Baseline and Future CO_2 Emissions from the Built Environment

Reducing CO_2 emissions from Northumberland's built environment is a significant challenge - as at 2008 the demand to heat and power the County's homes, schools and other buildings accounted for 1.5 million (M) tonnes of CO_2 per annum. The largest concentration of these emissions comes from the former authority areas of Blyth Valley, Tynedale and Wansbeck, which each have a demand for heating of beyond 500 Gigwatt hours (GWh) per annum.

Projected development over the next ten years is unlikely to have a *significant* impact on emissions, with the 10,000 homes estimated to be provided by 2021 only resulting in a net increase in emissions of some 5%. This is because the proportion of new growth to existing (10,000 homes vs. an existing building stock of well over 145,000 homes at 2009) is small but, crucially, new homes will be built to higher standards of energy efficiency; standards which are being implemented through national building regulations.

Reducing Emissions in the Existing Built Environment

At a national level the government recognises that responding to emissions arising from the existing built environment is a major priority, which is why they plan to implement a number of initiatives including the recently announced Green Deal which aims to drive the take-up of energy efficiency measures. The role of the planning system and the Northumberland LDF in delivering the range of energy measures necessary to reduce emissions associated with the existing built environment is clearly limited, since planning has most of its influence on new build development. However, there is an important opportunity to consider where planning policy could have a role to play; that is developer contributions towards efficiency schemes within existing buildings to 'offset' emissions associated with new developments. This is likely to have a key role to play in order to achieve the zero carbon standards that new homes are expected to be built to from 2016.

Northumberland's Renewable and Low Carbon Resource

Alongside energy efficiency measures this report explores the range of opportunities for bringing forward renewable and low carbon energy projects to serve both the existing and new built environment. Renewable and low carbon energy projects will be fundamental to reducing CO_2 emissions in response to local commitments and the drive for a Low Carbon Northumberland.

At the outset it is important to note that Northumberland already has significant potential from renewable energy schemes in the pipeline, from wind farms in particular. As at January 2011, almost 290 Megawatts (MW) and over 100 turbines has planning consent across the County on top of the 5MW that is already operational at Kirkheaton and Blyth Harbour. Alongside wind, biomass also makes a contribution, most notably from the Egger plant at

Hexham with an installed capacity of some 50MW (heat). In addition, there is around 8MW installed capacity biomass. At a smaller scale there are operational hydro, landfill gas and solar schemes generating electricity across the County, typically serving specific buildings and developments.

Further understanding is needed on what further potential exists for renewable and low carbon energy schemes and how a supportive policy framework can be provided to encourage its take-up in response to the Climate Change PPS. This is one of the primary focuses of this study, underpinned by a comprehensive Renewable and Low Carbon Resource Assessment (Appendix A).

Tables ii and iii show that there is significant 'technical potential' to supply energy from renewable and low carbon sources, from biomass, waste, wind, hydro and micro-generation. The aim of identifying this technical potential is to provide a comprehensive overview of what potential exists across the County to guide NCC, developers, landowners and local communities. At a practical level only a proportion of this potential is likely to be delivered which will depend on a range of factors, not least the market, developer interest, political will and the future direction of national energy policy. What this study shows however is that the opportunities exist from a range of sources which could have a major role to play as part of an overall strategy for reducing the County's CO_2 emissions, reducing the reliance on fossil fuels, providing greater energy security and to help to support the Council's wider economic ambitions for a low carbon Northumberland.

This technical potential has been estimated from a desk-based analysis reflecting the availability of the resource (e.g. wind speeds, biomass fuel and water flows for hydro) and key constraints such as environmental designations. The aim of this assessment is *not* to identify particular areas as suitable in planning policy terms (e.g. for allocation in the LDF) because this will depend on a range of factors at a project specific level, including consideration of social, economic and environmental impacts. The implication of this is that where potential has been identified in relation to particular areas (e.g. least constrained areas for wind) this does not mean that proposals should be considered favourably by the Council, nor does it mean that proposals for other areas should be rejected as unsuitable.

Table ii Summary of Technical Potential for Renewable and Low Carbon Electricity

Resource	Potential electricity supply (MWh per annum)	Installed Capacity (MW electrical)	Approximate proportion of electricity demand in 2008*
Biomass	1,170,000	170	73%
Waste	50,000	10	3%
Wind	44,700,000	17,020	2779%
Hydro	250,000	60	15%
Micro-generation	70,000	n/a	4%
Total	**46,240,000**	**17,260**	**2874%**

Source: Entec

*DECC energy consumptions figures from 2008 show an existing electricity demand for 1,608,000MWh across the built environment

Table iii Summary of Technical Potential for Renewable and Low Carbon Heat

Resource	Potential heat supply (MWh per annum)	Installed Capacity (MW thermal)	Approximate proportion of heat demand in 2008*
Biomass	3,680,000	660	135%
Waste	180,000	30	6%
Wind	0	0	0%
Hydro	0	0	0%
Micro-generation	290,000	n/a	11%
Total	**4,150,000**	**690**	**152%**

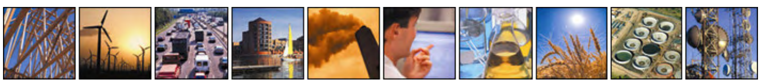
Source: Entec

*DECC energy consumptions figures from 2008 show an existing electricity demand for 1,608,000MWh across the built environment

In considering technical potential the report also identifies some of the key challenges that NCC and others will need to overcome to bring this potential forward, challenges that are in some cases beyond the scope of planning policy (Table iv).

Table iv Overcoming Challenges to Delivery of the Renewable and Low Carbon Resource

Technology	Overcoming key challenges to delivery
Wind turbines	Land ownership and developer interest: *availability of land and whether or not there is developer interest is crucial to understand at the outset* Perceived community impacts/opposition to wind developments: *can be addressed through early engagement/education, as well as exploring opportunities for community ownership/shares in wind farm schemes* Grid connection and capacity: *early liaison with NEDL (distribution network operator) and National Grid for larger schemes* Physical constraints, including highways, access and design (construction & operation): *undertake access feasibility studies when sites identified. Transport Assessment (TA) will be required at planning application stage* Views of stakeholders (MOD, Nats En Route Radar Ltd, microwave link operators, Newcastle Airport, HSE, National Grid - note, list not exhaustive): *early engagement as part of feasibility studies and pre-application discussions* Impacts on landscape, cultural heritage and biodiversity (including cumulative impacts): *likely to be addressed in detailed as part of Environmental Impact Assessment (EIA) process though early understanding of the issues essential. Discussions with Natural England, English Heritage and NCC encouraged at the outset and will help to understand the risks involved*
Biomass, waste and other combustible fuel	Availability of fuel: *although there is locally available biomass and waste, larger scale projects may require fuel to be imported from other regions. The supply of biomass, waste or other fuel is not seen as an overall constraint to development however – where the demand exists the market should be there (locally or further afield)* Impacts associated with heating networks: *biomass, waste and other combustible fuels typically used to serve heating networks, which are associated with a range of challenges to delivery (see below)*



Technology	Overcoming key challenges to delivery
Heating networks with combined heat and power (CHP)	Environmental impacts (e.g. air quality, noise and visual effects): *air quality is a particular issue associated with a high concentration of heating networks/plants in urban areas and unlikely to be a major issue in Northumberland, however where networks are planned air quality and a range of other impacts will need to be addressed, with EIA likely to be required for larger schemes* Costs and delivery (who pays?): *the upfront capital costs associated with the plant and infrastructure are a key issue, particularly for developers of mixed use schemes where heating networks are considered. However many developers are now recognising the need to plan for such networks - in anticipation of higher standards being introduced via Building Regulations - and forming partnerships with energy developers and Energy Services Companies (ESCO) to take these projects on*
Micro-generation in existing development	Funding and financial incentives: *to retro-fit micro-generation within existing housing requires the financial incentive to do so. In some cases individual households are doing so in response to green aspirations, reduced energy bills and financial incentives such as the Feed-in-Tariff. How this can be delivered at a more 'strategic' scale (e.g. across a neighbourhood) is something that needs to be considered alongside energy efficiency schemes which may be cheaper/more effective in terms of reducing emissions. There are examples in the UK of where retrofit schemes of this type have been implemented, such as Birmingham City Council's proposal to fit solar panels to 10,000 Council-owned properties (see main report for further detail). There is also a role for developers of new schemes to contribute to schemes such as this as part of a wider package of measures to 'offset' the emissions associated with their schemes, particularly as we move towards the target of zero carbon homes by 2016 (again, something that is explored in more detail in the main report)* Impacts on historic environment: *the historic nature of Northumberland's towns and villages, which includes designated Conservation Areas and Listed Buildings means that proposals for technologies such as solar PV and solar thermal on roofs of buildings would need careful attention.*
Other opportunities	Identifying specific projects: *for projects such as hydro schemes, solar farms and geothermal opportunities it is much more challenging to identify specific site opportunities as part of a County-wide desktop study such as this. In practice, site investigations and fieldwork will be required to identify specific projects, work which could be pursued by NCC, the private sector or in partnership.*

Spatial implications for the Core Strategy and wider LDF

Significant growth is planned for Northumberland over the next ten years, including the provision of an estimated 10,000 new homes, employment and supporting community infrastructure. Whilst the spatial strategy and distribution of this growth is yet to be determined (it is for examination via the LDF process) it is expected that the South East Northumberland Growth Point will be one of the key areas where this growth will be delivered, comprising several strategic extensions to settlements including Morpeth, Blyth and Ashington. In addition there will be growth across the County's rural areas in response to local needs.

Within this growth context it is crucial to note the current government target for all homes to be 'zero carbon' from 2016 - that is, the energy used to heat and power a dwelling over the course of a year results in no net increase in CO_2 emissions (note: there is also a target for non-residential development to be zero carbon by 2019, but work to support this at a national level is less advanced). Recognising that this is a challenging target, the previous government set up the Zero Carbon Hub to help facilitate discussion and undertake research in order to achieve this ambition. Currently the Zero Carbon Hub are working closely with the government to develop a consistent definition of zero carbon which can be applied consistently via planning and building regulations, focussing in particular on the level of carbon reduction that can be achieved on-site and the off-site measures (most likely financial) that developers will be allowed to pursue.

It is clear that the next five years are hugely significant if this zero carbon standard is to be achieved and the Core Strategy and wider LDF can have a significant role to play in making this happen in Northumberland. Whilst there is a reliance on building regulations and national policy to ultimately drive the housebuilders to this level of performance there is policy that NCC can adopt now to help ensure that zero carbon is taken into account at the outset in the planning and design of new developments.

This study appraises a number of Growth Area sites, setting out what different technologies could achieve and what level of CO_2 reductions could be secured based on current information regarding the level and mix of development. This exercise - along with a similar appraisal of 'typical' developments that are likely to come forward over the next ten years - is intended as a helpful guide for NCC and developers to understand how higher national standards can be delivered.

E. 'Key Priorities' for the LDF

In response to the main findings the study proposes two 'key priorities' for action in the LDF which are outlined as follows:

Key Priority 1: Develop an Overarching Policy Supporting Renewable Energy Projects

The Climate Change PPS requires planning authorities to provide a positive policy framework for renewable and low carbon energy schemes, with the 'need' for schemes not to be questioned. In providing this policy framework in the LDF, particularly for strategic scale and stand-alone schemes, it is important to note the central conflict that the Council faces: responding to national and local commitments for delivering renewable energy projects in response to the global challenges posed by climate change, versus the potential local impacts that these schemes can have on local communities as well as the historic built environment, ecology and landscape. As highlighted in Box i Northumberland is particularly sensitive in terms of its environmental assets. This conflict is something that the Council is already dealing with (as are planning authorities across the country) and demonstrated most notably in relation to recent planning and appeal decisions relating to wind farm proposals in particular.

Whilst the merits of planning proposals can be assessed on a case-by-case base via the development control system, including Environmental Impact Assessment (EIA) where required, it is considered important that the Council has a policy setting out the criteria against which proposals for renewable and low carbon energy schemes will be assessed. Without a regional policy framework[4] and in the likely absence of detailed national policy[5] a locally

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[4] Although currently subject to legal challenge it is likely that the North East Regional Spatial Strategy (RSS) will ultimately be revoked as part of government changes to the planning system. Crucially, the RSS included policy criteria against which renewable energy schemes will be appraised, similar to those identified in Box ii.

[5] As part of changes to the planning system the government plans to withdraw Planning Policy Statements (PPS) and Planning Policy Guidance (PPG) and to replace them with a more concise National Planning Framework. Ultimately, some of the detail

adopted policy setting out how proposals should be assessed is crucial. What is also essential however is that this policy is not overly *restrictive* since NCC still needs to be positive regarding the overall potential of schemes a provide a supportive policy 'hook' in the Core Strategy for developers to respond to. To this end, draft policy wording for testing, consultation and refinement via the LDF process is presented in Box ii.

Box ii. Draft wording for renewable and low carbon energy generic policy

Policy wording and criteria for further testing via the LDF process (emphasis added solely for the purposes of this report)

Proposals for the development of renewable and low carbon energy projects will be supported and encouraged and assessed against the following criteria:

- anticipated effects resulting from development, construction and operation such as air quality, atmospheric emissions, noise, odour, water pollution and the disposal of waste;
- acceptability of the location, and the scale of the proposal and its visual impact in relation to the character and sensitivity of the surrounding landscape;
- effect on national and internationally designated heritage sites or landscape areas, including the impact of proposals close to their boundaries (including Northumberland National Park, Northumberland Coast AONB and North Pennines AONB);
- effect of development on nature conservation sites and features, biodiversity and geodiversity, including internationally designated and other sites of nature conservation importance, and potential effects on settings, habitats, species and the water supply and hydrology of such sites;
- effect of development on cultural heritage and archaeological features, including designated Listed Buildings, Scheduled Ancient Monuments, Registered Parks and Gardens, Conservation Areas, historic settlements and undesignated features where these are considered as having local importance;
- effects on the openness of the Northumberland Green Belt;
- accessibility by road and public transport;
- effect on agriculture and other land based industries;
- visual impact of new grid connection lines;
- cumulative impact of the development in relation to other similar developments; and
- proximity to the renewable fuel source such as wood-fuel biomass processing plants within or close to major woodlands and forests.

Policy justification & basis for supporting text

The type of policy presented here would be applicable to all proposals for renewable and low carbon energy projects, regardless of their size and scale. The level of detailed required would vary depending on the nature of the proposals, with Environmental Impact Assessment (EIA) likely to be required to assess significant effects for larger scale schemes.

The policy provides the supporting hook for developers to respond to (renewable energy projects will be 'encouraged' by the Council) alongside clear criteria to ensure that schemes respond to local impacts. Specific policies for different types of energy project are not deemed necessary - this policy allows the flexibility to respond to schemes from wind farms to solar parks to biomass heating networks.

Key Priority 2: 'Future proof' the Spatial Strategy so that Zero Carbon Aspirations can be Achieved

In response to this challenging timetable for zero carbon development this study recommends that the Core Strategy includes minimum standards for new development reflecting the characteristics of the types of development likely to come forward in the County and its location. These minimum standards are presented in the

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which is in Planning Policy Statement 22: Renewable Energy and Climate Change PPS could be lost, so local policies will become even more important.

form of a draft policy (Box iii) for further testing and refinement via the LDF process. The aim of this policy would be to go with the grain of current best practice in the County and established building regulations rather than go significantly beyond the agreed national timetable. The policy is therefore focussed more on ensuring that developers plan for these future standards to future proof their schemes at the outset. A failure to do so could mean that developers do not fully understand the viability of their scheme (i.e. the costs associated with any necessary renewable or low carbon energy) as well as the risk of having to redesign schemes where provision has not been made (e.g. the land-take to accommodate an energy centre for example).

Box iii. Draft policy wording and requirements for renewable & low carbon energy and sustainable buildings

Policy wording and standards for further testing via the LDF process

PART A. MINIMUM STANDARDS BY DEVELOPMENT SIZE AND TYPE – COUNTY-WIDE

To help ensure that developers plan for higher standards the Council proposes the following minimum standards, but in most cases will expect these standards to be exceeded where the opportunities exist to do so (note: these minimum standards may ultimately be superseded by national amendments to Building Regulations).

Development type	Minimum standard
***All* new residential development, including conversions**	**Code for Sustainable Homes Level 3 overall (or future national equivalent standard)**
Non-residential development	**BREEAM ‘very good’ (or future national equivalent standard)**

In considering the overall sustainability of schemes developers will be required to set out in the Design and Access Statement (or Planning Statement) how the development: i. uses less energy, ii. uses energy efficiently and iii. uses renewable energy.

PART B. REQUIREMENT FOR STRATEGIC SITES (E.G. GROWTH POINT SITES)

Given the size and scale of strategic site allocations (i.e. mixed use and larger developments to be phased over a number of years) developers will be expected to demonstrate how energy efficiency measures and on-site or locally connected renewable/low carbon energy will ensure that:

- Homes built post-2013 will be able to achieve greater than or equal to a 25% improvement on the 2010 DER/TER (commensurate with Level 4 of the Code for Sustainable Homes)
- Homes built post-2016 will be able to achieve greater than or equal to a 100% improvement on the 2010 DER/TER with provisions for ‘zero carbon’ (Code 6).

Provision of funds towards off-site solutions with respect to the 2016 standard is likely to be acceptable pending further guidance from government (e.g. price of carbon etc – this is expected to be announced in 2011).

Policy justification & basis for supporting text

Minimum standards

The minimum standards presented in Part A of the policy are not intended to be overly onerous and will broadly align with best practice development in the County.

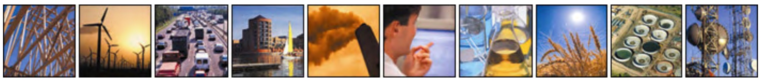
Strategic sites

The Strategic Sites considered as part of this report include those sites within the South East Northumberland Growth Point.

The planning and design of these sites - and other developments which are at planning stage now and likely to be phased over a number of years - needs to address how these targets have been taken into account given land-take and cost implications in particular (particularly where communal scale systems such as heating networks are proposed). Whilst energy efficiency, micro-generation and off-site measures will all have a role to play it will be particularly important to consider the potential for heating networks as is already being considered at Blyth.

The review of Growth Area sites included in this report provides a helpful starting point for developers and NCC to understand what technologies could be suitable for these sites, with the wider appraisal of ‘typical’ developments providing further guidance for other types of site across the County.

Achievement can be tested and monitored via a Code for Sustainable Homes Pre-Assessment submitted at detailed design stage, though would need to be considered carefully at outline stage.



E. Working in Partnership

It is not just NCC who are responsible for the delivery of a low carbon Northumberland. There a wide range of actors alongside the Council including energy developers, residential and commercial developers, landowners and local communities. Table v therefore sets out how this report can be used by these various stakeholders, also reflecting their wider role in successful delivery and implementation.

Table v How this report can be used

Stakeholder	How this report can be used
NCC	To support the development of planning policies and targets for CO_2 reduction in the LDF, including the Core Strategy, Strategic Site Allocations and the Infrastructure Delivery Plan To guide NCC's strategic priorities and investment decisions with respect to where the greatest potential is to deliver low and zero carbon development and renewable energy schemes To help NCC meets its corporate and wider commitments to reducing CO_2 emissions and the Council's response to climate change
Developers	To understand what opportunities exist for renewable and low carbon energy to supply their schemes to help support the achievement of national targets for zero carbon development, for example: ▪ Developers of particular types of site - from infill development to urban extensions - will be able to use the 'typologies assessment' presented in this report as a starting point to compare the types of on-site energy that could be used as part of a scheme and the levels of CO_2 reduction that could be possible (as well as key technical, feasibility and viability considerations) ▪ For developers of Growth Point sites (Cramlington South West Sector, Bates Colliery, Ellington, Cambois, and St George's Hospital), the report takes the conclusions of the typologies assessment further to identify specific recommendations on achieving higher levels of performance, particularly in terms of the opportunities and challenges associated with delivering 'zero carbon' homes from 2016 which needs to be planned for as early as possible in the planning and design process
Energy companies/Energy Service Companies (ESCO)	The larger energy companies and utilities providers in the region are likely to have their own understanding of what resource exists in Northumberland, however this report will still be helpful in terms of providing a comprehensive overview of the different opportunities - including wind, hydro, solar, biomass, communal heating networks and micro-generation. Alongside any existing evidence, the study can therefore be used in parallel for energy companies to identify possible opportunities for investment (including project-specific further feasibility work) With public sector finance continuing to be cut, the private sector will have an ever increasing role to play in the delivery of renewable and low carbon energy projects and exploiting the County's resource. The role of ESCOs could be particularly important
Landowners	The renewable resource presents a significant opportunity for landowners to increase the value of their assets, through accommodating renewable and low carbon energy projects to provide a fixed return over a period of time: e.g. wind farms, solar parks and biomass production. This study, whilst not identifying specific sites/ownership boundaries, will be a key reference point for landowners in the County to consider what potential exists working with developers, investors and the local planning authority to explore what may be possible

Stakeholder	How this report can be used
Local communities	Renewable and low carbon energy projects, particularly at a strategic-scale (e.g. wind farms), need to be sensitively planned in relation to community impacts. The planning process will be the key mechanism to balance these competing views, with Environmental Impact Assessment (EIA) to help mitigate significant community, environmental and economic effects typically required for larger projects. However, the benefits of renewable and low carbon energy schemes can be explored through working with local community groups drawing on the findings of this report (considering factors such as security of energy supply, responding to fuel poverty, responding to climate change and education regarding sustainable living). Local schools and colleges (e.g. Northumberland College) could have an important role to play here. The Localism Bill and associated proposals for Neighbourhood Plans announced by the Coalition Government - whereby local communities are to lead on the plan-making process - presents opportunities for community scale energy projects to the benefit of local people - such as a community owned wind turbine where residents buy shares in a scheme and receive discounted energy bills and income where surplus energy is sold to the grid. Crucially, this is already happening in Northumberland, as demonstrated by the Berwick Community Wind Turbine (see http://www.corecoop.net/index.php?option=com_content&task=view&id=32&Itemid=46 – page last visited February 2011)

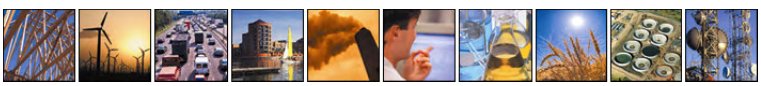
Source: Entec

E. The Next Steps…

The conclusions made in this study are to help inform the emerging LDF, and specifically the Core Strategy. As the plan is still in its early stages of preparation the policy recommendations made in this study will be subject to further testing, consultation, examination and refinement as part of the LDF process. In addition, it is important to note that there are, at present, significant changes pending for the planning system which may result in a need to update and refresh the findings of this report.

There are also a range of measures that can be pursued alongside the LDF, including:

- Preparation of a Supplementary Planning Document (SPD) for sustainable design, renewable and low carbon energy to assist developers in responding to the policies presented in this study;
- Community consultation and education events, working with local schools or colleges (Northumberland College for example);
- Workshops with energy companies, developers and ESCOs active in the area;
- Training event with local planning officers; and
- Detailed feasibility and viability work undertaken in support of specific projects.



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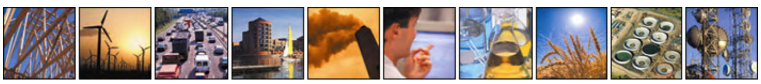

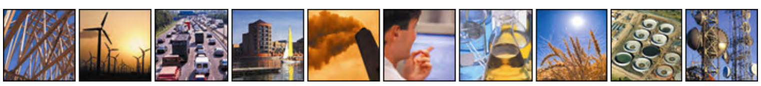

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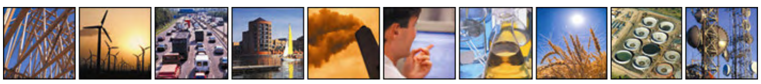


1. Introduction

1.1 Purpose of this Report

This report has been produced by Entec UK Ltd (Entec) to support the development of planning policies in Northumberland County Council's (NCC) Local Development Framework (LDF) which will help support the reduction of carbon dioxide (CO_2) emissions. As the statutory planning authority NCC is required to develop such policies to meet national targets and Council-wide commitments in response to climate change and in order to reduce the reliance on fossil fuels. The fundamental purpose of this report is to provide NCC with a robust evidence base to support the development and implementation of policies in the LDF.

It is important to note that although this study has been specifically commissioned by and written for NCC, the findings will be relevant to a wider audience including local communities, commercial and residential developers, energy companies and landowners.

1.2 Context, Challenges and Opportunities

Northumberland's potential for renewable energy is already well known with a number of schemes operational or in the pipeline: wind most significantly, as well as biomass, solar, hydro and other schemes. For major new developments developers are already actively considering the use of on-site renewable or low carbon technologies. Alongside this, the Council has its own corporate commitments to deliver a low carbon Northumberland, including those commitments set out in their Sustainable Energy Action Plan (SEAP). This study therefore draws on the valuable progress that has already been made, but looks to the future in terms of what opportunities exist and how key challenges can be overcome.

A summary of the overall context for the study is provided in Box 1.

Box 1 Context, challenges and opportunities: delivering a 'Low Carbon Northumberland'

Responding to national planning policies for tackling climate change: national planning policy in the **Climate Change PPS**[6] is clear that local planning authorities should develop policies in their LDFs to reduce CO_2 emissions supported by a robust local evidence base. The PPS sets the context for encouraging the take-up of strategic scale renewable energy schemes as well as requiring new developments to be connected to locally supplied renewable and low carbon energy. The recently published **Planning for Climate Change: Guidance and Model Policies for Local Authorities**[7] provides further details on best practice in planning policy setting.

Local commitments: NCC is already committed to reducing CO_2 emissions in response to climate change demonstrated by its signing of the Covenant of Mayors, a voluntary commitment to go beyond EU objectives in reducing CO_2 emissions. As part of this commitment the Council plans to achieve a 34% reduction in emissions over 1990 levels by 2020 rather than the 20% which other authorities are working towards; this is set out in their Sustainable Energy Action Plan (SEAP). The Council is also covered by other commitments such as the CRC Energy Efficiency Scheme (formerly Carbon Reduction Commitment) and becoming a 'low carbon economy' by 2020 is one of the key priorities set out in the Northumberland Economic Strategy.

Building on current achievements: significant progress has already been made in the County with respect to renewable and low carbon energy projects. A number of wind and biomass schemes already operational or with planning consent granted. In addition, the Council - through its Carbon Management Board - is leading on a number of initiatives, such as the Blyth Valley Low Carbon Energy Project where options for an Energy Service Company (ESCO) to deliver a low carbon heating network are being considered.

Providing a framework for low and zero carbon growth: the Council anticipates the need to plan for around **10,000 new homes over the next ten years** together with related employment growth and supporting community infrastructure. A significant proportion of this new development will be centred on the **South East Northumberland Growth Point (Figure 1.1)** which covers settlements including Blyth, Morpeth, Ellington, Cramlington and Ashington. This presents a number of challenges for the Council and developers to respond to:

- Promoting 'sustainable' patterns of growth which support the delivery of low carbon communities served by renewable energy.
- Future proofing developments to ensure that they take account of the government's timetable for 'zero carbon' homes from 2016 and non-residential developments from 2019 given the implications for emerging masterplans (i.e. need to plan for and test the feasibility and viability on-site renewable and low carbon technologies **at the outset**, given likely land-take and cost implications).
- The ambition for "***South East Northumberland*** **(Growth Point)** ***to become an exemplar for sustainable development***"[8].
- Balancing the need for higher sustainability standards against the need to ensure development viability and not constrain overall delivery.

National/global priorities vs. local impacts: Northumberland is a predominantly rural area, characterised by high quality landscapes, countryside and towns and villages with valued cultural heritage. One of the central conflicts that the Council will need to balance through the planning process (plan-making and via development control) will be how renewable technologies - fundamental in the global response to climate change and reducing the dependency on fossil fuels - can be delivered in a way which is sensitive to local impacts.

6 *Planning Policy Statement: Planning and Climate Change*, *Supplement to Planning Policy Statement 1*, DCLG, December 2007

7 *Planning for Climate Change, Guidance and Model Policies for Local Authorities*, Planning and Climate Change Coalition, November 2010

8 *South East Northumberland New Growth Point Programme of Development*, October 2008

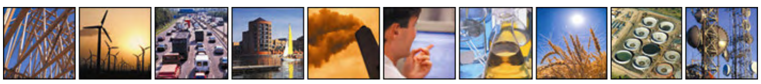
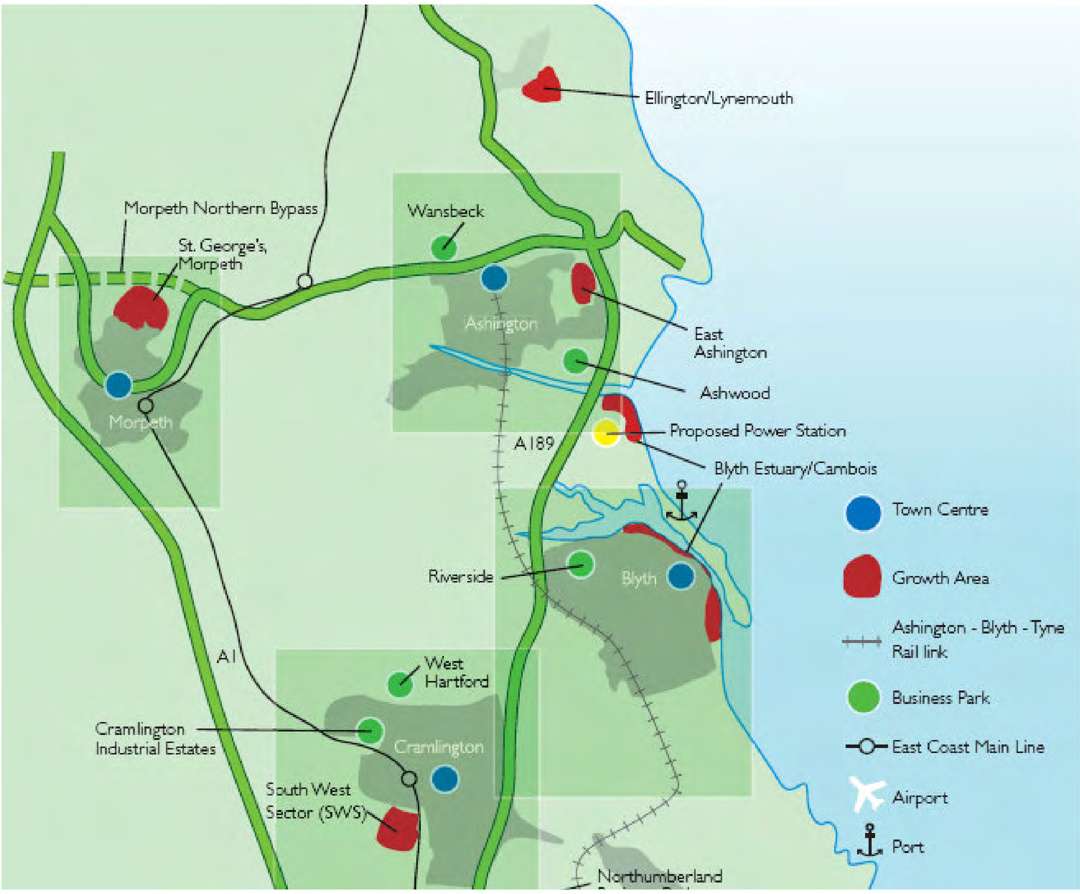


Figure 1.1 South East Northumberland Growth Point



Source: South East Northumberland New Growth Point, Programme of Development, 2008

1.3 Scope and Objectives of the Study

Covering all land within the administrative boundary of NCC, this desktop study concentrates solely on the opportunities for reducing CO_2 emissions associated with energy use from the built environment - i.e. emissions associated with heating and powering the Northumberland's homes, schools, places of work and other buildings.

Specifically focussing on the role of planning policy in reducing emissions, the study also considers the crucial and complementary links with building regulations as part of an overall package of measures. What is outside the scope of this study is consideration of the other factors which will also be essential in reducing the County's overall CO_2 emissions, including social, environmental and transport policy. It is also important to note that in key areas the links are made with Northumberland National Park (a separate planning authority), however the findings, conclusions and recommendations do not relate to the National Park. Cross-boundary working between both Councils in bringing forward renewable and low carbon energy projects will be important however.

As set out in Box 1 one of the primary drivers for this study is the Climate Change PPS. Table 1.1 sets out how the scope and objectives of this study relate to this PPS as well as Guidance and Model Policies for Local Authorities published by the Climate Change Coalition.

Table 1.1 Study Scope and Objectives in response to the Climate Change PPS (Mitigation Focussed)

Climate Change PPS	Response
The PPS is clear that in developing their Core Strategy and supporting planning documents planning authorities should provide a framework which encourages renewable and low carbon energy generation. *"Policies should be designed to promote and not restrict renewable and low-carbon energy and supporting infrastructure"* (paragraph 18) Recent guidance published by the Climate Change Coalition, which can be seen as demonstrating the direction of future policy, adds further emphasis to providing this positive framework for renewable energy	This study provides a comprehensive review of Northumberland's renewable and low carbon resource to guide the Council, developers and landowners as to what potential exists and where In addition, the study presents policy options (for testing via the LDF process) to encourage both strategic scale renewable energy projects as well as on-site renewable energy as part of new developments
The PPS also states that planning authorities should consider defining criteria against which renewable energy projects should be considered alongside policies in PPS22 (paragraph 20). This is something that is also set out in the Climate Change Coalition's guidance	In developing an overarching policy for renewables provision is made for the criteria against which renewable and low carbon energy projects will need to be assessed relevant to the particular characteristics of Northumberland
The PPS identifies the potential to identify 'suitable areas' for renewable or low carbon energy, but adds caution to avoid rejecting proposals solely because they are outside of such areas (paragraph 20). The Climate Change Coalition's guidance goes further, setting the context for the 'allocation' of sites in the Core Strategy	This study identifies areas with potential for renewable and low carbon energy projects but does not recommend 'suitable' areas for particular types of technology in planning terms – this is for the application of planning policy and decision-making on a case-by-case basis What is identified however is where the potential exists and what the opportunities are (e.g. priority areas for communal heating), with an assessment of the technologies that could be employed alongside typical developments and some of the Growth Point sites
Expect a proportion of energy supply to new developments to come from on-site renewable and low carbon sources (paragraph 20) The Climate Change Coalition's provides an emphasis on site and area specific targets	The study includes the testing of Growth Point sites and 'typical sites' to inform targets for adoption in the Core Strategy Recommendations on minimum standards are made at an authority-wide level, as well as specific recommendations on what needs to be planned for at the Growth Point sites

1.4 Method Statement

1.4.1 Overview

The approach adopted in this study is to systematically appraise existing and potential energy efficiency and renewable energy generation across Northumberland, identifying key areas and sites, the role of targets in delivering change, and policies which might be used in the Core Strategy to help implement these targets. The prospects for change focus on three main areas:

- **Existing development**, through improving the energy efficiency of buildings and installation of on-site low-carbon and renewable technologies.
- **New development**, through best practice construction standards and the employment of low-carbon and renewable technologies.
- **Community-wide schemes** which use low-carbon energy systems at a strategic scale, addressing existing and new development together.

The role of spatial planning is of particular importance in effecting change in all three circumstances: at scales from the individual site to County-wide networks, for example, the latter being especially significant in viability terms where technologies such as communal heating schemes demand strategic planning. This broader spatial scale also informs how natural resources such as wind, solar and biomass might be used strategically as part of developing the infrastructure for renewables. In considering the development of local policies for reducing carbon emissions and for sustainable buildings this study focuses solely on the built environment (houses, schools, offices, factories and other buildings) and particularly new build development where planning policies will have the most effect, though there are opportunities to link with the existing built environment that can also be explored. Other factors necessary to reduce emissions, such as sustainable transport measures (which will also be an important part of the LDF), are not included within the scope of this study. The findings of the study and the draft policies that are provided will be subject to further consultation, public examination and testing prior to adoption in the final published LDF.

This study covers all land within the administrative boundaries of Northumberland County. Offshore potential (i.e. in relation to wind, wave or tidal) is not considered. It is important to note that this is a desk-based study, with no site surveys or fieldwork having been undertaken. Findings made with respect to areas with potential for renewable and low carbon energy would need to be assessed at a site- and project-specific level.

1.4.2 Approach by Task

The methodology for tackling the study is divided into nine tasks. These are set out in Table 1.1.

Table 1.2 Study Tasks and Outputs

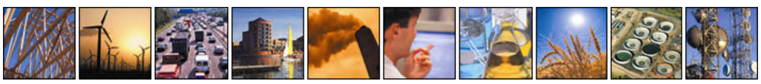
STAGE	TASKS
PART A: REDUCING DEMAND – ENERGY EFFICIENCY AND SUSTAINABLE DESIGN & CONSTRUCTION	
Section 2. Energy Demand and Energy Efficiency in Northumberland	Quantify current CO_2 emissions associated with the built environment using figures from DECC Estimate CO_2 emissions associated with the built environment at 2021 as a result of planned growth
Section 3. The Contribution of Energy Efficiency to Reducing CO_2 emissions in Northumberland	Appraise the opportunities and benefits of a range of energy efficiency measures, including: cavity/solid wall insulation, roof insulation, high performance windows, condensing boilers, advanced building controls and other measures Consider costs and uptake scenarios and what can realistically be achieved
Section 4. Realising Energy Efficiency in New Development: Site and Building Design	Identify site design principles that could form the basis for a future sustainable design and construction SPD Appraise the impacts of the Government's national timetable for delivering zero carbon developments
Section 5. Conclusions on Energy Efficiency in Northumberland	Summary on the potential opportunities that exist to reduce emissions via energy efficiency measures alone
PART B: ENABLING DELIVERY OF A LOW CARBON NORTHUMBERLAND	
Section 6. Approaches to Realising Renewable Energy in Northumberland	Overview of the available technologies that can be considered and their typical scale of application
Section 7. Northumberland's Capacity for Renewable Energy Generation	Assessing the existing contribution that renewables make in Northumberland Considering the potential for additional renewable capacity based on a comprehensive 'renewable resource assessment'
Section 8. Feasibility and Viability of Renewable Energy Schemes	Considering the feasibility and viability of stand-alone renewable energy schemes Appraisal of opportunities for development integrated renewables alongside new development schemes (including Growth Point sites) using a 'Renewable and Low Carbon Technology Appraisal Model'
PART C: POLICY DEVELOPMENT AND DELIVERY	
Section 9. Policy Development for Energy Efficiency and Renewables	Setting out strategic policy considerations for the Core Strategy with respect to the spatial strategy and key sites Review and appraisal of policy models for requiring new developments to reduce emissions/use on-site renewable energy
Section 10. Delivering Energy Efficiency and Renewables	Delivery strategy with respect to both planning policy and the Council's wider activities and programmes
Section 11. Conclusions on Realising Energy Efficiency and Renewables in Northumberland	Summary conclusions and recommendations of key findings from the study and the next steps

Note: specific methodologies for each stage and task are outlined in the relevant section of the report or supporting appendices.

1.4.3 Report Structure

This report is divided into three parts:

Part A considers energy efficiency and the opportunities for its increase across the County, targets which could be set and scenarios and principles for their implementation:



Section 2: Energy demand and energy efficiency in Northumberland - explores the character of current energy demand across the County and opportunities for raising energy efficiency standards.

Section 3: Energy efficiency – considers how energy efficiency measures can be applied to existing buildings in Northumberland, and the levels of CO_2 emissions reductions that could be achieved.

Section 4: Realising energy efficiency through site and building design - sets out key principles for use by planners and developers in making the most of opportunities for new-build and retrofitting schemes, including the demands of building regulations.

Section 5: Conclusions on energy efficiency in Northumberland - a summary of Northumberland's challenges and opportunities in respect of enhancing its energy efficiency performance,

Part B considers how low-carbon and renewable energy sources might be developed across the County:

Section 6: Approaches to realising renewable energy capacity in Northumberland - sets out how renewable energy is best assessed in the context of Northumberland.

Section 7: Northumberland's capacity for renewable energy generation and application - establishes how far renewable energy might be developed in Northumberland.

Section 8: Feasibility and viability of renewable energy schemes - through scenarios, sets out the praticalities of employing schemes at various scales and locations through Northumberland.

Part C explores the delivery of a low-carbon Northumberland through policy development which could assist in realising this through the Core Strategy and delivery mechanisms which will need to employed:

Section 9: Policy development for energy efficiency and renewables - explores templates for policy which might be used in the Core Strategy.

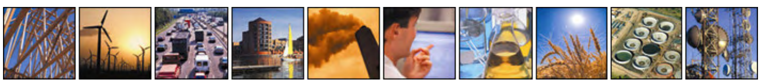
Section 10: Delivering energy efficiency and renewables - sets out the mechanisms which might be employed by Northumberland CC to realise aspirations for energy efficiency and renewables, considering the spatial implications for delivery in particular.

Section 11: Conclusions - reflects on the opportunities for delivering both energy efficiency and renewable energy opportunities across the County, including key areas for moving the agenda forward.

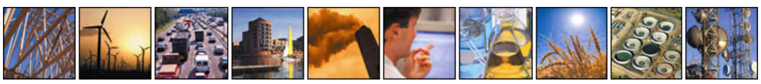
The main body of the report is supported by a Glossary (after section 11) as well as a number of Appendices which provide further detail on the renewable and low-carbon resource assessment. These are as follows:

- Appendix A: Renewable and Low Carbon Resource Assessment;
- Appendix B: Entec's Approach to Estimating the Accessible Wind Resource;

- Appendix C: Renewable and Low Carbon Technology Appraisal Model: Growth Area sites;
- Appendix D: Renewable and Low Carbon Technology Appraisal Model: ‘typical’ developments;
- Appendix E: Renewable and Low Carbon Technology Appraisal Model: Method and Assumptions;
- Appendix F: Low Carbon infrastructure Case Studies; and
- Appendix G: Cost Review of CSH & BREEAM.



Part A: Reducing Demand - Energy Efficiency and Sustainable Design and Construction in Northumberland



2. Energy Demand and Energy Efficiency in Northumberland

2.1 Purpose of this Section

This section of the Report reviews the current patterns of energy demand and related CO_2 emissions across Northumberland, for both energy and heat. The analysis looks at the current performance of the building stock and considers how this is likely to change over time, via demand modelling. A discussion of strategic and local opportunities for realising greater energy efficiency is offered, followed by observations on targets and scenarios for achieving these targets. CO_2 emissions from electrical and thermal energy consumption have been calculated using Defra carbon conversion factors[9].

2.2 Current Energy Demand and CO_2 Emissions

2.2.1 Energy Demand

Table 2.1 sets out Northumberland's annual energy demand from the built environment (i.e. homes, schools, shops etc) as at 2008. It is important to note that this only considers energy use and related emissions associated with homes and employment (industrial and commercial) uses; not from transport or other sectors. 2008 is used as the baseline year because these are the most recent figures published by the Government. This shows that the demand for heat is over double that for electricity. With respect to electricity, some 63% of demand is from the commercial sector and for heat there is a reverse trend, with 60% used in residential buildings.

[9] http://www.defra.gov.uk/environment/business/reporting/pdf/20090928-guidelines-ghg-conversion-factors.pdf, accessed January 2011

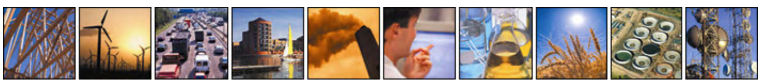


Table 2.1 Energy Demand in Northumberland (2008)

	Energy Consumption (GWh/year)		
	Residential	**Commercial**	**Total**
Electricity	594	1,014	1,608
Gas	2,042	1,366	3,408
*Equivalent gas demand as heat**	*1,634*	*1,093*	*2,726*

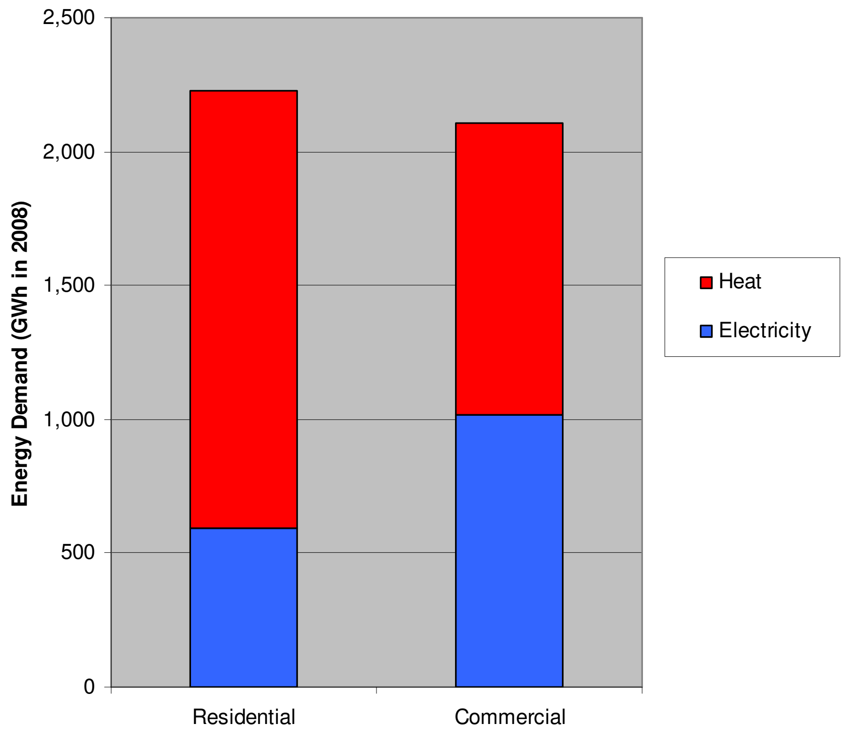
Source: Department of Energy and Climate Change (DECC) (http://www.decc.gov.uk/en/content/cms/statistics/regional/regional.aspx)

Note that 2008 is used as the baseline because these are the most recent figures with respect to both electricity and gas use.

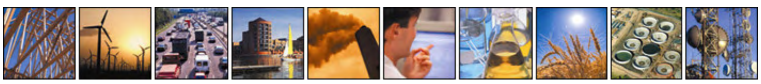
* The equivalent heat demand has been determined by assuming that gas is converted to heat with an average efficiency of 80%. Data on the use of alternative fuels such as oil, coal and biomass are not available in this form so has not been included.

A breakdown of the energy demand by residential and commercial sector is shown in Figure 2.1. This demonstrates there is a fairly even split between the sectors, though the demand for heat is considerably higher in domestic buildings.

Figure 2.1 Energy Demand in Northumberland (2008)



Source: based on figures from DECC, 2008 (see Table 2.1)



The average electricity consumption per household at 2008 was 4,133kWh, which is consistent with the Great Britain[10] average though average gas consumption was 10% higher (18,447kWh compared to a Great Britain average of 16,906kWh), which reflects the local climate and predominantly rural nature of the County. It is also important to note that as a sparsely populated and rural area the energy demand from Northumberland's built environment is less than 1% of the total demand across Great Britain.

2.2.2 CO_2 Emissions

Using the demand figures in Table 2.1 we estimate that Northumberland produces approximately 1.5M tonnes of CO_2 per year from the built environment. An estimated of breakdown of emissions associated with residential and commercial buildings in Northumberland is provided in Table 2.2. Note that this is based only on the electricity and gas consumption, the use of alternative fuels for heating such as oil and wood is not included in this estimate. However, these alternative fuels are only expected to make up a small proportion of the overall demand.

Table 2.2 CO_2 Emissions from Buildings in Northumberland (2008)

	CO_2 Emissions (tonnes per year)		
	Residential	**Commercial**	**Total**
Electricity	329,000	561,900	891,000
Gas/Heat	377,800	252,700	630,500
Total	**706,900**	**814,600**	**1,521,500**

Source: uses energy demand figures from Table 2.1 and assumes a CO_2 factor of 0.554 tonnes of CO_2 per MWh of grid electricity and 0.184 tonnes of CO_2 per MWh of natural gas (Defra, 2009)

A breakdown of the CO_2 emissions by former district (i.e. before Northumberland became a Unitary Authority) is provided in Figure 2.2 and mapped in Figure 2.3.

[10] Note GB only – figures exclude Northern Ireland

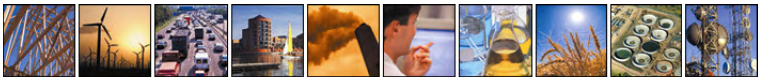
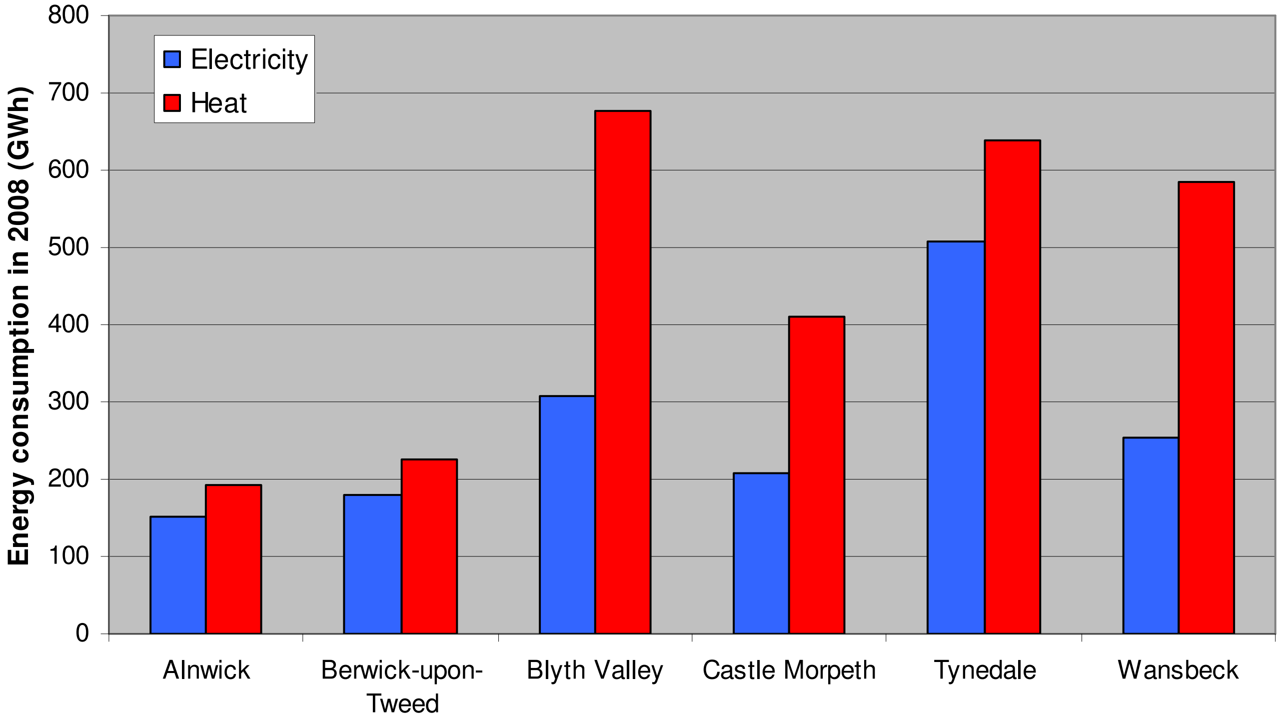


Figure 2.2 **CO_2 Emissions by Former District (2008)**

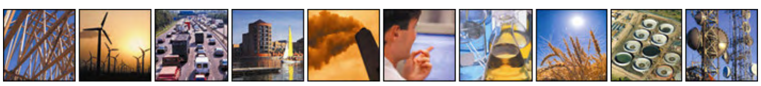


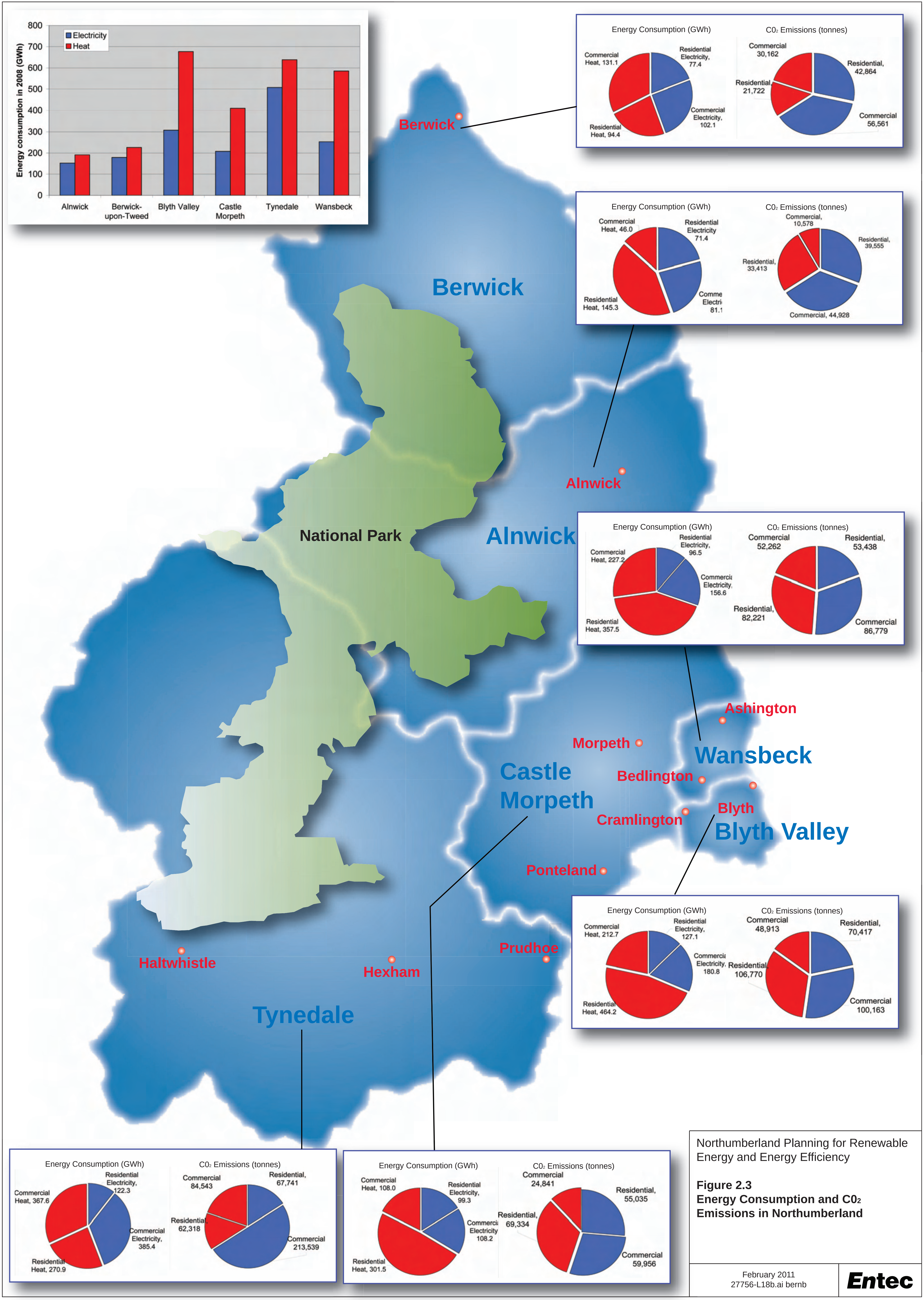
Source: DECC, 2008

Figure 2.2 shows the proportionately higher electricity and heat consumption associated with Blyth Valley, Wansbeck and Tynedale in particular.

2.3 Future Development and Impact on CO_2 Emissions

A simple estimate of the change in electricity and heat demand in Northumberland over the next 10 years (business as usual with no additional energy efficiency measures) has been made by determining the number of additional dwellings planned up to 2020 (Table 2.3). The energy demand and CO_2 emissions associated with electricity and heat use are shown in Figure 2.4 for domestic buildings.





Northumberland Planning for Renewable Energy and Energy Efficiency

Figure 2.3
Energy Consumption and CO_2 Emissions in Northumberland

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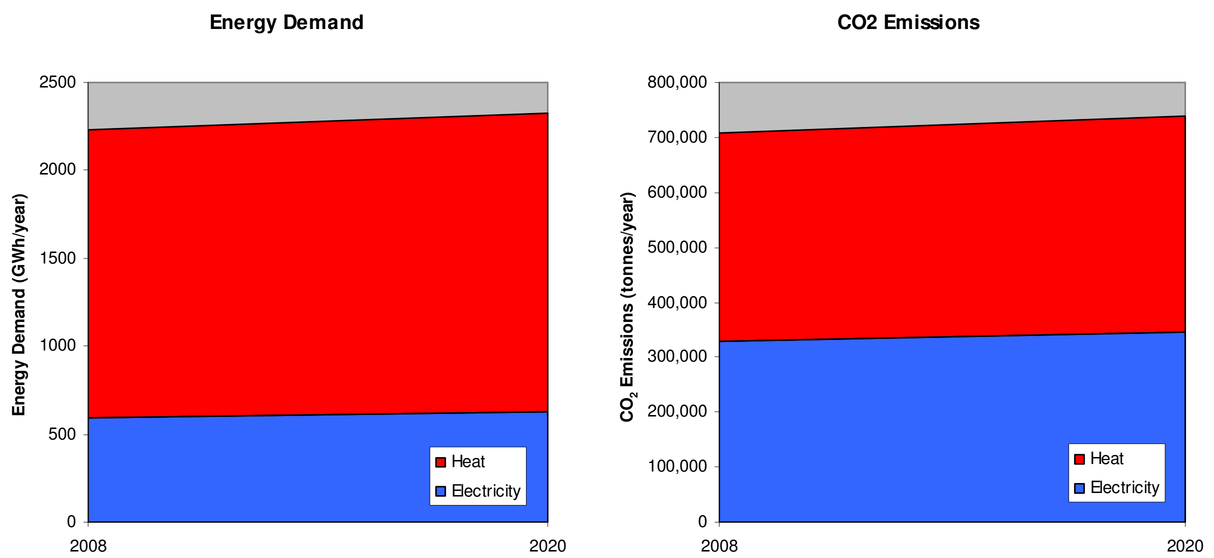
Table 2.3 Housing Stock and Future Growth to 2021

Former district	Total Stock 2009	Detached	Semi Detached	Terrace	Flat	Other	Housing Projection 2004-2021	Built 04/05 - 08/09	Total to be built 2010-2021	% increase 2009-2021
Alnwick	**16,189**	4,957	5,213	4,436	1,557	24	1,635	808	827	5.1
Berwick-upon-Tweed	**14,144**	3,508	4,875	4,098	1,627	38	1,395	720	675	4.8
Blyth Valley	**36,607**	5,535	16,360	9,880	4,799	11	4,650	597	4,053	11.1
Castle Morpeth	**21,987**	8,377	7,212	4,833	1,541	22	2,230	745	1,485	6.8
Tynedale	**27,449**	9,193	8,586	7,279	2,317	74	2,055	971	1,084	3.9
Wansbeck	**29,092**	4,262	9,801	11,608	3,380	38	3,060	953	2,107	7.2
TOTAL	**145,468**	**35,831**	**52,047**	**42,134**	**15,221**	**207**	**15,025**	**4,794**	**10,231**	**7.0**

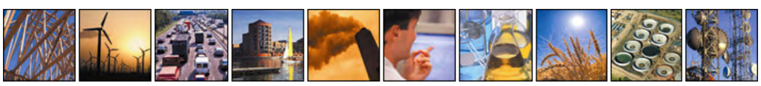
Source: Northumberland AMR 2008/09

Figure 2.4 Increase in Domestic Energy Demand and CO_2 Emissions in Northumberland From 2008 To 2020 Associated with Residential Growth



Source: Entec, based on growth figures from Table 2.3 and CO2 emissions per dwelling based on standard residential benchmarks (see Appendix E)

It can be seen that the increase in emissions due to new development is relatively modest, an increase of approximately 5%. As a proportion of the total emissions (including commercial and industrial buildings) this is smaller still. Hence the vast majority of emissions at present are associated with the *existing* built environment,



with future growth contributing a relatively small amount (despite the projected growth of the housing stock of around 7%). Nevertheless, as illustrated in Table 2.3, some parts of County (notably Blyth Valley) are likely to experience proportionately significant amounts of growth, with commensurate opportunities to ensure that these developments take maximum advantage of both energy efficiency measures and renewable energy infrastructure.

The focus of the analysis regarding growth in this section is on new residential development, but commercial development will have an impact on overall emissions too. At this stage there is little certainty regarding the level of commercial growth that is likely to come forward by 2020 so no estimate has been made, however this is unlikely to affect the key conclusion here - that new growth will be unlikely to have a significant impact on overall emissions; it is the existing built environment that contributes the most.

3. Contribution of Energy Efficiency Measures to Reducing CO_2 Emissions in Northumberland

3.1 Strategic and Local Opportunities

Energy efficiency has an important role to play in reducing CO_2 emissions in the County. Retrofitting existing buildings with efficiency measures such as wall and loft insulation and more efficient boilers is often the most cost effective way to reduce emissions in domestic and commercial buildings alike, whilst providing additional benefits such as reduced fuel bills for occupants and the alleviation of fuel poverty. Whilst there has been some important progress in upgrading the current stock, we assume that on balance, there remain significant opportunities to improve energy efficiency performance across much of the existing building stock. In this section we present the methods and technologies available and the impact they could have on CO_2 emissions in Northumberland.

This section does not consider in detail building integrated renewable or low carbon energy technologies (‘microgeneration’) as these devices do not reduce the energy demand of the building.

3.2 Options for Reducing Demand

Addressing energy efficiency across Northumberland will require a combination of responses, entailing investment in the performance of existing stock of domestic and commercial buildings, (both directly in their fabric and energy-generating technologies used to supply them) and compliance with Building Regulations for new developments. A summary of the key energy efficiency technologies is provided in Box 2. The uptake of such measures depends significantly on the costs.

Box 2	**Energy Efficiency Measures (Domestic)**
Cavity wall insulation	One of the most effective efficiency measures in existing buildings with a cavity wall construction, this involves filling the gap between the walls with insulating material to reduce heat loss.
Solid wall insulation	Homes with single-skin solid walls (particularly applicable to pre-1920s construction) suffer from high heat losses, retrofitting insulation to the inside or outside can have a significant impact on heat loss. 28% of homes in Northumberland have solid walls.
Roof insulation	Insulation of the loft or roofspace of a building to reduce heat loss.
High performance windows	Replacement of single glazing with double or triple glazing.
Condensing boilers	Replacement of old inefficient boilers with high efficiency condensing gas boilers can give significant fuel savings.
Advanced controls	Fitting advanced thermostatic controls can help to regulate internal temperatures and increase overall system efficiency.
Other measures	Additional savings can be made by insulating hot water pipes and tanks, installing smart meters, improving draughtproofing and so on.

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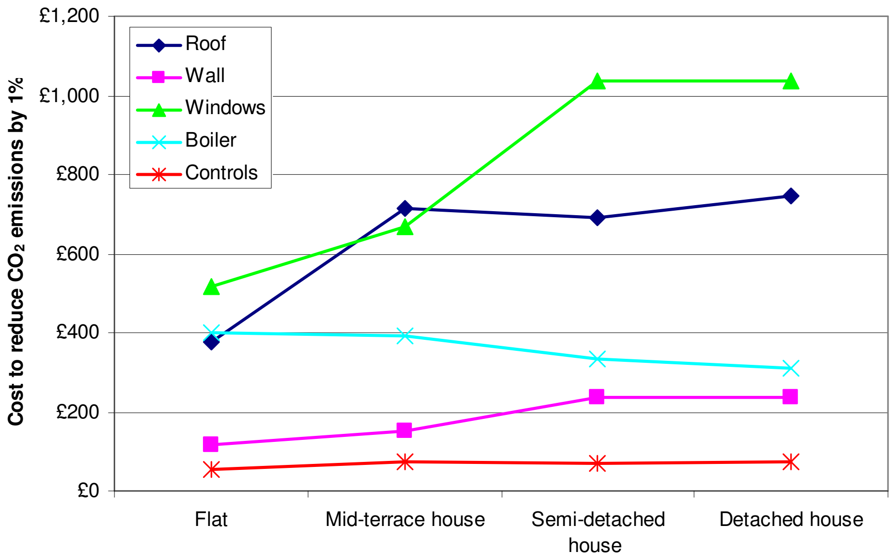
3.3 Domestic Buildings

There is significant scope to reduce energy demand in existing housing via the measures outlined above. The uptake of such measures depends significantly on the costs. Figure 3.1 demonstrates the cost effectiveness of five efficiency measures, when applied in a range of typical poorly insulated domestic buildings with gas boilers/central heating. This shows that the cheapest options for achieving equivalent reductions in CO_2 are typically measures such as thermostatic controls, and that in all cases it is cheaper to retrofit flats and terraced houses. The proportionately higher stock of these in Wansbeck (50%), Berwick (40%) and Blyth Valley (40%) makes these former districts a potentially significant focus of attention.

Figure 3.1 Cost-Effectiveness of Energy Efficiency Measures



Source: Entec, based on figures from a range of sources including the Energy Savings Trust and CIBSE

Table 3.1 summarises the potential to reduce CO_2 emissions in Northumberland's existing housing stock using these five measures. This takes into account the mix of housing type and an estimate of the proportion of buildings that would benefit from efficiency measures (e.g. the proportion of housing assumed suitable for cavity wall insulation).

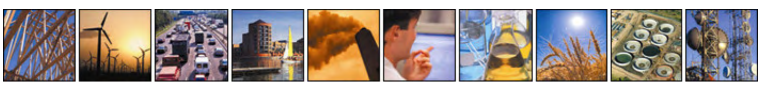


Table 3.1 Potential Average Reductions in CO_2 Emissions Across Northumberland's Existing Housing Stock (No. Dwellings and Mix from Table 2.3)

House Type	Roof Insulation	Wall Insulation	High Performance Windows	Efficient Boiler	Improved Controls	Total
Flat	4%	5%	1%	3%	2%	15%
Terrace	4%	5%	1%	3%	2%	16%
Semi Detached	5%	6%	1%	4%	3%	18%
Detached	5%	7%	1%	4%	3%	20%
Average reduction	**4%**	**6%**	**1%**	**4%**	**3%**	**18%**

Source: Entec, based on figures from a range of sources including the Energy Savings Trust and CIBSE

A potential reduction in emissions of approximately 18% has been identified using the above five measures. In order to consider the likely range of options three possible uptake scenarios have been considered, which has been informed by the relative costs of each measure. This leads to the high, medium and low uptake scenarios described in Table 3.2, along with the estimated reduction in CO_2 emissions from domestic buildings that would result.

Table 3.2 Scenarios for Uptake of Efficiency Measures

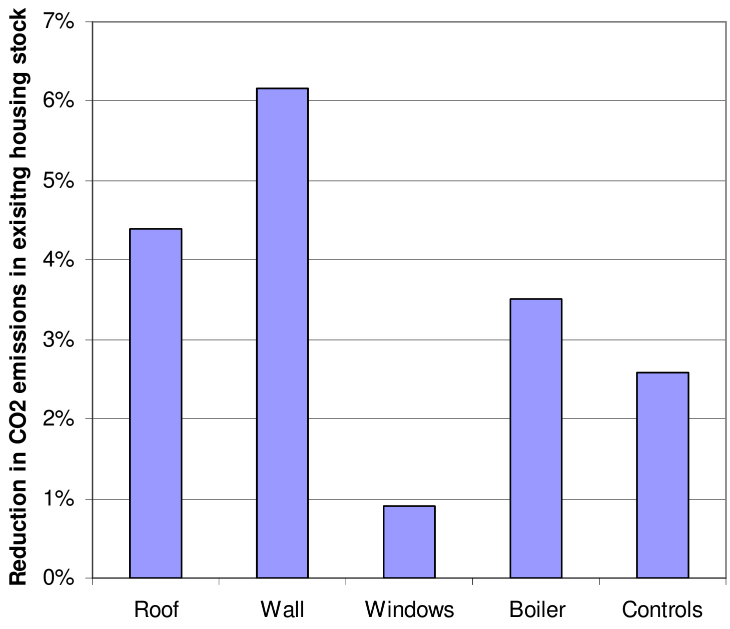
Scenario	Description	Approximate CO_2 emissions reductions
High uptake	All efficiency measures applied	**18%**
Medium uptake	Roof and cavity/solid wall insulation, efficient boilers	**14%**
Low uptake	Cavity/solid wall insulation and efficient boilers only	**10%**

Source: Entec

This suggests that a reduction in CO_2 emissions from domestic buildings of between 10 and 20% should be feasible via a small range of energy efficiency measures. This is equivalent to a reduction in emissions of 5 to 10% in the overall built environment, a significant reduction at relatively low cost. This has other major positive impacts in particular helping to alleviate fuel poverty and reducing the requirement for more expensive low carbon energy generation.

The relative impact of each of the five energy efficiency measures on CO_2 emissions reductions is shown in Figure 3.2.

Figure 3.2 Impact of Energy Efficiency Measures on Existing Domestic CO_2 Emissions



Source: Entec

In order to reduce emissions further it is necessary to consider retrofitting renewable and low carbon technologies is required. These measures are typically much more expensive per unit of CO_2 saved, so it is preferable to initially reduce demand as far as possible prior to considering these systems. The potential for micro-generation to contribute to emissions reductions is considered below.

3.4 The Contribution of Micro-Generation

Although not strictly an energy efficiency measure (as they do not reduce the energy demand of the building), building integrated renewable and low carbon energy systems are another retrofit technology that can reduce the CO_2 emissions from existing buildings.

Analysis of the potential contribution of small scale energy systems to reduce emissions from existing buildings is set out in Appendix A, with the overall results included as part of Section 6. If the ambitions of the Government's Heat and Energy Saving Strategy are to be achieved, then a dramatic increase in the use of building integrated renewables (solar thermal, solar photovoltaics, heat pumps and micro wind turbines) will be needed. An estimate of the potential of three of these technologies (solar thermal, solar photovoltaics, and heat pumps) reveals that a reduction in CO_2 emissions of *up to* 7% is technically possible in Northumberland (see Figure 3.2). However these technologies are generally more expensive to install than most efficiency measures, so it is good practice to first minimise energy demand prior to considering the installation of renewable energy.

3.5 Commercial Buildings

As well as improving existing homes, there is also considerable scope to reduce CO_2 emissions from the commercial and industrial sector. However the large variety of building types and construction methods along with the widely differing uses and processes means it is not straightforward to calculate the potential impact of efficiency measures. However, a report published by the Investment Property Forum in 2009[11] considers the potential CO_2 emissions reductions and costs associated with retrofitting efficiency measures in commercial buildings. The key technologies in commercial buildings are described in Box 3.

Box 3	**Energy Efficiency Measures (Commercial)**
Variable speed pumps	The replacement of fixed speed drives with variable speed drives in heating and cooling systems is relatively straightforward and can give significant savings in electricity used by pumps.
Energy efficient lighting	One of the most straightforward and cost effective measures, suitable for the majority of commercial buildings.
Air conditioning fan coil units	Help to regulate the temperature in a room or rooms, effective where cooling systems exist but can be disruptive to install
Heat recovery systems	Increases the efficiency of air conditioning systems, but again can be disruptive to install
Condensing boilers	Replacement of aging, inefficient boilers with modern high efficiency gas boilers (>90%)
Power factor correction	Technique to reduce losses in the electricity distribution infrastructure
High efficiency chillers	Replacement of existing chillers with a system with a high coefficient of performance

Table 3.3 summarises the typical CO_2 emissions reductions from several types of commercial buildings (note – not Northumberland-specific – analysis based on nationally published data). The 'market standard' figure is for a typical refurbishment using standard like-for-like replacements. The 'maximum' figure assumes the installation of all effective, high specification efficiency measures and represents a realistic limit on CO_2 emissions reductions.

[11] Investment Property Forum, 'Costing Energy Efficiency Improvements in Commercial Buildings', January 2009

Table 3.3 Potential Reduction in CO_2 Emissions from Commercial Buildings

Building Type	Potential CO_2 emissions reductions		Additional costs to move from 'market standard' to 'maximum' (£/m^2)
	Market standard (i.e. low uptake scenario)	Maximum (i.e. high uptake scenario)	
Office (average of a range of types)	26%	56%	£150/m^2 (~£75,000 per typical unit)
Retail (supermarket)	12%	47%	£130/m^2 (~£65,000 per typical unit)
Industrial/Warehouse	35%	66%	£130/m^2 (~£130,000 per typical unit)

Source: Investment Property Forum, 'Costing Energy Efficiency Improvements in Commercial Buildings', January 2009

Table 3.3 indicates that there is considerable potential to reduce CO_2 emissions from the commercial sector using efficiency measures. Even carrying out a typical market standard refurbishment will result in reductions in the region of 10 -35%. By spending a relatively small amount extra (e.g. <10% for offices) it is often possible to go significantly beyond this, which will have long term benefits in terms of reduced fuel costs. The majority of existing commercial buildings will be able to benefit (with only those constructed recently or recently refurbished unable to make significant savings).

3.6 Summary of Findings

The results of this section suggest there is considerable potential to reduce CO_2 emissions via the application of energy efficiency measures to existing buildings. In general basic efficiency measures are more cost effective than most renewable and low carbon technologies, and reducing demand can help to conserve resources and alleviate fuel poverty. A summary of some of the key findings from this analysis is as follows:

3.6.1 Domestic Buildings

- A 10 - 20% reduction in CO_2 emissions from domestic buildings should be possible via energy efficiency measures;
- The low uptake scenario would give approximately 10% CO_2 emissions reductions at relatively low cost;
- The high uptake scenario would give approximately 18% CO_2 emissions reductions, though the additional 8% reduction over and above the low scenario would cost proportionally more. In addition it may be more challenging to encourage certain measures like improved controls and higher performance windows than cavity wall insulation (e.g. due to higher cost. increased disruption to householders, and less well understood technologies for example);

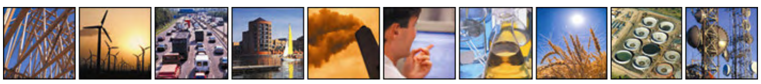
- As a result a minimum of a 10% reduction by 2020 may be a reasonable target to aim for; and
- Overall progress against targets can be measured broadly by considering the total demand for gas and electricity and the average gas and electricity consumption per dwelling, though the impact of growth would need to be considered.

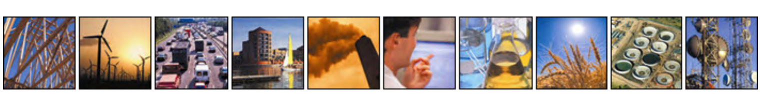
3.6.2 Commercial Buildings

- A 10 - 30% reduction in CO_2 emissions from existing commercial buildings is broadly possible via standard energy efficiency measures. These measures typically have short or very short payback periods. The proportion of buildings that would benefit from such a refurbishment programme is unknown, but expected to be considerable (perhaps greater than 50%);
- Spending slightly above market standard refurbishment (e.g. of the order of £10/m^2 for offices) can as much as double the efficiency savings, with the impact particularly significant in retail buildings;
- It is best to target older buildings as most significant CO_2 reductions can be achieved in this way; and
- Greater than 50% reduction is possible in some cases, though this requires more significant investment and may not be attractive to all businesses.

3.6.3 Overall

It is clear that there is good scope to make significant reductions in CO_2 emissions in Northumberland via the retrofit of energy efficiency measures in existing buildings. Achieving an overall reduction in CO_2 emissions from existing buildings of **10 to 15%** should be feasible via the retrofit of energy efficiency technologies. With sufficient encouragement and support it should be feasible to go beyond this, though achieving overall reductions in excess of 20% will be challenging. Spatially, the higher proportion of flats and terraced housing in the former districts of Wansbeck, Berwick and Blyth Valley suggests that attention could be focused on these areas first in order to make the most significant gains for the least proportionate cost. Rolling out an energy efficiency measures across the housing stock as a whole will inevitably be a long-term process and significant returns will become progressively more difficult and expensive to achieve, particularly when going beyond a 10 - 15% reduction in emissions.





4. Realising Energy Efficiency in New Development: Site and Building Design

4.1 Site Design

Promoting energy efficiency through site design is crucial. At the street or block scale measures include:

- Consideration of the interrelationships between density and built form - higher density development can influence the viability of centralised energy provision.
- Ensuring good levels daylighting within dwellings at every floor level, so optimising passive solar gain.
- Reducing the energy demand of a building or a group of buildings through passive design techniques (such as massing, daylighting or form).
- Shelter, shade, water and plants to produce a microclimate that contributes to low energy design.
- Green roofs and walls can also directly modify the heat transfer characteristics of buildings, thus potentially reducing energy demands, particularly for cooling where green surfaces can reduce unwanted solar gains through the building fabric.
- Choice of house type can have a significant bearing on energy efficiency performance. Figure 4.1 illustrates the energy losses associated with building type, in turn influencing overall site design in terms of dwelling mix.

4.2 Building Design

The most effective way of minimising energy consumption is to design the building to exploit natural forces to best effect, consider the building as a whole, how it is conceived and designed. Air infiltration and conduction losses can be minimised through increased performance standards of the building envelope. When considering the shape of a building the aim should be primarily to keep undesirable heat exchanges between indoors and outdoors to a minimum and therefore the efficiency of the building envelope is of prime concern and several design strategies will be taken into consideration.

Consideration should also be given to designing efficient building forms with a low surface to volume ratio in order to expose the least surface area for a given volume and introducing dense and compact structures by grouping units together in forms of row of houses or apartment buildings. However, this must be balanced with the need for good natural ventilation and daylighting provision, otherwise efficiency savings achieved through minimising heat losses may be negated by the need for mechanical ventilation or artificial lighting. Disadvantaged building geometries should be compensated by improved insulation and adequate solar control. Once the heat loss of a dwelling has been minimised, the objective is to maximise the provision of passive solar heating systems which are based on the collection, storage and distribution of solar energy.

The layout of buildings should be based on the premise that rooms have different temperature requirements and rooms with the highest heating requirements, such as living rooms, should be located where possible on the south side of the building in order to benefit from direct solar radiation. Conversely rooms that require less heat should be orientated to the north. Rooms with a requirement for good daylighting provision, with minimal glare, should be orientated towards the north to take advantage of even northern light. Dwellings should be designed to be flexible, with building zones adaptable to external conditions, allowing activities to be able to migrate to different spaces.

Table 4.1 summarises the main design issues that should be considered at an early stage in order to minimise energy demand.

Table 4.1 Key Design Elements and Approaches in Energy Efficient Building Design

Design element	Objective and design approach
Passive solar building design	Optimise the amount of energy that can be generated directly from the sun and reduce the need for heating appliances. This can be achieved by: • large south facing windows that absorb the sun's heat and daylight • locating the main living areas of the development in south facing rooms to maximise these natural benefits • planting deciduous trees to the south of the building - this will provide shade during summer and allow heat through in winter
Thermal mass	The thermal mass of a building is the ability of a material to absorb heat. Choosing a building fabric that is effective at storing thermal energy is an efficient way of maintaining stable, comfortable temperatures. It also reduces the need for artificial systems and therefore reduces the building's energy demand. Materials with good thermal mass are those that have high specific heat capacity, high density and low thermal conductivity, enabling them to slowly store and release relatively large quantities of heat.
Passive ventilation	Utilise natural ventilation methods to avoid the use of mechanical ventilation.
Insulation	A high level of insulation in any new development is an essential step to an energy efficient design. Mineral wools and oil-based products should be avoided as they are non-renewable, have high embodied energy, are difficult to dispose of and release greenhouse gases during manufacture, installation, use and disposal. There are many types of natural, sustainable insulation on the market, for example hemp natural fibres, recycled cotton, sheep's wool or cellulose insulation (from recycled newspapers).
Lighting	Install fixed energy efficient light fittings to minimise energy consumption and reduce CO_2 emissions. This should include lighting in garages, outbuildings, communal areas and outside security or feature lighting.
Landscaping	Tree canopies and soft landscaping will provide natural shading and insulation. Open water in public places will also help reduce the heat island effect in urban areas.
Energy efficient appliances	These should be installed or specified, for example Combined Heat and Power systems (CHP) or gas condensing boilers.
Bicycle storage	Provision of these facilities will help encourage future occupants to use a bicycle for short journeys and leave the car at home.
Drying space	Provide residents with the option of allowing washing to dry naturally – avoiding the need for heating or drying appliances.
Home office	Office space with internet connection provides the opportunity to work from home, reducing the need to travel especially during peak travel times when roads are heavily congested.
Information packs	Developers should provide all future residents with a home information pack detailing the energy efficiency of the building and environmentally friendly tips to reduce energy use, water use, waste and travel.

Source: based on guidance produced by West Lancashire District Council

4.3 Building Regulations

Figure 4.1 shows the national timetable for sustainable building standards. Of particular relevance is the national timetable for zero carbon homes, with changes to Building Regulations coming into force in October 2010, 2013 and 2016. The standards to which the 2013 and 2016 Building Regulations standards will be based are yet to be determined but broadly they are intended to align with Levels 4 and 6 of the Code for Sustainable Homes respectively.

The Code for Sustainable Homes (the Code) is the national standard for the sustainable design and construction of new homes. The Code aims to reduce our carbon emissions and create homes that are more sustainable. It applies in England, Wales and Northern Ireland.

The Code is not a set of regulations. The Code goes further than the current building regulations, but is entirely voluntary, and is intended to help promote even higher standards of sustainable design. The Code measures the sustainability of a new home against nine categories of sustainable design, rating the 'whole home' as a complete package. It covers Energy/CO_2, Water, Materials, Surface Water Runoff (flooding and flood prevention), Waste, Pollution, Health and Well-being, Management and Ecology.

The Code uses a one to six star rating system to communicate the overall sustainability performance of a new home against these nine categories. The Code sets minimum standards for energy and water use at each level and, within England, replaces the EcoHomes scheme, developed by the Building Research Establishment (BRE).

Table 4.2 National Timetable for Increasing Sustainable Building Standards

	Milestones	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
	HOUSING: MANDATORY REQUIREMENTS (PRIVATE SECTOR)													
CODE FOR SUSTAINABLE HOMES	Code for Sustainable Homes replaces 'EcoHomes' as voluntary assessment rating for houses in England	April												
CODE FOR SUSTAINABLE HOMES	Rating against Code for Sustainable Homes becomes mandatory		May											
CODE FOR SUSTAINABLE HOMES	Period of Stamp Duty Land Tax Relief for Zero Carbon Homes	01 October 2007 – 30 September 2012												
CODE FOR SUSTAINABLE HOMES	Building Regulations (see Building a Greener Future, Policy Statement, 2007). Sets minimum energy standards, which can be related to energy standards in Code for Sustainable Homes (CSH). Note: no government timetable for achieving CSH Levels *overall*. Timetable just relates to energy standards.				25% reduction in carbon emissions from 2006 Building Regulations from October 2010 Energy standard *equivalent* to CSH3			44% reduction in carbon emissions from 2006 Building Regulations from 2013 Energy standard *equivalent* to CSH4			Zero carbon in relation to 2006 Building Regulations from 2016 Energy standard *equivalent* to CSH6			
	HOUSING: MANDATORY REQUIREMENTS (PUBLIC SECTOR – HOMES AND COMMUNITIES AGENCY [HCA] FUNDED[110]													
CODE FOR SUSTAINABLE HOMES	English Partnerships Quality Standards, 2007. Requires *whole* levels of CSH for all EP/HCA owned sites		Require CSH3 2008-2009		Require CSH4 2010-2012			Require CSH6 2013+						
CODE FOR SUSTAINABLE HOMES	Housing Corporation Design and Quality Strategy 2007. Requires *whole* levels of CSH to secure funding for affordable housing		Funding stream requires CSH3 2008-2010			Funding stream likely to require CSH4 2011-2013			Funding stream likely to require CSH4 2014+					
	NON-RESIDENTIAL													
BREEAM	2008 Budget Report. No equivalent BREEAM standard or targets set nationally. Cannot directly relate energy performance measures to BREEAM standards alone										Zero carbon schools & colleges		Zero carbon public sector buildings	Zero carbon non-domestic buildings
BREEAM	English Partnerships Quality Standards, 2007 (applicable to HCA schemes)	BREEAM 'Very Good' for offices and industrial buildings (no compulsory timetable for planned improvements, though note wider timetable for zero carbon non-domestic by 2019												
BREEAM	Department for Children, Schools and Families (DCSF)	BREEAM 'Very Good' for new schools (rating required to secure capital funding). Note timetable for zero carbon schools by 2016.												
BREEAM	Department of Health (DoH)	BREEAM 'Excellent' rating required for new buildings seeking Outline Business Case approval ('Very Good' required for refurbishment projects)												

Source: Entec

5. Conclusions on Energy Efficiency in Northumberland

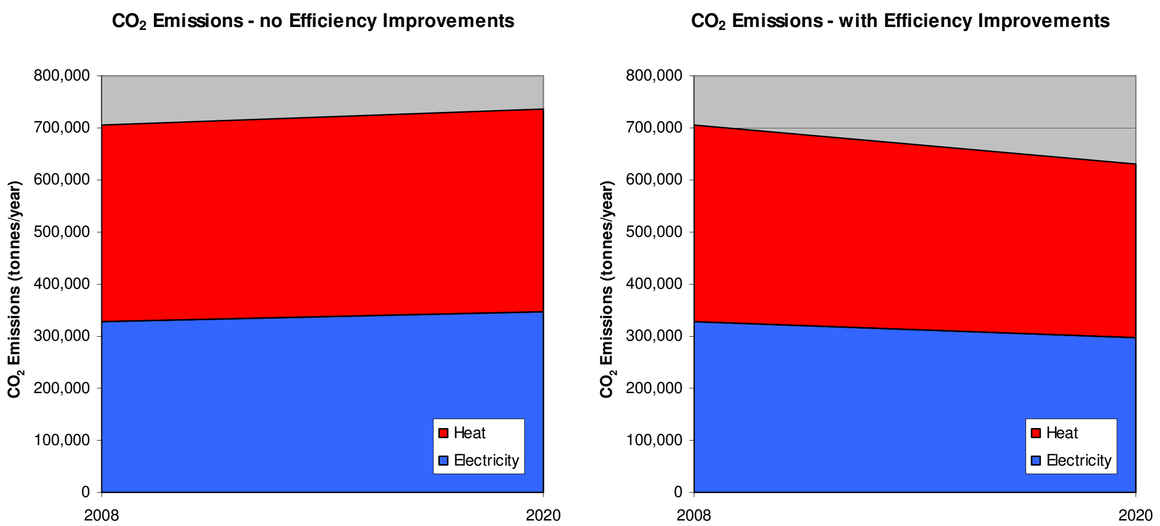
5.1 What Role can Energy Efficiency play in Reducing Emissions?

Gains in energy efficiency across Northumberland can be made through attention on both the existing housing and commercial stock and new build. For new build the progressively greater stringency of Building Regulations as discussed in Section 4 (44% reduction by 2013 and zero carbon by 2016) means that achieving standards will incur significant additional costs on new buildings. However, by far the biggest gains can be made in the existing built environment.

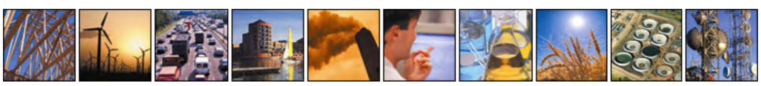
The results of Section 3 conclude that achieving an overall reduction in CO_2 emissions from existing buildings of **10 to 15%** should be feasible via the retrofit of energy efficiency technologies. It should be theoretically possible to go beyond this, though in excess of 20% reductions will be challenging. Rolling out energy efficiency measures across the housing stock as a whole will inevitably be a long-term process and significant returns will become progressively more difficult and expensive to achieve, particularly when going beyond a 10 - 15% reduction in emissions.

Applying energy efficiency measures to existing buildings has a significant impact on the overall CO_2 emissions of the county, as demonstrated in Figure 5.1 (which assumes a 15% reduction in emissions to 2020).

Figure 5.1 Impact of Retrofitting Energy Efficiency Measures on CO_2 Emissions



Source: Entec



The graph on the left represents the 'business as usual' scenario, assuming there is no improvement in the building performance of the existing residential or commercial stock before 2020. The graph on the right shows the situation where a 15% reduction in CO_2 emissions in the existing built environment is achieved as a result of applying energy efficiency measures. **This assumes there is no change in the fuel mix supplying the developments (i.e. natural gas for heating and grid electricity).**

Development of a policy which will address these issues is considered in section 9, following the analysis of renewable potential in Northumberland, entailing factoring in the higher standards, particularly on larger sites which will need to be phased over a number of years. In summary:

- The potential to realise greater energy efficiency in the existing building stock should be the focus of particular attention;
- Equally, large energy users should be targeted for energy efficiency measures;
- Overall CO_2 emissions can be influenced by site and building design. Added to the effect of evolving building regulations, the encouragement of best practice in site layout, higher densities in particular, should be encouraged through policy;
- Retrofitting renewable and low carbon technologies to exiting buildings should only be carried out after the demand has been reduced as far as reasonably possible; and

Opportunities to switch the use of highly polluting fuels oil and coal fuels to low carbon alternatives such as biomass should be taken (this potential is considered in Part B).

5.2 Funding and Key Drivers to Support Energy Efficiency Measures

The uptake of efficiency measures is encouraged in the domestic sector by the following sources of funding and regulatory drivers:

- Carbon Emissions Reduction Target (CERT) - scheme that requires energy suppliers to reduce emissions from the homes they supply. Providing free or subsidised energy efficiency measures (e.g. free low energy light bulbs) is one way that energy suppliers can meet their obligations.
- Warm Zone - this scheme targets various regions including Northumberland and provides support for energy efficiency and other measures with the primary aim of reducing fuel poverty.
- The Green Deal currently being pursued by the Coalition Government to replace the existing Warm Front scheme for reducing emissions and fuel poverty by providing financial support for efficiency measures to low income households (e.g. discounted energy bills).

Funding and drivers for the uptake of energy efficiency measures in commercial sector include the following:

- Carbon Trust Industrial Energy Efficiency Accelerator - provides funding for efficiency measures in a variety of industrial sectors.
- Enhanced Capital Allowances - enable cost savings to be made on the purchase of low energy equipment.
- CRC Energy Efficiency Scheme (formerly Carbon Reduction Commitment) - emissions trading scheme which constitutes a strong driver for companies (above a certain size) to reduce energy demand in the most cost effective manner.

The case study below (Box 3) is an example of a scheme established by a local authority to retrofit solar PV into council owned homes. Whilst it illustrates the complexities of delivering the schemes on a significant scale, particularly concerning the financing arrangements, a similar model could be used for energy efficiency measures (it is noted that solar PV is an expensive technology so this is a high capital cost initiative).

Box 4 Solar installations in Birmingham properties

Proposal: to fit solar panels to 10,000 council owned properties in Birmingham. It is seen as the biggest proposal for retrofitting in the UK to date.

"The plan – Birmingham Energy Savers – will be jointly funded by Birmingham council and investment from energy suppliers and commercial banks, and follows two successful pilot schemes conducted in Europe's biggest local authority. Paul Tilsley, deputy leader of Birmingham city council, said: "Birmingham Energy Savers offers a fantastic opportunity for residents and businesses to cut carbon pollution, and save themselves thousands of pounds by reducing future bills. This scheme will significantly improve the lives of people in Birmingham, setting a green standard beyond that of any city in the world."

Under the scheme, the commercial banks will provide half the up-front investment, supplemented by £25m from the energy companies and £25m borrowed by the council. Consumers will pay a levy on their energy bills to repay the loans but Sandy Taylor, head of the city's climate change unit, said households would still be paying lower bills after the retrofit. The council, run by a Conservative-Liberal Democrat coalition, has been working on the idea of a Birmingham "green new deal" for the past year following the commitment made in 2006 to cut carbon emissions by 60% by 2026. With high levels of unemployment, councillors hope the project to improve the council's housing stock will also create and provide training and protect jobs, and support the growth of green industry in a city still heavily dependent on manufacturing.

The next phase of the programme will involve using the proceeds from the first 10,000 retrofits for a refinancing of the scheme that will deliver funding of £2bn, enough to refurbish 200,000 homes. Taylor said that the council would begin by targeting those households with the greatest social need, singling out people living in fuel poverty or who were particularly vulnerable. Eventually, he added, the plan was to upgrade all 420,000 homes in the city, which would mean moving on from publicly owned homes to those currently owner-occupied or in the private rented sector."

Guardian, 03 October 2010 - http://www.guardian.co.uk/environment/2010/oct/03/birmingham-solar-panel-council-proposal

5.3 The Role of Planning and the LDF

The role of the planning system in delivering the range of energy efficiency measures proposed in this section is clearly limited, since planning has its most influence on *new* rather than *existing* buildings. The ability to retrofit efficiency measures will therefore be driven more by national policies such as the Green Deal. However, there is an important opportunity to consider where planning policy could have a role to play; that is developer contributions towards efficiency schemes within existing buildings to 'offset' emissions associated with new developments which are required to achieve zero carbon standards. This is something that is explored in more detail in Section 9.

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Part B: Enabling Delivery of a Low-Carbon Northumberland

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6. Approaches to Realising Renewable Energy Capacity in Northumberland

6.1 Overview

Part B of this report considers the potential for renewable and low-carbon energy technologies to contribute to energy supply in Northumberland. Starting with an audit of existing capacity and the further 'technical potential' that exists across the County (section 7), detailed consideration is given to the delivery and spatial implications (County-wide and for specific sites) relevant to the take-up and suitability of renewable and low carbon energy projects (section 8).

6.2 Resource Potential

In estimating Northumberland's renewable and low carbon potential we have considered the following resources:

- Wind resource – exploited via wind turbines;
- Biomass resource – potential to use existing arisings from forestry, woodland, parks and gardens and to add existing capacity in the form of energy crops;
- Waste resource - similar to biomass, a range of options including energy from waste and anaerobic digestion;
- Hydro resource - large scale or smaller run-of-river systems using water turbines.
- Geothermal resource - exploiting the earth's internal heat where sufficiently close to the surface to do so. Ground source heat pumps are not included as these systems use stored solar energy close to the surface.

We have also looked at the potential from micro-generation, specifically, heat pumps, solar thermal and solar photovoltaic panels (technologies that can be integrated within buildings). Micro-wind turbines are not considered within this analysis since their success depends on site specific characteristics and local wind speeds, which would require detailed site survey work to ascertain their potential.

Please refer to the Renewable and Low Carbon Resource Assessment in Appendix A for further detail regarding the approach to assessing potential from each of the different sources of supply.

6.3 Deployment Potential

This report also considers the potential to deploy the above technologies to meet Northumberland's targets. Particular reference has been made to the Covenant of Mayors target of a 20% reduction in CO_2 emissions by 2020 and the ability to go beyond this. We have therefore considered the realistic uptake of renewable energy by 2020. This is particularly relevant to the following technologies:

- Wind deployment – consideration of the realistic development trajectory factoring in uptake constraints;
- Biomass deployment – consider the demand that could be realistically supplied via biomass (or other forms of bio-energy), including biomass fuelled communal heating networks in towns and stand alone systems in industrial applications and off-gas properties;
- Hydro deployment - consideration of the realistic development trajectory including reference to ongoing studies.

6.4 Strategic Scale Versus Local Scale

'Strategic scale' refers to plants that are not required to be located close to the demand, i.e. the location is determined by other factors such as the requirement to be located where the resource exists (e.g. wind, hydro) or their location is restricted to specific sites due to regulatory issues (e.g. waste). As a result, strategic scale plants tend to focus on the production of electricity.

'Local scale' plants tend to be smaller scale and co-located with demand, a necessary requirement for the delivery of renewable and low carbon heat. Higher efficiencies can often be achieved but the delivery of such schemes can be more challenging.

Table 6.1 summarises the characteristics of the key renewable and low-carbon technologies, categorised broadly by their suitability at strategic or local scale. Clearly some of these technologies can be used in combination with one another, again at a variety of scales, and there is some crossover.

Table 6.1 Renewable and Low-Carbon Energy Technologies: A Summary of their Character and Application

Technology	Energy source	Character	Typical Scale of Application	Type of energy output
Strategic scale				
Large scale wind	Wind	Large turbines for grid connection. Must be co-located with resource	> 1MW	Electricity
Biomass electricity generation	Biomass	Typically	> 5MW	Electricity
Energy from waste	Waste	Large scale plant for direct or grid connection	>1 MW	Electricity and heat
Hydro-power	Water	Volume and flow-dependent. Must be co-located with resource	Highly variable	Electricity
Geothermal	Earth	Must be co-located with resource	Highly variable	Electricity and heat
Local scale				
Photovoltaics	Sun	Roof-mounted or as stand-alone installation	Single house upwards	Electricity
Micro-wind	Wind	Mounted close to demand for direct supply or grid connection	Single house upwards	Electricity
Ground source heat pumps	Ground	Within curtilage of house	Single house upwards	Heat
Solar hot water	Sun	Roof-mounted	Single house upwards	Heat
Biomass heating	Biomass	Flexible (house or communal)	Single house upwards	Heat
Natural gas or biogas CHP	Biomass/Gas	Minimum numbers, mix and density of houses	Single house upwards	Electricity and heat

Source: Entec

7. Northumberland's Capacity for Renewable Energy Generation

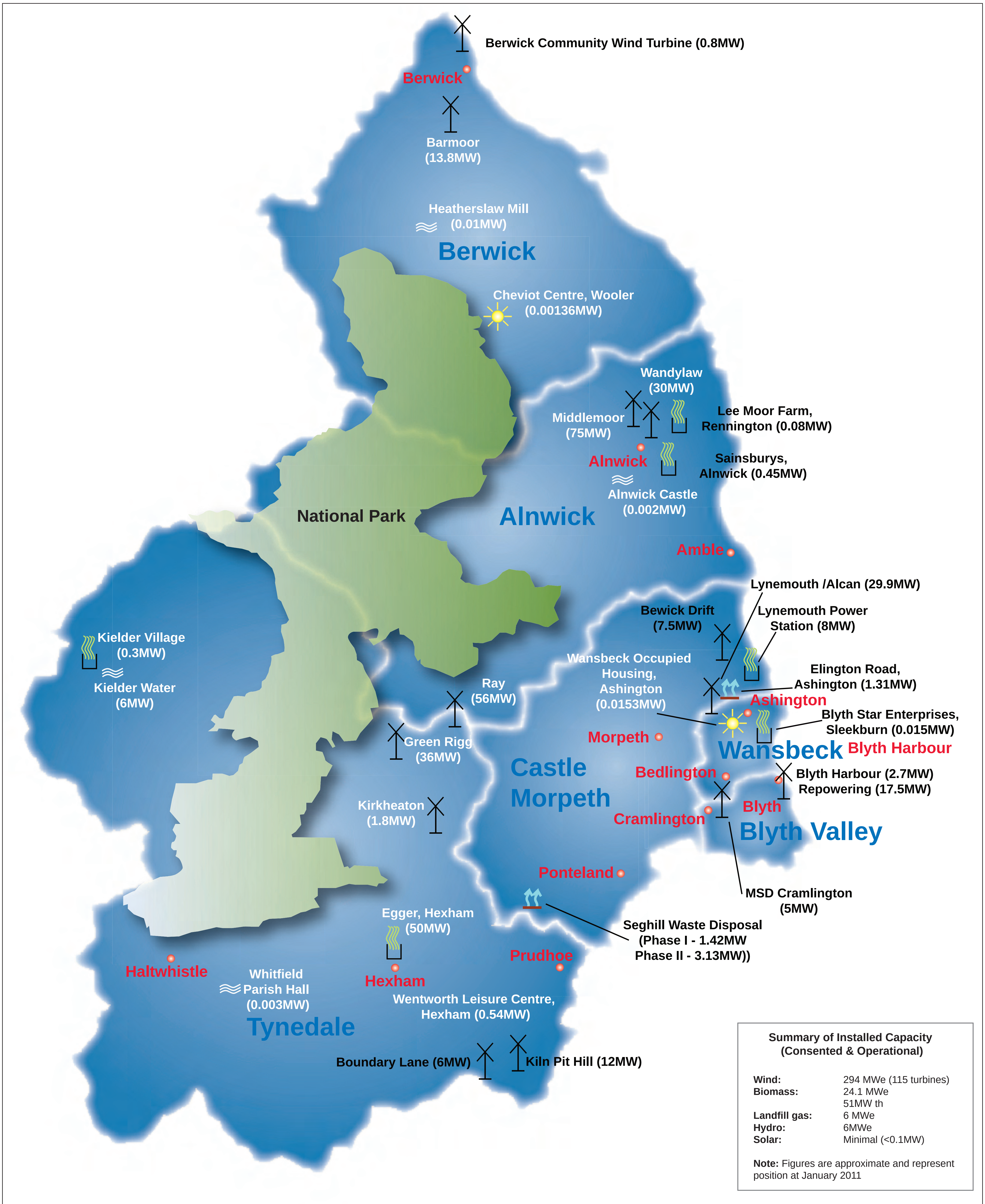
7.1 Existing Contribution from Renewable and Low Carbon Sources across Northumberland

Table 7.1 and Figure 7.1 set out the existing and planned contribution from renewable and low carbon energy schemes. This includes operational schemes and those where planning consent has been granted. This is based on NCC's planning information and represents the position at January 2011. Figures regarding installed capacity should be seen as indicative.

This shows that there is already a significant level of installed capacity from renewable electricity, specifically consented and planned wind farm schemes. Relative to electricity there is only a small level of renewable/low carbon heat associated with the operation Egger biomass plant at Hexham. Given that Northumberland's heat demand accounts for over 40% of total emissions associated with energy demand from the built environment this is clearly an area that the Council needs to address.

Table 7.1 Existing and Planned Contribution from Renewable and Low Carbon Sources: Position at January 2011

Site	Location	Installed Capacity (MW)		Further information (where available)
		Electricity	Heat	
WIND TURBINES				
Operational schemes				
Blyth Harbour Wind Farm	Blyth	2.7	-	9 turbines approved by LPA
Kirkheaton Wind Farm	Kirkheaton	1.8	-	3 turbines approved following Public Inquiry
Consented schemes				
MSD Cramlington	Cramlington	5	-	2 turbines approved following Public Inquiry
Berwick Community Wind Turbine	Berwick	0.8	-	1 turbine approved by LPA
Barmoor	Ford/Lowick	13.8	-	6 turbines approved following Public Inquiry
Boundary Lane	Whittonstall	6	-	3 turbines approved by LPA
Ray	Kirkwhelpington	56	-	16 turbines Approved by Secretary of State (DECC) (S.36/S90)



Key

- Wind
- Hydro
- Biomass
- Solar
- Landfill gas

Northumberland Planning for renewable Energy and Energy Efficiency

Figure 7.1
Northumberland Renewable Energy Capacity: Operating and Permission Granted

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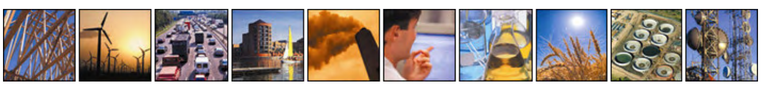
Site	Location	Installed Capacity (MW)		Further information (where available)
		Electricity	Heat	
Wandylaw	Chathill, Alnwick	30	-	10 turbines approved following Public Inquiry
Blyth Harbour Repowering	Blyth	17.5	-	7 turbines approved by LPA
Bewick Drift	Lynemouth	7.5	-	3 turbines (variation app changes to tip height approved) approved on Appeal
Green Rigg	Birtley (nr. Wark)	36	-	18 Turbines approved following Public Inquiry
Kiln Pitt Hill	Nr Shotleyfield	12	-	6 turbines approved following Public Inquiry
Middlemoor	North Charlton, Alnwick	75	-	18 turbines approved by Secretary of State (BERR) (S36/S90)
Lynemouth CMBC	Lynemouth	16.1	-	7 turbines approved on Appeal (hearing)
Lynemouth WDC		13.8		6 turbines approved by LPA
Sub-total of consented and operational capacity		**294**		
BIOMASS				
Operational schemes				
Blyth Star Enterprises	Sleekburn	-	0.015	Talbotts T500 warm air heater. Sleekburn, Northumberland
Egger	Hexham	-	50	Uses offcuts and fines to produce heat for chipboard manufacture
Lee Moor Farm	Rennington, nr Alnwick	-	0.08	Woodchip-fired boiler, with fuel from forest residues at Lee Moor Farm
Lynemouth Power Station	Lynemouth	8	-	Coal fired power station that co-fires biomass. Fuelled by pulverised wood pellets and olive residues. Figure used in the table is an estimate of the equivalent installed capacity of biomass only
Wentworth Leisure Centre, Hexham	Hexham	-	0.54	Installed in 2007
Sainsbury's, Alnwick	Alnwick	-	0.45	Installed in 2008
Consented schemes				
None		-	-	
Sub-total of consented and operational capacity		**8**	**51**	
LANDFILL GAS				
Seghill Phase 2 (Phase 2)	Seghill	3.13	-	Sita Holdings UK
Seghill Village Waste Disposal Site	Seghill	1.42	-	Seghill Village Waste Disposal Site. Owned by Sita UK Ltd.
Ellington Road Landfill Site (extended)	Ashington	1.31	-	Sita Holding UK Ltd, Ellington Road, Newmoor, Ashington



Site	Location	Installed Capacity (MW)		Further information (where available)
		Electricity	Heat	
Sub-total of operational capacity		5.86	-	No consented schemes apparent
SEWAGE GAS				
Hexham STW	Hexham	0.08	-	Northumbrian Water. Only site registered under the Renewables Obligation.
Sub-total of operational capacity		0.08	-	No consented schemes apparent
HYDRO				
Kielder Hydro	Kielder Water	6	-	Located near Hexham. Commissioned in 1984, is currently the largest hydro electricity scheme in England
Alnwick Castle	Alnwick	0.02	-	Restored 19th Century scheme
Whitfield Parish Hall	Whitfield	0.003	-	Micro hydro scheme powering a ground source heat pump which heats the hall
Heatherslaw Mill	Nr Berwick	0.01	-	-
Sub-total of operational capacity		6	-	No consented schemes apparent
SOLAR				
Cheviot Centre	Wooler	0.00136		Building Integrated Owned by Glendale Gateway Trust Wooler, Northumberland
Wansbeck Occupied Housing	Ashington	0.0153		Ashington. BP Solar laminates - bolt on modules owned by Wansbeck District Council
Sub-total of operational capacity		0.02	-	No consented schemes apparent
TOTAL CAPACITY		314	51	

Source: NCC

Note: no information on energy from waste/AD facilities available

7.2 Technical Potential for Additional Renewable and Low Carbon Energy Projects

A detailed assessment of the available renewable and low carbon energy resource in Northumberland has been carried out, with the detail of the process and the results provided in Appendix A. The key findings are set out in this section.

Tables 7.2 and 7.3, alongside Figure 7.3 show that there is significant 'technical potential' to supply energy from renewable and low carbon sources, from biomass, waste, wind, hydro and micro-generation. The aim of identifying this technical potential is to provide a comprehensive overview of what potential exists across the County to guide NCC, developers, landowners and local communities. At a practical level only a proportion of this potential is likely to be delivered which will depend on a range of factors, not least the market, developer interest, political will and the future direction of national energy policy. What this study shows however is that the opportunities exist from a range of sources which could have a major role to play as part of an overall strategy for reducing the County's CO_2 emissions, reducing the reliance on fossil fuels, providing greater energy security and to help to support the Council's wider economic ambitions for a low carbon Northumberland.

Table 7.2 Summary of Technical Potential for Renewable and Low Carbon Electricity

Resource	Potential electricity supply (MWh per annum)	Installed Capacity (MW electrical)	Approximate proportion of electricity demand in 2008*
Biomass	1,170,000	170	73%
Waste	50,000	10	3%
Wind	44,700,000	17,020	2779%
Hydro	250,000	60	15%
Micro-generation	70,000	n/a	4%
Total	**46,240,000**	**17,260**	**2874%**

Source: Entec

*DECC energy consumptions figures from 2008 show an existing electricity demand for 1,608,000MWh across the built environment

Table 7.3 Summary of Technical Potential for Renewable and Low Carbon Heat

Resource	Potential heat supply (MWh per annum)	Installed Capacity (MW thermal)	Approximate proportion of heat demand in 2008*
Biomass	3,680,000	660	135%
Waste	180,000	30	6%

Resource	Potential heat supply (MWh per annum)	Installed Capacity (MW thermal)	Approximate proportion of heat demand in 2008*
Wind	0	0	0%
Hydro	0	0	0%
Micro-generation	290,000	n/a	11%
Total	**4,150,000**	**690**	**152%**

Source: Entec

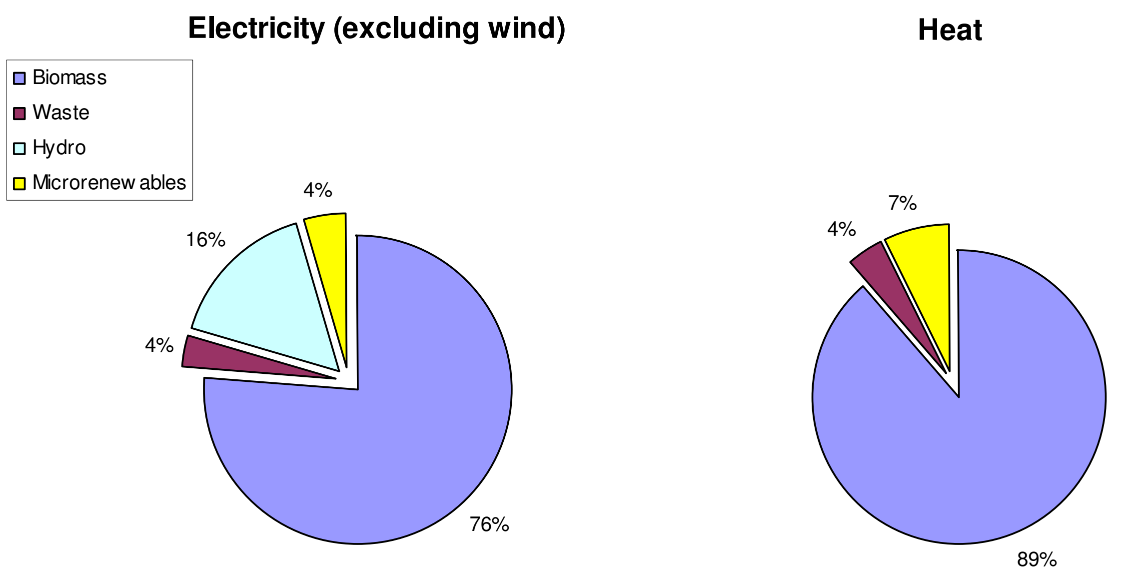
*DECC energy consumptions figures from 2008 show an existing electricity demand for 1,608,000MWh across the built environment

The relative contribution of each resource is shown in Figure 7.2 and approximate locations in Figure 7.3. It is crucial to note that this technical potential has been estimated from a desk-based analysis reflecting the availability of the resource (e.g. wind speeds, biomass fuel and water flows for hydro) and key constraints such as environmental designations. The aim of this assessment is *not* to identify particular areas as suitable in planning policy terms (e.g. for allocation in the LDF) because this will depend on a range of factors at a project specific level, not least consideration of social, economic and environmental impacts. This means that where potential has been identified in relation to particular areas (e.g. least constrained areas for wind) this does not mean that proposals should be considered favourably by the Council, nor does it mean that proposals for other areas should be rejected as unsuitable.

The potential contribution from wind has been excluded for clarity as this resource makes up 96% of the technical potential from renewable. This demonstrates that after wind it is biomass that has the greatest potential to contribute to both electricity and heat supply in the County. However, it is important to note that the actual technical potential is often unrelated to the realisable potential.

For example, significant technical potential for hydro has been identified, though as this is made up predominantly of a large number of small schemes and the actual realisable resource is expected to much less than this. The uptake of biomass relies on the establishment of supply chains, so although the majority of the technical potential is exploitable, it may take significant time to develop the resource and there is competition for other uses. Conversely, micro-generation and waste have a relatively low technical potential, but it should be feasible and often economically viable to exploit the majority of these resources in relatively short timescales. The realistic uptake is considered in more detail in section 7.3, and this analysis demonstrates the ‘gap closing’ between the different technologies to some extent when uptake constraints and timescales are considered.

Figure 7.2 Relative Technical Potential of Renewable and Low Carbon Energy in Northumberland



Source: Entec

The technical potential for renewable and low carbon energy in Northumberland is very high. The county is in an enviable position regarding the potential to reduce CO_2 emissions as there is both a very high resource and a relatively low energy demand, meaning that the county could feasibly meet all its energy needs locally, even becoming a net exporter of renewable electricity.

However realising this potential is not straightforward, and will take significant time even under the most optimistic of uptake estimates. In addition it is unlikely to be practical, viable or even desirable to exploit the resource fully, and so it is necessary to consider what level can realistically be exploited in reasonable timescales. This is an essential step when moving towards target setting.

7.3 Uptake Scenarios

In order to convert the technical potential to an estimate of the realistic uptake potential, a number of scenarios have been analysed which reflect technical constraints likely to affect the uptake rate (i.e. it is essentially an estimate of deployment rates by technology for the next ten years). A key driver for uptake of renewable energy in Northumberland is the Covenant of Mayors target of reducing CO_2 emissions by 20% by 2020. Hence we have considered 2020 as the target year. The scenarios that have been considered are set out in Table 7.4.

A brief summary of how projections have been made for each technology is provided in Box 3.

Key:

- County Boundary
- Urban Boundary
- Least constrained areas for Wind *
- Hydro Potential
- Forested Areas (biomass resource potential)
- B Areas with potential for >10 gwh / year of heating biomass

* Note: relects technical and environmental constraints only - refer to main report for further detail

Northumberland Planning for Renewable Energy and Energy Efficiency

Figure 7.3
Potential locations for renewable energy sources

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What is crucial to note here is the range of other factors that will ultimately affect the uptake of renewable energy schemes, not least market and economic conditions and the level of political will in local planning decisions.

Table 7.4 Uptake Scenarios to 2020

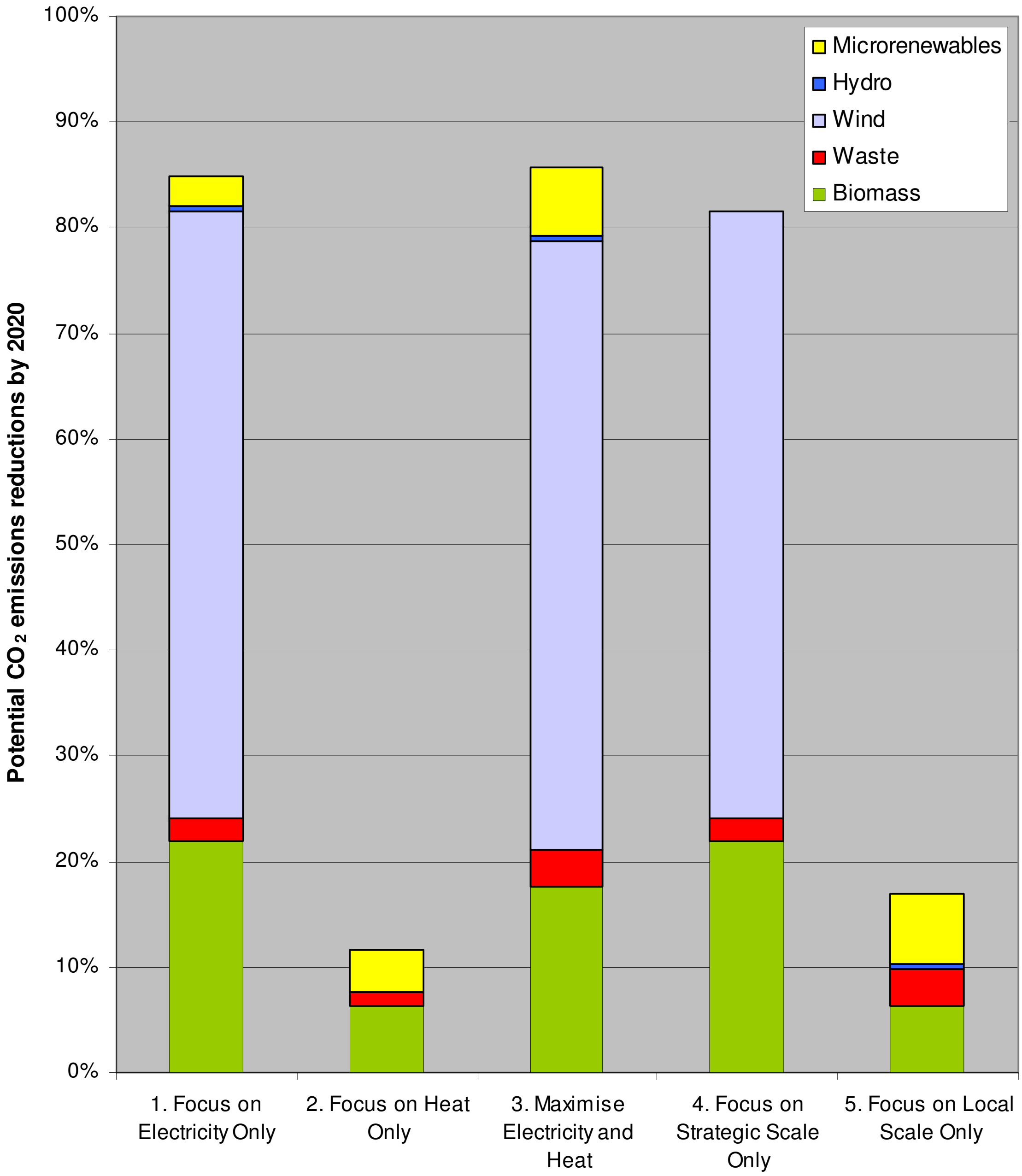
Scenario	Description
1. Electricity only	Maximise renewable electricity generation. No take-up of renewable heat.
2. Heat only	Maximise renewable heat generation. No take up of renewable electricity.
3. Maximise electricity and heat	High uptake scenario in which both renewable electricity and heat are maximised.
4. Strategic scale only	Only consider large scale generation of electricity (>1MW), i.e. strategic scale wind, biomass and waste. Excludes hydro as the vast majority of potential is at small scale.
5. Local scale only	Only consider small scale generation that is linked to existing and future development, i.e. maximise biomass and waste for heating, microgeneration and small-scale hydro.

Source: Entec

Box 5	**Estimate of developable potential by 2020 for informing uptake scenarios**
Wind	Scenarios 1, 3 and 4 - takes existing consented wind farms in planning system, then adds additional capacity based on following an estimated uptake curve for the UK (based on historical trends) and projections for onshore wind by 2020. Scenario 2 and 5 – no contribution from large scale wind
Biomass	Scenario 1 – assumes all existing biomass resource used for electricity generation. Energy crops excluded. Scenario 2 - assumes all heat demand identified in section 8.2.5 is supplied from biomass. Remaining resource not exploited for energy purposes. Scenario 3 – 5 – assumes all heat demand identified in section 8.2.5 is supplied from biomass, remaining existing resource used for electricity generation. Energy crops excluded
Waste	Scenarios 1 and 4 - assumes entire technical potential harnessed for electricity generation Scenarios 2, 3 and 5 – assumes entire technical potential used in CHP plant
Hydro	Scenarios 1, 3 and 5 - assume only the potential identified by recent surveys of the River Tyne and catchment areas is exploited, and only the 'win-win' schemes are developed. Scenarios 2 and 4 – no uptake of hydro
Micro-generation	Scenario 1 – assumes only PV developed Scenario 2 – assumes only solar thermal and heat pumps developed Scenario 3 and 5 - assumes entire technical potential developed Scenario 4 – no micro-generation

The overall level of carbon dioxide emissions reductions and the breakdown by technology for each scenario is shown in Figure 7.4.

Figure 7.4 Potential CO_2 Emissions Reductions by Scenario by 2020



Source: Entec

The appraisal of scenarios and Figure 7.4 reveal some key findings:

Meeting Existing Targets and going Beyond

- The SEAP target of a 34% reduction in emissions by 2020 **should be feasible via the development of renewable energy alone,** so long as the focus is not purely on heating or electricity generation at a local level. It should also be possible to go significantly beyond this level of reductions, but the viability of doing so will depend largely on economic factors and political will.

- Wind has by far the greatest potential to reduce CO_2 emissions of the renewable energy technologies in Northumberland.

- If all currently consented wind farms are constructed this would reduce CO_2 emissions from the built environment by 25-30%. This demonstrates that the existing targets are achievable.

- It should be technical feasible possible to meet the 20% Covenant of Mayors target by either wind or biomass electricity generation alone, though encouraging a mix of technologies will allow greater CO_2 reductions to be achieved.

Renewable Electricity versus Renewable Heat

- There is much more potential for reducing emissions from electricity than heat in Northumberland. This is largely a function of the good wind and hydro resource, good opportunities for large biomass electricity plants, low population density and the limited potential for large scale heating networks.

- Focusing solely on renewable electricity gives similar emissions reductions to the scenario where both renewable heat and electricity are maximised. The most appropriate mix will depend primarily on non-technical constraints and economics.

Other Key Considerations

- At a local scale it may be more cost effective to reduce demand for electricity and heat via energy efficiency measures prior to, or alongside, the development of renewable energy systems.

- There may be good potential to export biomass outside the county if it is not used internally, which could lead to economic benefits and job creation in the county.

- High penetration of renewables gives greatly increased energy security and less exposure to fluctuating energy prices and foreign imports, so there are drivers other than purely reducing CO_2 emissions.

7.4 Other Factors Affecting Delivery

Table 7.5 summarises potential from the different technologies considered as part of the assessment and should be read alongside Figure 7.3. Table 7.6 identifies particular constraints that need to be noted with respect to the delivery of each resource.

Table 7.5 Renewable Energy Sources in Northumberland - Key Resources, Locations and Technical Potential

Technology	Extent of resource	Key locations	Technical potential
Large/medium scale wind	Widespread with very high technical potential identified	Majority of potential in northern and central regions	High
Biomass (solid)	Good resource, majority from existing forested areas. Good potential for energy crops given land area potentially available.	National Park for existing biomass (note although outside of study area but clear biomass potential identified)	High
Biomass (other)	Significant potential for farm slurry for treatment in anaerobic digestion	No key locations - challenging to collect given highly dispersed nature of arisings	Medium
Communal heating with CHP	Some potential in towns, but limited. Majority of potential from future development associated with Growth Areas	Growth Areas and heat priority areas (see section 8 for further exploration)	Medium
Micro-generation in existing development	Generally good. Low population density and high proportion of off-gas housing presents opportunities (over 20% of existing housing is off-gas)	Off gas areas, social housing	High
Hydro energy	Good, widespread potential, though mostly small scale run-of-river schemes with low output	North and South Tyne and catchment areas	High
Energy from waste	No potential from municipal waste, but commercial waste offers some opportunities	Energy recovery plant best located close to population centres to maximise CHP potential	Medium
Energy from sewage and landfill	Generally exploited where viable, relatively low population growth so unlikely to significantly increase resource	None	Low/unknown
Geothermal energy	Limited, detailed assessment including site investigations required	Unknown	Low/unknown

Table 7.6 Overcoming Challenges to Delivery of the Renewable and Low Carbon Resource

Technology	Overcoming key challenges to delivery
Wind turbines	Land ownership and developer interest: *availability of land and whether or not there is developer interest is crucial to understand at the outset* Perceived community impacts/opposition to wind developments: *can be addressed through early engagement/education, as well as exploring opportunities for community ownership/shares in wind farm schemes* Grid connection and capacity: *early liaison with NEDL (distribution network operator) and National Grid for larger schemes* Physical constraints, including highways, access and design (construction & operation): *undertake access feasibility studies when sites identified. Transport Assessment (TA) will be required at planning application stage* Views of stakeholders (MOD, Nats En Route Radar Ltd, microwave link operators, Newcastle Airport, HSE, National Grid - note, list not exhaustive): *early engagement as part of feasibility studies and pre-application discussions* Impacts on landscape, cultural heritage and biodiversity (including cumulative impacts): *likely to be addressed in detailed as part of Environmental Impact Assessment (EIA) process though early understanding of the issues essential. Discussions with Natural England, English Heritage and NCC encouraged at the outset and will help to understand the risks involved*
Biomass, waste and other combustible fuel	Availability of fuel: *although there is locally available biomass and waste, larger scale projects may require fuel to be imported from other regions. The supply of biomass, waste or other fuel is not seen as an overall constraint to development however – where the demand exists the market should be there (locally or further afield)* Impacts associated with heating networks: *biomass and AD typically used to serve heating networks, which are associated with a range of challenges to delivery (see below)*
Heating networks with combined heat and power (CHP)	Environmental impacts (e.g. air quality, noise and visual effects): *air quality is a particular issue associated with a high concentration of heating networks/plants in urban areas and unlikely to be a major issue in Northumberland, however where networks are planned air quality and a range of other impacts will need to be addressed, with EIA likely to be required for larger schemes* Costs and delivery (who pays?): *the upfront capital costs associated with the plant and infrastructure are a key issue, particularly for developers of mixed use schemes where heating networks are considered. However many developers are now recognising the need to plan for such networks - in anticipation of higher standards being introduced via Building Regulations - and forming partnerships with energy developers and Energy Services Companies (ESCO) to take these projects on*
Micro-generation in existing development	Funding and financial incentives: *to retro-fit micro-generation within existing housing requires the financial incentive to do so. In some cases individual households are doing so in response to green aspirations, reduced energy bills and financial incentives such as the Feed-in-Tariff. How this can be delivered at a more 'strategic' scale (e.g. across a neighbourhood) is something that needs to be considered alongside energy efficiency schemes which may be cheaper/more effective in terms of reducing emissions. There are examples in the UK of where retrofit schemes of this type have been implemented, such as Birmingham City Council's proposal to fit solar panels to 10,000 Council-owned properties (see main report for further detail). There is also a role for developers of new schemes to contribute to schemes such as this as part of a wider package of measures to 'offset' the emissions associated with their schemes, particularly as we move towards the target of zero carbon homes by 2016 (again, something that is explored in more detail in the main report)* Impacts on historic environment: *the historic nature of Northumberland's towns and villages, which includes designated Conservation Areas and Listed Buildings means that proposals for technologies such as solar PV and solar thermal on roofs of buildings would need careful attention.*
Other opportunities	Identifying specific projects: *for projects such as hydro schemes, solar farms and geothermal opportunities it is much more challenging to identify specific site opportunities as part of a County-wide desktop study such as this. In practice, site investigations and fieldwork will be required to identify specific projects, work which could be pursued by NCC, the private sector or in partnership.*

8. Spatial Considerations Affecting the Delivery of Renewable and Low Carbon Energy Schemes

8.1 Introduction

This section explores the key spatial considerations which will affect the delivery of the renewable and low carbon resource and provides the evidence base to support target setting for particular areas/sites and strategic site allocations in the South East Growth Point.

8.2 Renewable and Low Carbon Electricity: Spatial Considerations

8.2.1 Overview

The potential exists for renewable and low carbon electricity across Northumberland, most significantly for wind farms, typified by the significant level of installed capacity that already has planning consent and the further technical potential that has been identified in this report. Other options such as hydro, biomass and solar will also have a role to play pending further work to identify potential schemes at a project-specific level using the findings in this report as a starting point.

One of the key issues affecting delivery of renewable and low carbon electricity projects is capacity of the grid to accommodate schemes (as well as distance and connection costs). Whilst these are not necessarily insurmountable constraints to projects coming forward they are important consideration. This section of the report provides an initial overview of the key issues.

8.2.2 Transmission Networks and Distribution Networks

The UK is covered by the Transmission and Distribution networks; Transmission networks (TN) in England typically operate at 275kV and above whereas the Distribution network (DN) generally operates between 132kV and 240V supplied to domestic customers (National Grid operates the TN and NEDL is the DN operator [DNO] in Northumberland). The high voltages used on the transmission network allow electricity to be transported with relatively low losses. Electricity can therefore be transported far more readily than heat resulting in the requirement for supply to be located close to demand not being as essential (heating networks can be restricted to 10's of km whereas the electricity grid covers the whole of the UK).

The operating voltage of nearby circuits and infrastructure is important when connecting generation to the electrical network as the lower voltage DN infrastructure is not designed to accommodate large-scale generators (such as conventional power stations with an installed capacity of hundreds of MW). As a general rule generators with an installed capacity of over 60MW are connected to TN while those with an installed capacity of less than 60MW are connected to the DN.

There are other issues to be considered when proposing a connection for a generator to the electricity grid. The primary issues are grid capacity (which is limited by the existing equipment), distance (which is limited by geographic location) and cost (which is partially dependant on capacity and distance).

8.2.3 Capacity

Projects beyond 30MW installed capacity (e.g. the larger wind farms) will typically need to connect to the 33kV network or higher depending on their size (Table 8.1). Up to 132kV this will be the responsibility of NEDL – the DNO in Northumberland, however for larger schemes which require connection to the main TN (275/400kV) National Grid will be the responsible authority.

Table 8.1 Typical Connection Requirements by Size of Project*

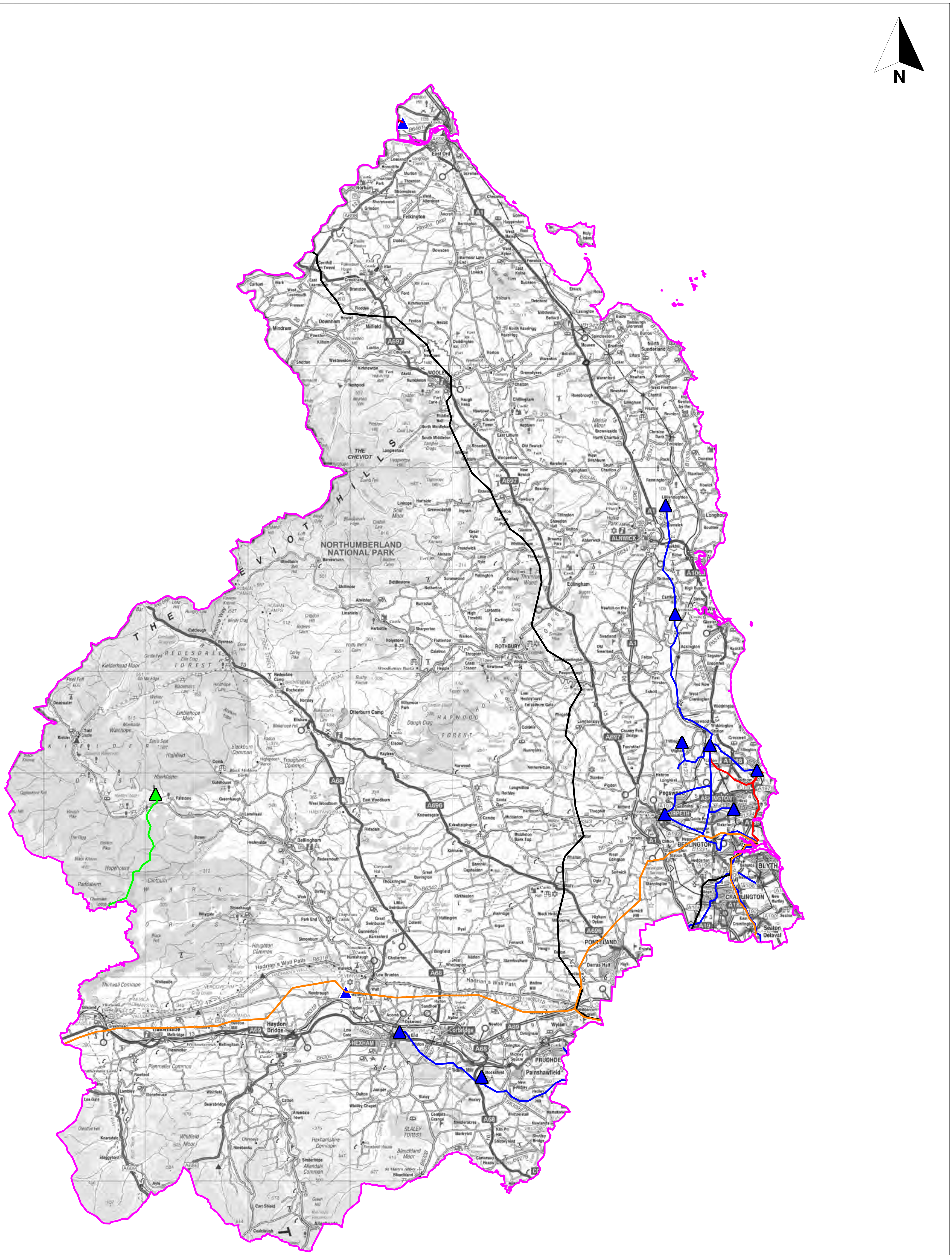
Development Installed Capacity	Connection Voltage	Company
Up to 10MW	11kV	DNO (NEDL)
Up to 30MW	33/66kV	DNO (NEDL)
Up to 60MW	132kV	DNO (NEDL)
Above 60MW	275/400kV	TNO (National Grid)

*Note: figures indicative and simply to be used as a guide

What Figure 8.1 shows is that both the TN and DN are limited to the northern and central parts of the County (except 11kV which is not included on this plan).

8.2.4 Distance to Connection

The distance between the generator and a suitable connection point is another potential barrier. Generators situated a long distance from the proposed grid connection point could incur more problems with planning permission simply due to the length of cable required and increased number of interested parties. It is possible to vary the installation method to reduce potential planning problems; however wayleaves are likely to be required for any route from a site to grid and costs will change depending on installation method.



Key

County Boundary	TNO 400kV Overhead Line
DNO 33kV Overhead Line	TNO 275kV Overhead Line
DNO 66kV Overhead Line	Approximate substation location
DNO 132kV Overhead Line	

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Figure 8.1
Grid Infrastructure Location

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8.2.5 Connection Costs

It is always *possible* to connect to a suitable point on the network for any generator size; however in some cases the costs associated with a technically feasible solution are prohibitive. There are a number of issues that can affect the cost of an acceptable grid connection; length and route of connection, type of installation method, necessary upgrades and permissions.

The length and route can vary depending on obstacles and required permissions. Necessary upgrades will be completed by the local DN operator (in Northumberland this is NEDL) and recharged to the generator. There are three main methods of installation for grid connection routes, however in practice all methods are used for particular sections of the route:

- Pole mounted overhead line, which is often the cheapest option, but potentially more onerous from a planning perspective (Section 37 of the Electricity Act 1989);
- Cross-country underground cable, more expensive installation per metre but the route can be designed to minimise length of cable required, agreements from particular landowners would be required; and
- Run cables alongside public highways, most expensive option per metre but is not required to obtain specific permissions from individual landowners.

In addition large generators are required by the regulator to hold an electricity supply licence; this can be costly although it is possible to appoint a company to provide the service that may be required thus negating the requirement on the generator - although this does come at a cost.

Summary

Given the rural nature of large parts of Northumberland and the fact that there are relatively few circuits passing through the region, a grid connection for a generator remote from the existing network could be long and potentially prohibitively expensive.

The issues described above do not necessarily apply to micro-generation technologies as the output from these systems is normally less than the demand of the site on which they are installed - effectively reducing the demand of the site.

Early discussions with both NEDL and National Grid (for larger projects) are therefore recommended. In addition, although the TN and DN infrastructure may exist to the south east of the County the overall capacity of the grid to accommodate significant new projects will need to be understood via early engagement with these operators.

8.3 Renewable and Low Carbon Heat: Spatial Considerations

8.3.1 Overview

There are two main options for supplying renewable and low carbon heat in Northumberland: micro-generation (e.g. solar thermal and ground source/air source heat pumps) and communal heating networks supplied by biomass, waste (including anaerobic digestion) or gas. Firstly we focus on the potential for communal heating works.

8.3.2 Communal Heating Networks: Identifying Priority Areas

Heat mapping is a helpful *starting point* to identify areas with potential for heating networks. DECC's online UK Heat Map (http://chp.decc.gov.uk/heatmap/) shows that the core areas in Northumberland are to the south east of the County surrounding Blyth, Cramlington, Ashington and Morpeth as will as moving north and looking at Alnwick and Berwick-upon-Tweed (areas with a heat load of 10,000-50,000kW). Heat demand in these areas is mainly associated with a concentration of residential, commercial and retail uses within the respective town centres, but at the outset it is important to note that the heat loads are nowhere near as high as in larger towns and cities (e.g. Newcastle and Gateshead) given their more rural character. At the outset it is important to note that the potential for communal heating networks has already been identified as an opportunity in the south east of the County, including the Low Carbon Blyth project.

Taking the DECC mapping further, as part of this report key settlements across Northumberland have been considered in detail with respect to their *existing* levels of development to explore the potential for heating networks further, identifying areas with high heat demand and specific sites which may be suited to stand-alone heating systems. Based on this analysis the following priority areas have been identifying for communal heating networks:

- Blyth;
- Morpeth;
- Cramlington; and
- Ashington.

The potential from these areas would need to be explored further at a project specific level as part of detailed feasibility and viability testing. The justification for identifying these priority areas is as follows:

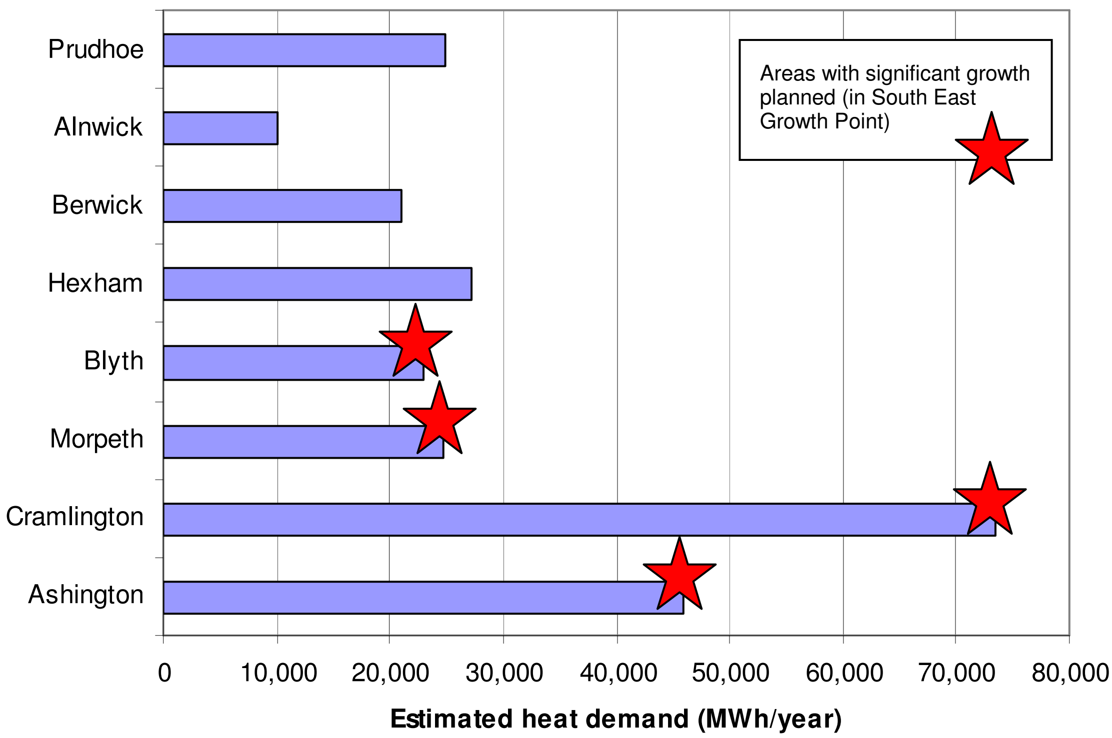
- DECC heat mapping shows that this area as a whole has areas with a high heat load;
- Entec's heat demand modelling of these areas (summarised in Figure 8.2) shows that there are clear opportunities associated with the existing heat demand from existing users and the opportunities presented by future growth (Growth Area sites in particular);

- Consideration of heating networks at the outset is considered essential for Growth Point sites to achieve higher national standards to be introduced via building regulations over the next five years (see Section 8.4 for further details); and

- The potential for networks in these areas has already been identified previously, for example as part of the Low Carbon Blyth project.

Figure 8.2 and Table 8.2 provide further justification for the identification of these priority areas. It is important to note however that the viability and feasibility of particular projects would need to be tested at a project specific level.

Figure 8.2 Estimated Heat Demand by Settlement (Existing Development only)



Source: Entec, based on modelling of key energy users within these settlements

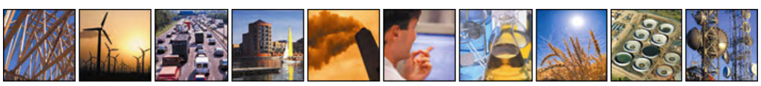
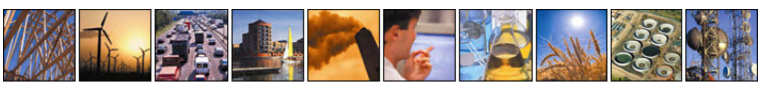


Table 8.2 Appraisal of Heat Demand and Potential for Communal Heating Networks By Settlement

Settlement	Potential
Ashington	**Summary** Demand of ~46,000MW per year with further demand expected from the East Ashington Growth Area (750 dwellings by 2021). Development of the Growth Area will require consideration of a communal heating network at the outset (to meet higher national standards introduced over the next 5 years), which could be extended where the opportunities exist to do so. In addition, there are opportunities for both a communal heating network serving the town centre (perhaps linked to heat from the Alcan smelter) or for stand-alone plants serving individual developments which could be linked in the future. **Further detail - key areas & sites** There are plans to redevelop part of Ashington town centre in the long term, as detailed in the Ashington Town Centre Supplementary Planning Document (February 2010). This may present a good opportunity to develop a communal heating network, particularly in the north east part of the centre where the majority of redevelopment is planned. This is especially the case given that by the time development is constructed there will be requirements for a high degree of sustainability. Other sites with potential for either stand alone plant or connection to a communal heating network include Wansbeck General Hospital, Ashington Barracks, Northumberland College and Ashington Leisure Centre. The Alcan Smelter aluminium works located at Lynemouth to the north east of Ashington is the highest single energy user in Northumberland, with an electrical requirement of approximately 310MW. This is provided entirely by the nearby 420MW Lynemouth coal fired power station, built specifically to power the smelter (the surplus being fed to the national grid). The carbon emissions associated with this plant are hence very high, and several initiatives are underway or under discussion to reduce emissions. Lynemouth power station currently co-fires biomass, and the operators Rio Tinto Alcan are considering increasing the proportion of biomass used. In addition the potential for installing Carbon Capture and Storage (CCS) equipment to greatly reduce the CO_2 emissions of the plant is being considered. Proposals for several wind turbines have been rejected. The smelting process requires electricity to separate the aluminium from the ore, so the heat demand is low and hence this is not considered to be a suitable location for gas CHP or biomass plant, so the focus should remain on reducing the emissions of the power plant. However, both the smelting and electricity generation processes produce large quantities of surplus heat that could be used as input to (or even entirely fuel) a communal heating network in the town. As a potentially cheap source of heat this would be worth further investigation and could considerably increase the efficiency of the plant and help security of energy supply. In addition this type of arrangement may help to guarantee the future of the smelting plant and power station, both of which are an important part of the local economy.
Cramlington	**Summary** Demand of ~73,000MW per year with further demand expected from the South West Sector Growth Area. Development of the Growth Area will require consideration of a communal heating network at the outset (to meet higher national standards introduced over the next 5 years), which could be extended where the opportunities exist to do so. In addition, there are opportunities for both a communal heating network serving commercial and leisure sites in the town centre and stand-alone plants serving specific sites. **Further detail - key areas & sites** There are a number of industrial estates to the north west of the town containing some large sites that are expected to have a high heat demand (Avery Dennison, GE Oil & Gas, Merck, Sharp and Dohme etc). These sites may present opportunities for stand-alone CHP or biomass heating plant (East Cramlington Hospital may also have potential). In addition there is potential for a communal heating network serving commercial and leisure sites in the town centre, perhaps centred on the Concordia leisure centre. The leisure centre previously had a gas CHP plant, but this has not been operational since 2006 as repairing it was judged not to be economical.

Settlement	Potential
Morpeth	**Summary** Demand of ~25,000MW per year with further demand expected from the St George's Hospital Growth Area. Development of the Growth Area will require consideration of a communal heating network at the outset (to meet higher national standards introduced over the next 5 years), which could be extended where the opportunities exist to do so. In addition, although there are other opportunities for a communal heating network (e.g. associated with the town centre), stand-alone CHP/biomass may be more suited in the short term. **Further detail - key areas & sites** A small communal heating network could be centred on the council offices to the south of the town. Developing a heating network in the town centre may be possible but is likely to be challenging due to the absence of a significant anchor load and the small size of most buildings (shops and other small businesses); this may mean a network is expensive and difficult to implement commercially. Any network in the town centre is likely to be focused around the main shopping area, library etc. The other main site is Northgate hospital to the north of the town which may offer an opportunity for a stand-alone gas CHP or biomass heating system.
Blyth	**Summary** Demand of ~23,000MW per year with further demand expected from the Blyth Estuary/Cambois Growth Area. Development of the Growth Area will require consideration of a communal heating network at the outset (to meet higher national standards introduced over the next 5 years), which could be extended where the opportunities exist to do so. **Further detail - key areas & sites** The potential for a communal heating network to serve future developments at Blyth is already recognised, with the Council already considering this as an option as part of the Low Carbon Blyth project. A communal heating network in Blyth could be centred on the Blyth Community Hospital, and could be extended to serve the town centre and potentially a much larger residential scheme. However, there are few major industrial or commercial sites to act as anchor loads following the decline of the coal and shipbuilding industries. The port area is not expected to have a high heat demand, so the majority of potential will be with existing housing and new commercial and residential development. Renewable Energy Systems (RES) Ltd has submitted plans to build a 100MWe biomass power station on the north bank of the River Blyth. RWE nPower has submitted plans for a 2,400MW clean coal power plant on the site of a now demolished coal plant at Cambois to the north of the town. The proposals are currently on hold, but if this were to be built in future there would be huge quantities of surplus heat that could be recovered and fed into a communal heating network in the town and beyond. Other possible uses for this site include a manufacturing facility for offshore wind turbines or residential and commercial development. The primary obstacle for utilising the heat from either plant is the River Blyth; the probable requirement for a pipeline to cross the river inland of the estuary will increase the pipe length and hence costs significantly.
Other settlements	Other settlements including Prudhoe, Berwick, Alnwick, Hexham, Ponteland, Newbiggin and Bedlington are not considered as having significant potential for heating networks owing to a range of factors not least their lack of overall development, mix of uses, lower density and no major anchor loads. However, there may be potential within these areas for 'stand-alone' plants providing heating or CHP: Prudhoe: the town is home to several large factories, including manufacturing plants occupied by SCA Hygiene and Hammerite Products which may be suitable for conversion to biomass heating or gas CHP. Berwick-upon-Tweed - the primary locations for stand-alone low carbon heating systems are Berwick Infirmary, Berwick Council offices and the Tweedside Trading Estate. Alnwick - Alnwick infirmary is the only large site that is likely to offer potential. Hexham - Hexham General Hospital, several schools, and the police station are the main loads. A 10MWe biomass plant under development could be a heat source if operated in CHP mode.

Source: Entec – heat demand based on modelling of key developments within these areas



It is estimated that a total of approximately 250,000 MWh per year of heat could realistically be supplied by biomass (or other low carbon fuels such as waste of gas CHP) in Northumberland's towns. This is equivalent to around 10% of the total heat demand of the county. Not included in this estimate is the energy demand of the Lynemouth aluminium works due to its low heat demand; however it is recognised that significant energy from biomass could be supplied to this plant in the form of electricity.

8.3.3 Renewable Heat in Off-Gas Properties

There may be significant scope for introducing stand-alone small renewable and low carbon heating systems in residential sites which are not close to the main centres of the development or not connected to the gas grid. Off-gas grid properties are often heated by oil or electricity which are expensive, high-carbon fuels. This means alternative fuels such as biomass may be more competitive than they would be against natural gas. Heat pumps (ground and air source) may also help to reduce carbon emissions and fuel costs in these properties.

At present 22% of homes in Northumberland are off the gas network, and the total heat demand of these developments is approximately 445,000 MWh per year. It has been assumed that approximately half these buildings would be suitable for conversion to biomass heating, particularly those currently heated by oil or solid fuel such as coal. The impact of various other micro-generation is considered in Appendix A.

8.3.4 Summary of Low Carbon Heat Potential

The total heat demand that could be met via biomass is provided in Table 8.3, along with the tonnage of biomass required to supply this demand and the proportion of the overall heat demand of Northumberland that this is equivalent to.

Table 8.3 Heat Demand and Biomass Requirements for Stand-Alone Sites and Communal Heating Networks

Type	Heat demand (MWh per year)	Biomass requirement (tonnes per year)	Proportion of overall heat demand
Potential communal heating schemes	250,000	71,000	9%
Off gas (assumed 50% of total are suitable)	223,000	64,000	8%
Total	**473,000**	**135,000**	**17%**

Note: to calculate biomass energy requirements, an assumption was made that the energy content of wood is 3.5MWh per tonne and the efficiency of biomass boilers and associated heating networks is 80%.

8.4 Target-Setting for Growth Area Sites

8.4.1 Overview

South East Northumberland Growth Point (Figure 1.1, section 1) is a particular focus of this report with respect to what standards the particular sites (Table 8.4) need to be planned to. These standards will inform policy requirements in the Core Strategy and wider LDF (including a Site Allocations DPD).

Table 8.4 Summary of Growth Area Proposals

Site	Development character	Target development scale
Cramlington	Urban extension	1,450 dwellings by 2021
Blyth Estuary	Mixed-use riverside development including Bates Colliery, South Harbour and Commissioners Quay	3,500 dwellings
Cambois	Residential and employment development on brownfield & greenfield land	300+ dwellings
East Ashington	Urban extension	750 dwellings by 2021
Ellington/Lynemouth	Mixed use	500 dwellings by 2021
St George's Hospital/North Morpeth	Mixed use	450 dwellings

Sources: South East Northumberland New Growth Point Programme of Development (main document and Technical Appendices)

In advance of preparing detailed policies for these sites, considering energy, infrastructure, affordable housing S106 requirements and a range of other factors, it is recommended that **at the very least developers should demonstrate how they have planned for higher standards at the outset, particularly the requirement for all homes to be 'zero carbon' from 2016** given the likely lead-in times and subsequent phasing of these schemes.

To achieve zero carbon development (and interim target for 2013) consideration needs to be given to the communal scale schemes, such as heating networks that are likely to be fundamental to achieving these standards. Whilst it is building regulations that are driving this it will have clear planning and design implications, including:

- Land-take associated with any energy plant and supporting infrastructure;
- Cost and viability implications; and
- Consideration of the impacts of an energy proposal on the scheme and wider area.

Whilst micro-generation, enhanced energy efficiency (in buildings and site design) and developer contributions towards off-site measures will all have a role to play it is prudent to plan for communal scale systems as early as possible in the planning and design process so that developers understand the masterplan and potential cost implications at the outset.

In the following tables we set out the range of technologies that could be used to achieve higher standards on five of the six Growth Area sites (East Ashington is excluded, but parallels can be drawn with similar scale developments such as Ellington/Lynemouth). **The aim is not to recommend a specific approach/technology, with the Climate Change PPS clear that targets should avoid being overly prescriptive and allow flexibility, but to show NCC and the respective developers what options exist to inform the planning and design process in anticipation of these higher national standards**. The analysis presented here is based on assessing the sites as part of Entec's Renewable and Low Carbon Technology Appraisal Model, with key assumptions presented in Appendix E.

As well as the analysis presented in this section existing and adopted toolkits such as the **North East Carbon Mixer Toolkit 2.0**[12] can be used by developers and the Council to understand the options that are available to meet carbon reduction targets.

8.4.2 Site-Specific Appraisals

This section presents the outputs from Entec's Renewable and Low Carbon Technology Appraisal Model which has been used to estimate the energy demand, emissions, and effectiveness of different technologies to deliver CO_2 reductions across Growth Area sites. Appendix C provides the outputs from the modelling process, with this section summarising the main findings by site. This information should be used by the Council and developers as a starting point to understand what technologies could be used to help achieve higher national standards, including zero carbon from 2016. **The consistent message across all of these sites is that communal heating networks need to be considered *now* given their potential to help achieve zero carbon development and interim targets to be introduced nationally via building regulations.**

Cramlington South West Sector

Development Characteristics

Development	Housing		Employment	
Development character	250 homes built at relatively low density (35 dwellings per hectare)		No significant employment planned	
Total energy demand	Heating and hot water demand (annual MWh)	2,382	Heating and hot water demand (annual MWh)	None

[12] http://www.narec.co.uk/sectors/distributed_energy/microrenewables_toolkit/

Development	Housing		Employment	
	Electricity demand (annual MWh)	1,098	Electric demand (annual MWh)	None
	Cooling demand (MWh/year)	None	Cooling demand (MWh/year)	None
Total estimated CO_2 emissions	**1,094,996 kg per annum**			

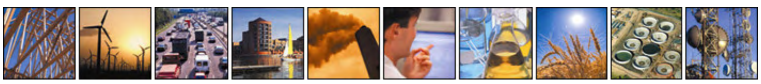
Renewables Potential

Technology	Potential CO_2 emissions reductions	Comments
Wind	> 100%	There is significant potential from wind in this part of Northumberland, which deliver well over 100% savings in emissions. The ability to deliver wind associated with this development would depend on what land is owned by the developers in this location (i.e. they would not want to depend on third party land to deliver their energy strategy). This is something that the Council could coordinate through a site allocations DPD.
Communal systems (biomass heat only, biomass CHP, gas CHP)	30 – 50%	
Micro-generation	10 – 20%	**In order to achieve future building regulations (2013 and zero carbon from 2016) it is likely that a communal heating network will be required.** Our assessment shows that this could deliver savings in the range of 30-50%, whilst micro-generation just up to 20%. When considering zero carbon development, the remaining balance of CO_2 would be what NCC and the developer would need to address through allowable solutions/off-site financial contributions.

Bates Colliery, Blyth

Development Characteristics

Development	Housing		Employment	
Development character	Assumed 2,000 homes (actual figure unknown though a total of 3,500 are planned for the Blyth growth point). Variable build density (35 to 55 dwellings per hectare)		No significant employment planned	
Total energy demand	Heating and hot water demand (annual MWh)	17,250	Heating and hot water demand (annual MWh)	None
	Electricity demand (annual MWh)	7,921	Electric demand (annual MWh)	None
	Cooling demand (MWh/year)	None	Cooling demand (MWh/year)	None
Total estimate CO_2 emissions	**7,915,062 kg per annum**			



Renewables Potential

Technology	**Potential CO_2 emissions reductions**	**Comments**
Wind	0%	No real potential for large or medium scale wind given proximity to sensitive receptors. Micro wind may have some potential but the contribution to overall demand and CO_2 emissions reductions will be very small.
Communal systems (biomass heat only, biomass CHP, gas CHP)	30 – 40% (up to 80% with biomass CHP)	**In order to achieve future building regulations (2013 and zero carbon from 2016) it is likely that a communal heating network will be required.** This has already been acknowledged, with significant work having been undertaken into the potential for a communal heating network serving the development. A number of heat sources have been considered including the use of mine water from the former colliery site, waste heat from the nearby NaREC facility and surplus heat from a future power station. A network appears feasible and viable (with financial support), though the mine water option gives no appreciable CO_2 reductions and the heat source from NaREC is highly erratic and would only be suitable as a supplementary input to the heat network. Biomass for heating (from a dedicated boiler or the larger electricity plant) would give CO_2 reductions of the order of 30 - 40%. Biomass CHP has not been considered in detail but could give greater emissions reductions.
Micro-generation	10 – 25%	Solar PV and solar thermal offer potential for modest emissions reductions. Heat pumps offer relatively low emissions reductions (5%) so are a less appropriate technology for this site.

Ellington

Development Characteristics

Development	**Housing**		**Employment**	
Development character	Mixed use development consisting of 300 homes and a range of commercial units. The development is aiming to achieve Code Level 3. Relatively low build density (35 dwellings per hectare)		Mix of employment and recreational buildings planned; approximately 1,700m^2 retail, 2,800m^2 offices, 800m^2 light industrial and a 600m^2 local centre. Non-domestic units aim to achieve BREEAM 'excellent'.	
Total energy demand	Heating and hot water demand (MWh/year)	2,581	Heating and hot water demand (MWh/year)	1,083
	Electricity demand (MWh/year)	1,182	Electric demand (MWh/year)	842
	Cooling demand (MWh/year)	None	Cooling demand (MWh/year)	606
Total CO_2 emissions	**1,966,172 kg per year**			

Renewables Potential

Technology	Potential CO_2 emissions reductions	Comments
Wind	0%	No real potential for large or medium scale wind given proximity to sensitive receptors
Communal systems (biomass heat only, biomass CHP, gas CHP)	20 – 30% (up to 50% with biomass CHP)	**In order to achieve future building regulations (2013 and zero carbon from 2016) it is likely that a communal heating network will be required.** Biomass for heating or gas CHP would give CO_2 reductions of the order of 30 - 40%. The mix of building types mean the profile may be well suited to a communal heating network but design and layout will need to be considered
Micro-generation	5 – 15%	Biomass CHP could give greater emissions reductions but is not yet considered technically proven at this scale and for this type of development Solar PV and solar thermal and heat pumps offer potential for modest emissions reductions, but relatively high electrical demand means achieving even a 10% reduction is challenging using building integrated systems

Cambois

Development Characteristics

Development	Housing		Employment	
Development character	467 homes in total (403 houses and 64 apartments) The site is split into northern and southern sectors and has a low build density (calculated to be approximately 25 to 30 dwellings per hectare)		A total of 1,800m^2 of office space is planned, located in close proximity to housing towards the centre of the development.	
Total energy demand	Heating and hot water demand (annual MWh)	4,160	Heating and hot water demand (annual MWh)	232
	Electricity demand (annual MWh)	1,908	Electric demand (annual MWh)	142
	Cooling demand (MWh/year)	None	Cooling demand (MWh/year)	12
Total CO_2 emissions	**2,035,313 kg per year**			

Renewables Potential

Technology	Potential CO_2 emissions reductions	Comments
Wind	0%	No real potential for large or medium scale wind given proximity to sensitive receptors.
Communal systems (biomass heat only, biomass CHP, gas CHP)	25 – 35% (up to 75% with biomass CHP)	**In order to achieve future building regulations (2013 and zero carbon from 2016) it is likely that a communal heating network will be required.**

Technology	Potential CO_2 emissions reductions	Comments
Micro-generation	5 – 20%	Biomass for heating or gas CHP would give CO_2 reductions of the order of 25 - 35%. The mix of building types mean the profile may be well suited to a communal heating network but design and layout will need to be considered. Biomass CHP could give greater emissions reductions but is not yet considered proven at this scale and for this type of development. Solar PV and solar thermal offer potential for modest emissions reductions with combined systems allowing up to 20% emissions reductions to be achieved.

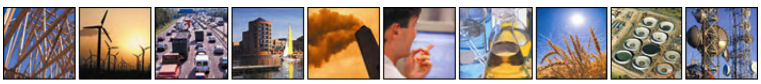
St Georges, Morpeth

Development Characteristics

Development	Housing		Employment	
Development character	Small site consisting of 200 homes. Relatively low build density (calculated to be approximately 25 dwellings per hectare)		A total of 1.6ha designated as employment land, developed floor area assumed to 1,600m^2 consisting of 600m^2 retail, 500m^2 offices and 500m^2 light industrial use.	
Total energy demand	Heating and hot water demand (annual MWh)	1,791	Heating and hot water demand (annual MWh)	292
	Electricity demand (annual MWh)	821	Electric demand (annual MWh)	262
	Cooling demand (MWh/year)	None	Cooling demand (MWh/year)	166
Total CO_2 emissions	**1,052,262 kg per year**			

Renewables Potential

Technology	Potential CO_2 emissions reductions	Comments
Wind	0%	No real potential for large or medium scale wind given proximity to sensitive receptors. **In order to achieve future building regulations (2013 and zero carbon from 2016) it is likely that a communal heating network will be required.** The mix of building types mean the profile may be well suited to a communal heating network but design and layout will need to be considered. Biomass CHP could give greater emissions reductions but is not yet considered proven at this scale and for this type of development. Solar PV and solar thermal offer potential for modest emissions reductions with combined systems allowing up to 20% emissions reductions to be achieved.
Communal systems (biomass heat only, biomass CHP, gas CHP)	25 – 35% (up to 70% with biomass CHP)	
Micro-generation	5 – 20%	



8.5 Target-setting for Other Developments across Northumberland

In addition to looking at what needs to be planned for on specific strategic sites, this study also considers the other types of development likely to come forward in the County, using the Renewable and Low Carbon Technology Appraisal Model to see what will be achievable on these sites. This will be useful information for both NCC and developers in the planning and design process. Seven 'typical' development types were agreed with NCC for this analysis, with case studies identified as benchmarks. For the larger developments, parallels can be drawn with the analysis of strategy sites presented in section 8.4.

As with the specific developments explored in section 8.4 NCC and developers will also be able to draw on existing toolkits such as the North East Carbon Mixer Toolkit 2.0 to understand how carbon reductions can be delivered on a particular type of development.

Table 8.5 'Typical' Developments Considered

Development type	Assumptions for options appraisal	Case studies used to inform typology development
1. Town Centre Retail	- 3,000m^2 retail	Morrisons Blyth (6,000m^2 total floorspace), Dransfield Morpeth (2,700m^2)
2. Major Mixed-use Schemes	- 5,000m^2 retail	Estimated as: 1000m^2 supermarket, 500m^2 restaurant/bars, 2000m^2 clothing shops, 1000m^2 small food shops and 500m^2 hotel.
3. Greenfield Urban Extensions	- 700 dwellings overall: 665 family houses and 35 apartments	SW Cramlington (1800 dwellings), East Ashington (up to 800 dwellings), Hiveacres Berwick (~250 dwellings), Summer House Lane Ashington (~650 dwellings), Castlefields Prudhoe (up to 550 dwellings).
4. Brownfield Sites	- 200 dwellings overall: 30 apartments and 170 family houses	Former Ashington Hospital (139 dwellings), Former Bates Colliery Blyth (327 dwellings), St Georges Hospital Morpeth (Phase 1: 200 dwellings)
5. Small Residential Infill Schemes	- 50 dwellings overall: 5 apartments and 45 family houses	Social Club Stobhill (26 dwellings), Broadway Garage Hexham (~50 dwellings), Shields Road Morpeth (18 dwellings)
6. Large Residential Infill Schemes	- 100 dwellings overall: 10 apartments and 90 family houses	Infill sites in Belford (92 dwellings) and Corbridge (71 dwellings)
7. Employment Park	- 20,000m^2 office/industry	Estimated as: 5,000m^2 office space, 7,500m^2 distribution and storage and 7,500m^2 light manufacturing.

The assessment of typical sites provides an overview of the likely suitable technology options for generic site types. This can help form principles on which actual sites can be developed, for example through policy or guidance. A summary of the key findings is presented in a series of graphs in Appendix D.

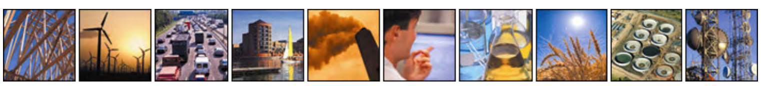
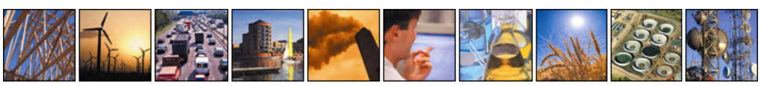


Table 8.6 Summary Appraisal of Typical Development Types

Typology	General Conclusions
Site 1 – Town Centre Retail	The high electrical and cooling demand and urban setting of this site means reducing CO_2 emissions is challenging 10% reduction using combinations of micro-generation and some types of communal system may be achievable at some sites Given town centre location (and therefore potentially high density) there may be practical constraints to micro-generation in many cases (roof space for solar options and space and ground conditions for ground source heat pumps) which could significantly reduce the potential for reducing emissions via these technologies Achieving more than 10% reduction in emissions will require communal systems (biomass or gas CHP), but only a 15% reduction can be expected. A combination of GSHP (heating and cooling) and solar PV achieves the biggest savings. Maximum savings are limited to around 20% due to high electrical demand of this typology. Energy costs range from 20% below to 15% above the baseline for all options considered Zero carbon unlikely to be achievable without allowable solutions
Site 2 – Major Mixed-use Schemes	The high electrical and cooling demand and urban setting of this site means reducing CO_2 emissions is challenging Up to 30% reduction using combinations of communal system and some types of micro-generation may be achievable at some sites Achieving more than 10% reduction in emissions will require combinations of communal systems (biomass or gas CHP) with solar PV, but only a 30% reduction can be expected. A combination of Biomass CHP and solar PV achieves the biggest savings Energy costs range from 15% below to 25% above the baseline for all options considered Zero carbon unlikely to be achievable without allowable solutions
Site 3 – Greenfield Urban Extensions	This site type has higher heating and lower electrical demand than Site 1 which means reducing CO_2 emissions is more easily achievable, but no less costly 10% reduction using micro-generation may be achievable at most sites via the use of solar PV and solar thermal. Using combinations of solar thermal and PV it may be possible to achieve reductions of between 20 and 25%, but this will require careful design to ensure sufficient roof space Depending on the eventual density of the sites there may be practical constraints to micro-generation in many cases (roof space for solar options and space and ground conditions for ground source heat pumps) which could significantly reduce the potential for reducing emissions via these technologies Achieving more than 25% reduction in emissions will require communal systems (biomass or gas CHP), and up to 30% reduction should generally be achievable. A combination of biomass CHP and solar PV achieves the biggest savings of approximately 80% Regardless of costs, higher than 10% reduction is likely to be required to achieve timetable for zero carbon homes from 2016, including interim targets for 2010 and 2013 so communal systems may be a necessity Costs of communal gas CHP and biomass heating systems are higher than micro-generation, but give significantly greater carbon savings Energy costs vary greatly depending on the system and may be between 20% lower to three times higher than the baseline for all options considered Zero carbon unlikely to be achievable without allowable solutions

Typology	General Conclusions
Site 4 – Brownfield Sites	10% reduction relies on combination of solar thermal and solar PV which may not be viable in all cases given dependency on roof space Communal system (gas CHP and biomass) could achieve three times the carbon savings at a similar additional build cost to solar PV and thermal. However energy costs may be more than 50% above the baseline so there may be viability concerns. The costs are highly dependent on building layout, so a carefully designed development may help to significantly reduce long-term costs The specification of very high levels of efficiency is an additional option to help reduce carbon emissions relative to the baseline Regardless of costs, higher than 10% reduction is likely to be required to achieve timetable for zero carbon homes from 2016, including interim targets for 2010 and 2013 so communal systems may be a necessity Zero carbon unlikely to be achievable without allowable solutions
Site 5 – Small Residential Infill Schemes	10% reduction relies on combination of solar thermal and solar PV which may not be viable in all cases given dependency on roof space Communal system (gas CHP and biomass) could achieve three times the carbon savings at a similar additional build cost to solar PV and thermal. However energy costs may be more than 50% above the baseline so there may be viability concerns. The costs are highly dependent on building layout, so a carefully designed development may help to significantly reduce long-term costs The specification of very high levels of efficiency is an additional option to help reduce carbon emissions relative to the baseline Regardless of costs, higher than 10% reduction is likely to be required to achieve timetable for zero carbon homes from 2016, including interim targets for 2010 and 2013 so communal systems may be a necessity Zero carbon unlikely to be achievable without allowable solutions
Site 6 – Large Residential Infill Schemes	10% reduction relies on combination of solar thermal and solar PV which may not be viable in all cases given dependency on roof space Communal system (gas CHP and biomass) could achieve three times the carbon savings at a similar additional build cost to solar PV and thermal. However energy costs may be more than 50% above the baseline so there may be viability concerns. The costs are highly dependent on building layout, so a carefully designed development may help to significantly reduce long-term costs The specification of very high levels of efficiency is an additional option to help reduce carbon emissions relative to the baseline Regardless of costs, higher than 10% reduction is likely to be required to achieve timetable for zero carbon homes from 2016, including interim targets for 2010 and 2013 so communal systems may be a necessity Zero carbon unlikely to be achievable without allowable solutions
Site 7 – Employment Park	10% reduction is potentially achievable via use of ground source heat pumps or combination of solar PV and solar thermal, but not in all cases Though GSHP is the cheapest option in terms of additional build costs *and* cost of energy in relation to the baseline, achieving 10% emissions reductions in this way is unlikely in practice in many cases The viability of achieving a significant reduction in emissions beyond 10% will depend on the nature of the development. Communal heating systems using biomass or gas CHP may be viable on some sites (e.g. high proportion of offices or near anchor loads like hospitals), but not on others (high proportion of warehouses or small units) Wind may be an option worth investigating on a site by site basis, particularly given that this type of site will typically be located away from housing and has a high electricity demand



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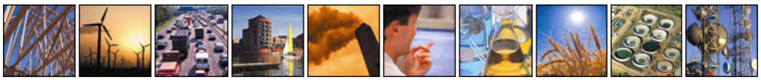


Part C: Policy Development and Delivery Mechanisms

9. Policy Development for Energy Efficiency and Renewables

9.1 Aim of this Section

The aim of this section is to help inform the development of planning policies in the Core Strategy, reflecting on the findings from Part 1 and Part 2 of this study. We address two key areas:

- **Strategic planning considerations for the Core Strategy**: assessing how the County's spatial strategy could reflect priorities to deliver energy efficiency and renewable energy schemes; and
- **Policy options to secure emissions savings and carbon reductions alongside new developments:** reviewing the range of policy models available to the Council for requirements to be placed on new developments, including consideration of the role for off-site 'allowable solutions'.

9.2 Strategic Planning Considerations for the Core Strategy

9.2.1 Relationship to the Council's Spatial Strategy

Northumberland CC expects to plan for circa 10,000 dwellings and related employment growth to 2021, the location of which will ultimately be set out in the Council's spatial strategy (one key part of their Core Strategy). We need to consider how different spatial strategy options could impact on the ability to deliver the following components of an energy strategy:

- Energy efficiency measures in existing properties;
- Energy efficiency in new build;
- Stand-alone renewable energy installations; and
- Site-specific renewable schemes (i.e. included as part of a new residential, mixed use or commercial development).

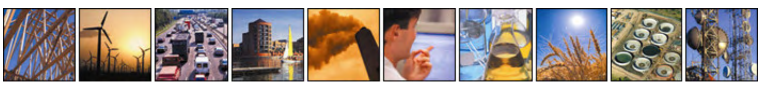
With no definitive spatial options/scenarios identified at present we assess the impact of three broad spatial development patterns, from concentrated development (i.e. the bulk of new housing within/adjoining the main settlements) to dispersed development (development spread out across the County's towns and villages). An analysis of the relationship between the key components of an energy strategy and the three broad spatial development options is presented in Table 9.1.

Table 9.1 Relationships between Energy Strategies and Spatial Development Patterns

	Energy strategy				
Spatial Development Options	**Energy efficiency measures in existing properties**	**Energy efficiency in new build**	**County-scale renewable energy development**	**Site-specific renewables**	**Summary**
Concentrated Development (i.e. all at main towns and Growth Points)	Relatively easy to secure, particularly as part of comprehensive renewal schemes	Readily achieved through Building Regulations	Opportunities for tying significant renewables capacity to areas of concentrated growth or existing demand	Well-suited to investment in schemes where economies of scale can be secured, CHP plants and DHNs in particular	**Can use a wide range of measures; efficient use of energy infrastructure with significant, clear impacts resulting from investment**
Mixed Development Pattern (a mix between development at the main towns Growth points plus more development in rural settlements)	Patchy change	Readily achieved through Building Regulations	Significant investment in infrastructure required to link new, remote, energy sources with consumers	Opportunities for the application of wind energy, for example, probably associated with community-specific opportunities e.g. small-scale communal heating networks	**Blend of measures likely to be required to respond to the opportunities presented**
Dispersed Development Pattern (development spread out across the County's towns and villages)	More difficult to secure systematic change	Readily achieved through Building Regulations	Significant investment in infrastructure could affect viability	Individual schemes likely to be most appropriate, probably focused on micro-generation	**Limited range of measures; requires significant infrastructure investment**
Overall contribution to CO_2 reduction	*Has a significant role to play, with existing properties accounting for the majority of emissions from the built environment in the County (see Section 2). Action is being led at a national level here – e.g. through the Government's 'Green Deal'.*	*New buildings will not have a significant impact on overall emissions (see Section 2) because development is already attaining higher standards introduced via Building Regulations. The key focus for energy efficiency measures needs to be the existing stock.*	*New County-scale renewables will be essential achieving a fundamental shift to a low carbon county. Planning is only part of the solution however, there will be a range of other factors to consider (see Section 11), not least responding to public perceptions and garnering community support.*	*Renewables as part of new developments will be important, and necessary to attain higher levels of building performance to be introduced via Building Regulations (e.g. zero carbon homes by 2016).*	

Table 9.1 shows that:

- The benefits yielded by energy efficiency measures are likely to be tangible in the short term in areas of significant new build and areas which are the targeted for refurbishment; more widely their impact will be considerably slower.



- Use of a range of renewable energies in concentrated areas of development, particularly new-build, will yield significant immediate benefits in terms of reductions in CO_2 emissions, as specific technologies such as CHP can be directly matched to areas of demand, and investment in infrastructure is more straightforward.

- Dispersed development, notably in rural areas, is likely to need to make greater use of measures such as micro-generation which are tailored to the specific characteristics of the settlement pattern. The overall impact is likely to be patchy in the short and medium term as investment is only gradually made.

- County-scale investment across a wide range of renewable technologies, whilst potentially yielding cumulatively significant reductions in CO_2 emissions, will need to be carefully targeted to secure the efficient and effective impacts. Thus whilst wind-power, for example, can readily feed into the grid, this may not be the best renewable solution for a particular development which could benefit from the development of other technologies such as outputs from an Energy from Waste plant.

In conclusion it is likely that a concentrated development pattern is likely to be where the biggest benefits in terms of CO_2 reduction can be achieved. Fundamentally this is because the concentration of development in a smaller number of areas increases the potential viability of communal schemes as well as the opportunity to deliver wider benefits in the form of ‘allowable solutions’ (i.e. financial contributions towards retrofitting existing buildings using allowable solutions).

With respect to the best option to secure emissions reductions in the built environment a concentrated pattern of development is therefore likely to yield the most success, however the Council’s ultimate decision on their spatial strategy will depend on this and a wide range of other factors including housing needs, proximity to public transport and employment and environmental constraints for example.

9.2.2 Making Provision for Stand-Alone Renewable Energy Schemes

The Climate Change PPS requires planning authorities to provide a positive policy framework for renewable and low carbon energy schemes, with the ‘need’ for schemes not to be questioned. In providing this policy framework in the LDF, particularly for strategic scale and stand-alone schemes, it is important to note the central conflict that the Council faces: responding to national and local commitments for delivering renewable energy projects in response to the global challenges posed by climate change, versus the potential local impacts that these schemes can have on local communities as well as the historic built environment, ecology and landscape. As highlighted in Box i Northumberland is particularly sensitive in terms of its environmental assets. This conflict is something that the Council is already dealing with (as are planning authorities across the country) and demonstrated most notably in relation to recent planning and appeal decisions relating to wind farm proposals in particular.

Whilst the merits of planning proposals can be assessed on a case-by-case base via the development control system, including Environmental Impact Assessment (EIA) where required, it is considered important that the Council has a policy setting out the criteria against which proposals for renewable and low carbon energy schemes will be assessed. Without a regional policy framework[13] and in the likely absence of detailed national policy[14] a locally adopted policy setting out how proposals should be assessed is crucial. What is also essential however is that this policy is not overly *restrictive* since NCC still needs to be positive regarding the overall potential of schemes a provide a supportive policy 'hook' in the Core Strategy for developers to respond to. To this end, draft policy wording for testing, consultation and refinement via the LDF process is presented in Box 6.

Box 6 Draft wording for renewable and low carbon energy generic policy

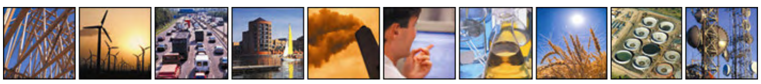
Policy wording and criteria for further testing via the LDF process (emphasis added solely for the purposes of this report)

Proposals for the development of renewable and low carbon energy projects will be supported and encouraged and assessed against the following criteria:

- anticipated effects resulting from development, construction and operation such as air quality, atmospheric emissions, noise, odour, water pollution and the disposal of waste;
- acceptability of the location, and the scale of the proposal and its visual impact in relation to the character and sensitivity of the surrounding landscape;
- effect on national and internationally designated heritage sites or landscape areas, including the impact of proposals close to their boundaries (including Northumberland National Park, Northumberland Coast AONB and North Pennines AONB);
- effect of development on nature conservation sites and features, biodiversity and geodiversity, including internationally designated and other sites of nature conservation importance, and potential effects on settings, habitats, species and the water supply and hydrology of such sites;
- effect of development on cultural heritage and archaeological features, including designated Listed Buildings, Scheduled Ancient Monuments, Registered Parks and Gardens, Conservation Areas, historic settlements and undesignated features where these are considered as having local importance;
- effects on the openness of the Northumberland Green Belt;
- accessibility by road and public transport;
- effect on agriculture and other land based industries;
- visual impact of new grid connection lines;
- cumulative impact of the development in relation to other similar developments; and
- proximity to the renewable fuel source such as wood-fuel biomass processing plants within or close to major woodlands and forests.

[13] Although currently subject to legal challenge it is likely that the North East Regional Spatial Strategy (RSS) will ultimately be revoked as part of government changes to the planning system. Crucially, the RSS included policy criteria against which renewable energy schemes will be appraised, similar to those identified in Box ii.

[14] As part of changes to the planning system the government plans to withdraw Planning Policy Statements (PPS) and Planning Policy Guidance (PPG) and to replace them with a more concise National Planning Framework. Ultimately, some of the detail which is in Planning Policy Statement 22: Renewable Energy and Climate Change PPS could be lost, so local policies will become even more important.



Policy justification & basis for supporting text

The type of policy presented here would be applicable to all proposals for renewable and low carbon energy projects, regardless of their size and scale. The level of detailed required would vary depending on the nature of the proposals, with Environmental Impact Assessment (EIA) likely to be required to assess significant effects for larger scale schemes.

The policy provides the supporting hook for developers to respond to (renewable energy projects will be 'encouraged' by the Council) alongside clear criteria to ensure that schemes respond to local impacts. Specific policies for different types of energy project are not deemed necessary - this policy allows the flexibility to respond to schemes from wind farms to solar parks to biomass heating networks.

9.3 Planning Policy Requirements for New Developments

9.3.1 Overview of Key Policy Options

In line with the requirements of the PPS1 Supplement on Climate Change the Council can set requirements for new developments to be connected to decentralised and renewable or low carbon energy. This section appraises the options that exist for the Council, reflecting on four main policy models that have been adopted by local planning authorities across the Country:

- Option 1: 'Merton rule' style policy, requiring a percentage of a development's predicted energy supply to be met via on-site renewables;
- Options 2: carbon reduction target – similar to the Merton rule but requiring a percentage reduction in predicted CO_2 emissions rather than predicted energy supply;
- Option 3: requiring a specific level of the Code for Sustainable Homes/BREEAM, since energy efficiency and on-site renewables are implicitly required; and
- Option 4: an 'energy hierarchy' based approach whereby developments need to demonstrate how they have, in the first instance maximised energy efficiency (be lean), then use decentralised heating networks (be clean), then use renewables (be green).

In some cases these options are used in combination (i.e. a Merton rule type policy supported by an energy hierarchy. This section of the report reflects on the relative strengths and weaknesses of these different options for the Council's consideration and for further testing via the LDF process.

9.3.2 Overview of Option 1: Merton Rule Style Policy

This is the most common type of policy adopted by local planning authorities across the country. It is similar to that which was included in the now revoked North East RSS. Typical policy wording is as follows:

*"The Council will **expect** all development (either new build or conversion) with a floorspace of 1,000 m2 or ten or more residential units to incorporate renewable energy production equipment to provide **at least 10% of the predicted energy requirements**"*

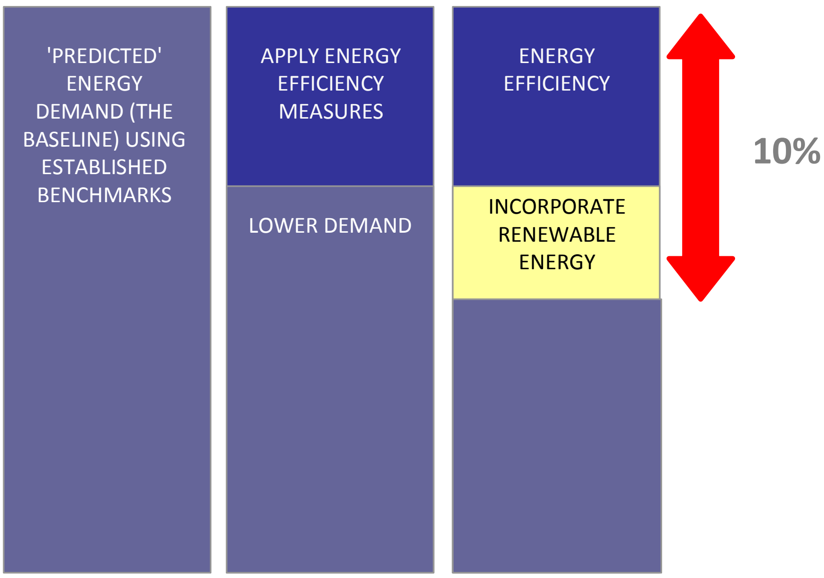
In support of this policy the Planning Inspectorate also published a 'model' condition to attach to a planning consent:

*"At least **10% of the energy supply of the development** shall be secured from **decentralised and renewable or low-carbon energy sources** (as described in the glossary of Planning Policy Statement: Planning and Climate Change (December 2007)). **Details and a timetable of how this is to be achieved, including details of physical works on site, shall be submitted to and approved in writing by the Local Planning Authority (as part of the reserved matters submissions required by condition x).** The approved detailed shall be implemented in accordance with the approved timetable and retained as operational thereafter, unless otherwise agreed in writing by the Local Planning Authority."*

The key variables in this policy are the threshold to which the policy applies and the percentage target adopted. Some authorities go beyond the 10% requirement and seek 20% for example.

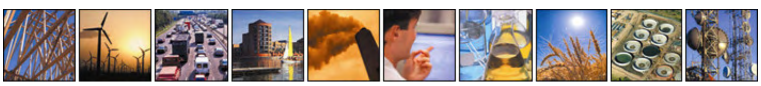
Figure 9.1 demonstrates how the percentage target is intended to be measured – i.e. that the 10% target also takes into account any energy efficiency measures, with energy efficiency actually reducing the level of renewables that needs to be incorporated.

Figure 9.1 How the Merton Rule can be measured



9.3.3 Overview of Option 2: Carbon Reduction Target

Typical policy wording is as follows:



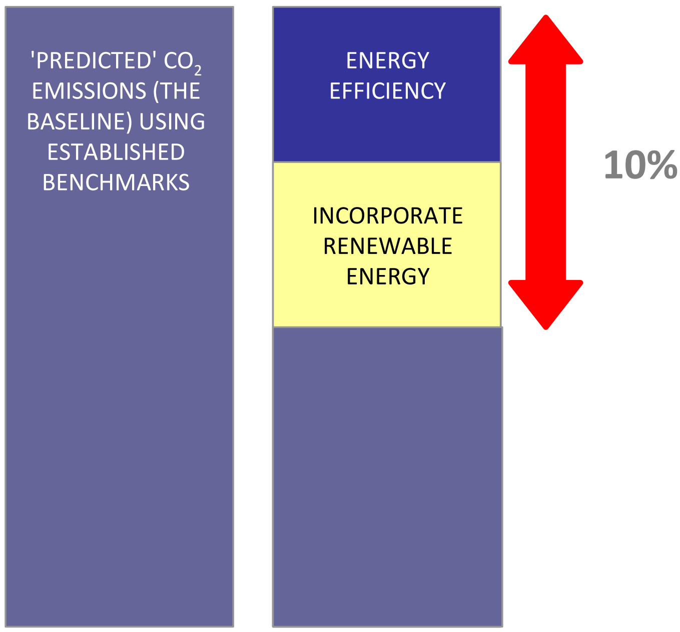
"The Council will expect all development (either new build or conversion) with a floorspace of 1,000 m2 or ten or more residential units to incorporate renewable energy production equipment to reduce the predicted CO_2 emissions by at least 10%"

A similar condition could be attached to planning consents as suggested under Option 1:

"The development's predicted CO_2 emissions should be reduced by at least 10%. Details and a timetable of how this is to be achieved, including details of physical works on site, shall be submitted to and approved in writing by the Local Planning Authority (as part of the reserved matters submissions required by condition x). The approved detailed shall be implemented in accordance with the approved timetable and retained as operational thereafter, unless otherwise agreed in writing by the Local Planning Authority"

The percentage reduction in emissions would be measured against a defined baseline (see Figure 9.2).

Figure 9.2 How a Carbon Reduction Target can be Measured



9.3.4 Option 3: CSH/BREEAM Requirement

Typical policy wording is as follows:

"New residential development permitted after the adoption of the strategy should meet Code for Sustainable Homes/BREEAM level X (or any future national equivalent)"

The Planning Inspectorate's model condition is as follows:

"The dwelling(s) shall achieve Level X of the Code for Sustainable Homes/BREEAM. No dwelling shall be occupied until a final Code Certificate has been issued for it certifying that Code Level X has been achieved."

Dover District Council has adopted a policy requiring levels of the CSH in its Core Strategy (Box 7).

Box 7	CSH/BREEAM Policy Case Study: Dover Core Strategy (adopted February 2010)
*"New residential development permitted after the adoption of the strategy should meet **Code for Sustainable Homes level 3 (or any future national equivalent), at least Code level 4 from 2013 and at least Code level 5 from 1 April 2016.*** *New non-residential over 1,000 square metres gross floorspace permitted after adoption of the Strategy should meet **BREEAM very good standard (or any future national equivalent).*** *Where it can be demonstrated that a development is unable to meet these standards, **permission will only be granted if the applicant makes provision for compensatory energy and water savings elsewhere** in the District..."*	

9.3.5 Overview of Option 4: Energy Hierarchy

Under this option there would be no specific policy 'target'. The policy would be assessed from a more qualitative perspective with developers required to demonstrate how they:

- **Use less energy (be lean):** via the design, layout and orientation of the development and its individual buildings.
- **Supply energy efficiently (be clean):** considering the use of combined heat and power (CHP) or combined cooling heat and power (CCHP) networks in the following order of preference:
  - connection to an existing CHP/CCHP network; or
  - establishing a site wide CHP/CCHP network; or
  - incorporating a gas-fired CHP/CCHP network accompanied by renewables or communal heating and cooling fuelled by renewables (e.g. biomass)
- **Use renewable or low carbon energy (be green).**

9.3.6 Options Appraisal

Key Components of a Successful Policy

In this section we consider the relative strengths and weaknesses of these policy options for the Council's consideration. The appraisal of strengths and weaknesses reflect the following criteria of a successful planning policy:

- defined against a clear baseline, i.e. what the policy or target is being measured against;
- viable and feasible so as not to constrain the delivery of growth and development;
- flexible to account for the government's aspirations for zero carbon development (and future changes to this timetable and related standards); and
- clear and concise, allowing for local planning authorities to implement the policy and so that developers are clear on what is expected of them.

These points are explored in more depth as follows.

i. Defining a Clear Baseline

In developing any local policy targets the local planning authority and developers need to be clear about what the policy (for example a percentage reduction in CO_2 emissions) is being measured against. A clear and consistent baseline is therefore essential. We suggest that this baseline is 'fixed' at a particular point in time (i.e. 2010) because a continually changing baseline can create uncertainty for both the local planning authority and developers. The baseline that we suggest the policy is measured against is 2006 Building Regulations (Part L) which aligns with the targets presented in the CSH. Appendix E provides the benchmarks used in this study, with the sources of this information set out in Table 9.4. These benchmarks estimate the likely emissions from different types of buildings built to Building Regulations standards simply as a guide. Actual performance will depend on the developer's own SAP/SBEM assessments.

Table 9.2 Data Sources for the Baseline (See also Appendix E for further details and Benchmarks used)

Type of development	Source of baseline reference
Residential	Our assumptions on what the baseline relate to figures in Tables 2.3 and 2.6 of CLG's Research to Assess the Costs and Benefits of the Government's Proposals to Reduce the Carbon Footprint of New Housing Development 2008 (http://www.communities.gov.uk/documents/planningandbuilding/pdf/953098.pdf). The figures are based on typical house types and construction methods compliant with current Building Regulations. It is these figures that we use in our spreadsheet model when appraising the different typologies.
Non-residential	Benchmark energy demand assumptions are taken from 'Energy Efficiency in Buildings, CIBSE Guide F, Chartered Institute of Building Services Engineers (2004)' for a range of commercial and industrial building types. In all cases 'Good Practice' standards of building are assumed.

ii. Viable and Feasible

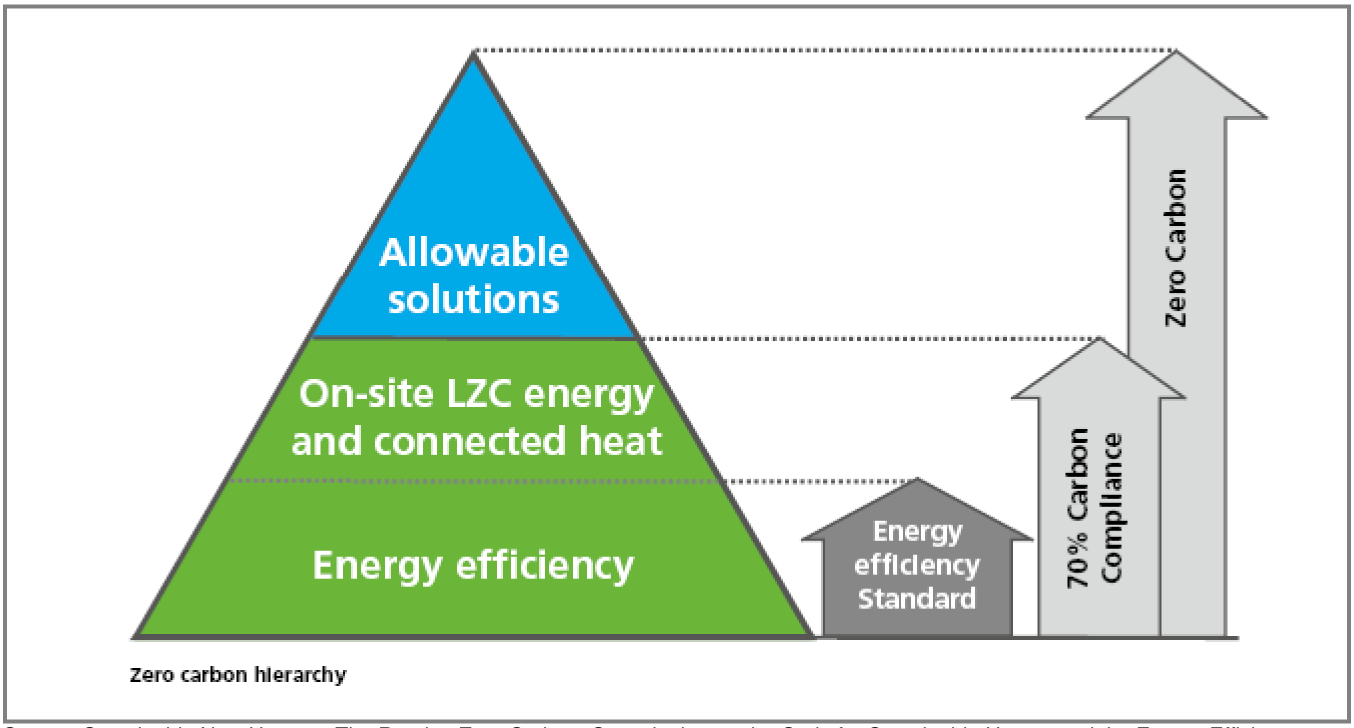
This is a key factor affecting the achievability of a local policy requirement. If it significantly impacts on development viability it could open the Council to challenges from developers that the policy is unviable and, ultimately, constrain new housing and other development coming forward (e.g. the ability to deliver Growth Point priorities). It is important to note however that viability cannot be considered in relation to renewable energy in isolation – the viability of a particular development will depend on a wide range of factors including land remediation costs, Section 106 contributions and levels of affordable housing for example.

In addition to viability, the policy requirement also needs to be feasible at a technical level - i.e. that it is possible to achieve a specific level of performance on a site using currently available technologies. Our typology appraisal is a helpful starting point to understand what different technologies could be feasible on a range of development types.

iii. Flexibility: Planning for Zero Carbon Development

The Core Strategy timescale of 15-20 years presents a significant challenge when setting a local policy for decentralised and renewable or low carbon energy given the rapidly changing policy environment in energy, planning and building regulations. An important consideration when setting local policy requirements is the government's timetable to deliver zero carbon homes by 2016 and zero carbon non-residential development by 2019 (see timetable set out in Table 4.1, section 4). In particular it is important to note the Government's recognition that on-site measures alone will not be enough to achieve zero carbon development and that some form of 'allowable solutions' will be required, most likely in the form of a financial contribution.

Figure 9.3 Zero Carbon Hierarchy



Source: Sustainable New Homes - The Road to Zero Carbon, Consultation on the Code for Sustainable Homes and the Energy Efficiency standard for Zero Carbon Homes, Department for Communities and Local Government (DCLG), December 2009.

Note: LZC = Low/ Zero Carbon

With respect to a potential financial contribution to achieve zero carbon development, Milton Keynes Council was one of the first local planning authorities to do so in their Sustainable Construction Policy D4 and supporting SPD in 2007. The Council's approach is to require financial contributions to the Milton Keynes 'carbon offset fund' where it is not possible to achieve zero carbon development on site. Following the calculation of a development's likely CO_2 emissions (tonnes per annum) a contribution of £200 per tonne for net additional emissions via a Section 106 agreement or unilateral undertaking is required of developers. The carbon offset fund is managed by the MK Energy Agency on behalf of and monitored by the Council. This type of approach could be pursued in Northumberland in order to achieve the 2016 target.

Table 9.3 provides a review of the other opportunities for allowable solutions.

Table 9.3 Allowable Solutions - Advantages and Disadvantages

Allowable Solution options	Advantages	Disadvantages
Further carbon reductions on site beyond the regulatory standard	Demonstration of potential; anticipation of further tightening of standards	Cost

Allowable Solution options	Advantages	Disadvantages
Energy efficient appliances meeting a high standard which are installed as fittings within the home	Effective means of directly addressing energy use	Initial cost
Advanced forms of building control system which reduce the level of energy use in the home	Comprehensive, real-time management	Cost
Exports of low carbon or renewable heat from the developer to other developments	Income-earning potential	Cost of infrastructure and management
Investments in low and zero-carbon community heat infrastructure	Efficient solution for significant number of dwellings	Cost and masterplanning co-ordination

Source: based on criteria in CLG (2009) Sustainable New Homes – The Road to Zero Carbon. Consultation on the Code for Sustainable Homes and the Energy Efficiency standard for Zero Carbon Homes

iv. Clear and Concise: Ease of Implementation for Local Planning Officers

The policy will be used by planners in both development control and enforcement. That the policy is easy to understand, implement and enforce is therefore crucial. To help support the delivery and implementation of these types of policies some local planning authorities are adopting Supplementary Planning Documents (SPDs) providing further guidance.

9.3.7 Developers Workshop

At the outset it is important to note that together with NCC Entec ran a workshop with residential and commercial developers active in the County to discuss their experiences in responding to planning policies for renewables alongside new developments. The key findings from this workshop are summarised in Box 8 and this has informed the policy conclusions made in this section.

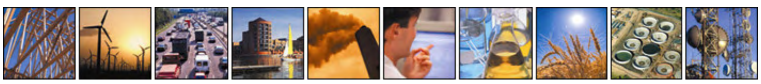
Box 8 Workshop: key findings

Date of workshop: 6th October 2010

Attendees: Representatives from Northumberland County Council and Entec, NLP, Banks, BHP Develop, Persimmon, HBF, Barratts, Butler Haig Associates, Taylor Wimpey.

Key findings

- **Difficulties with any policy option requiring on-site renewables** (e.g. Merton rule) because it was stated that the majority of house purchasers are not interested in having renewable or low carbon technologies on their homes. The issue is therefore who pays for this, with developers typically having to absorb the costs.
- **Use of CHP type schemes is difficult for residential only developments** – it is preferable to co-locate with a site/building with a steady base heat load, either as part of a large mixed use scheme or existing development nearby.
- **A policy target for on-site carbon reduction preferred to Merton rule (**on-site energy supply) because it is seen as more flexible to allow for the use of energy efficiency measures.
- **Concerns raised regarding targets which require *whole* levels of the Code for Sustainable Homes/BREEAM** with a range of local factors that need to be taken into account (e.g. one developer argued that even achieving BREEAM 'Good' can be challenging in Northumberland). One option discussed was the potential to produce a locally specific policy based on identifying which of the constituent parts of the Code for Sustainable Homes would be achievable in Northumberland, without requiring a whole Code level outright.



- **Energy hierarchy approach questioned** given the likely limited potential of heating networks across the County as a whole. Are more target driven approach was preferred by NCC.
- **Noted that what is achievable on specific sites depends on who the landowner is** – e.g. public sector landowners require higher levels of the Code for Sustainable Homes to be built to. Typically private sector landowners not as concerned with this, which is why it is the developers that often have to the bear the costs (i.e. comes out of their profit).
- **General point that reducing emissions from the *existing* built environment should be the focus** given that new build will already be more efficient as enforced via Building Regulations.
- **Developers would prefer to contribute to a community energy fund** to secure carbon reductions (e.g. to make existing older stock more efficient) than try to accommodate on site renewable or low carbon energy technologies.
- **Development viability** - the requirement for levels of the Code for Sustainable Homes etc needs to be balanced carefully against other policy requirements affecting sites, including levels of affordable housing and other S106 costs. The costs of achieving higher Code levels is a particular concern (see Appendix G for a cost review)

9.4 Draft Policy for Testing and Examination via the LDF Process

In response to the appraisal of options and findings from the developer workshop this section presents draft policy wording for testing via the LDF process. The aim of this policy would be to go with the grain of current best practice in the County and established building regulations rather than go significantly beyond the agreed national timetable. The policy is therefore focussed more on ensuring that developers plan for these future standards to future proof their schemes at the outset. A failure to do so could mean that developers do not fully understand the viability of their scheme (i.e. the costs associated with any necessary renewable or low carbon energy) as well as the risk of having to redesign schemes where provision has not been made (e.g. the land-take to accommodate an energy centre for example). Box 9 sets out this draft policy wording, together with accompanying justification as the basis for supporting text.

Box 9	Draft policy wording and requirements for renewable and low carbon energy and sustainable buildings

Policy wording and standards for further testing via the LDF process

PART A. MINIMUM STANDARDS BY DEVELOPMENT SIZE AND TYPE – COUNTY-WIDE

To help ensure that developers plan for higher standards the Council proposes the following minimum standards, but in most cases will expect these standards to be exceeded where the opportunities exist to do so (note: these minimum standards may ultimately be superseded by national amendments to Building Regulations).

Development type	Minimum standard
***All* new residential development, including conversions**	**Code for Sustainable Homes Level 3 overall (or future national equivalent standard)**
Non-residential development	**BREEAM 'very good' (or future national equivalent standard)**

In considering the overall sustainability of schemes developers will be required to set out in the Design and Access Statement (or Planning Statement) how the development: i. uses less energy, ii. uses energy efficiently and iii. uses renewable energy.

PART B. REQUIREMENT FOR STRATEGIC SITES (E.G. GROWTH POINT SITES)

Given the size and scale of strategic site allocations (i.e. mixed use and larger developments to be phased over a number of years) developers will be expected to demonstrate how energy efficiency measures and on-site or locally connected renewable/low carbon energy will ensure that:

- Homes built post-2013 will be able to achieve greater than or equal to a 25% improvement on the 2010 DER/TER (commensurate with Level 4 of the Code for Sustainable Homes)
- Homes built post-2016 will be able to achieve greater than or equal to a 100% improvement on the 2010 DER/TER with provisions for 'zero carbon' (Code 6).

Provision of funds towards off-site solutions with respect to the 2016 standard is likely to be acceptable pending further guidance from government (e.g. price of carbon etc – this is expected to be announced in 2011).

Policy justification & basis for supporting text

Minimum standards

The minimum standards presented in Part A of the policy are not intended to be overly onerous and will broadly align with best practice development in the County.

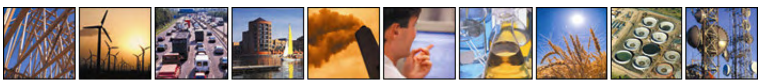
Strategic sites

The Strategic Sites considered as part of this report include those sites within the South East Northumberland Growth Point.

The planning and design of these sites - and other developments which are at planning stage now and likely to be phased over a number of years - needs to address how these targets have been taken into account given land-take and cost implications in particular (particularly where communal scale systems such as heating networks are proposed). Whilst energy efficiency, micro-generation and off-site measures will all have a role to play it will be particularly important to consider the potential for heating networks as is already being considered at Blyth.

The review of Growth Area sites included in this report provides a helpful starting point for developers and NCC to understand what technologies could be suitable for these sites, with the wider appraisal of 'typical' developments providing further guidance for other types of site across the County.

Achievement can be tested and monitored via a Code for Sustainable Homes Pre-Assessment submitted at detailed design stage, though would need to be considered carefully at outline stage.



9.5 Implementation and Monitoring

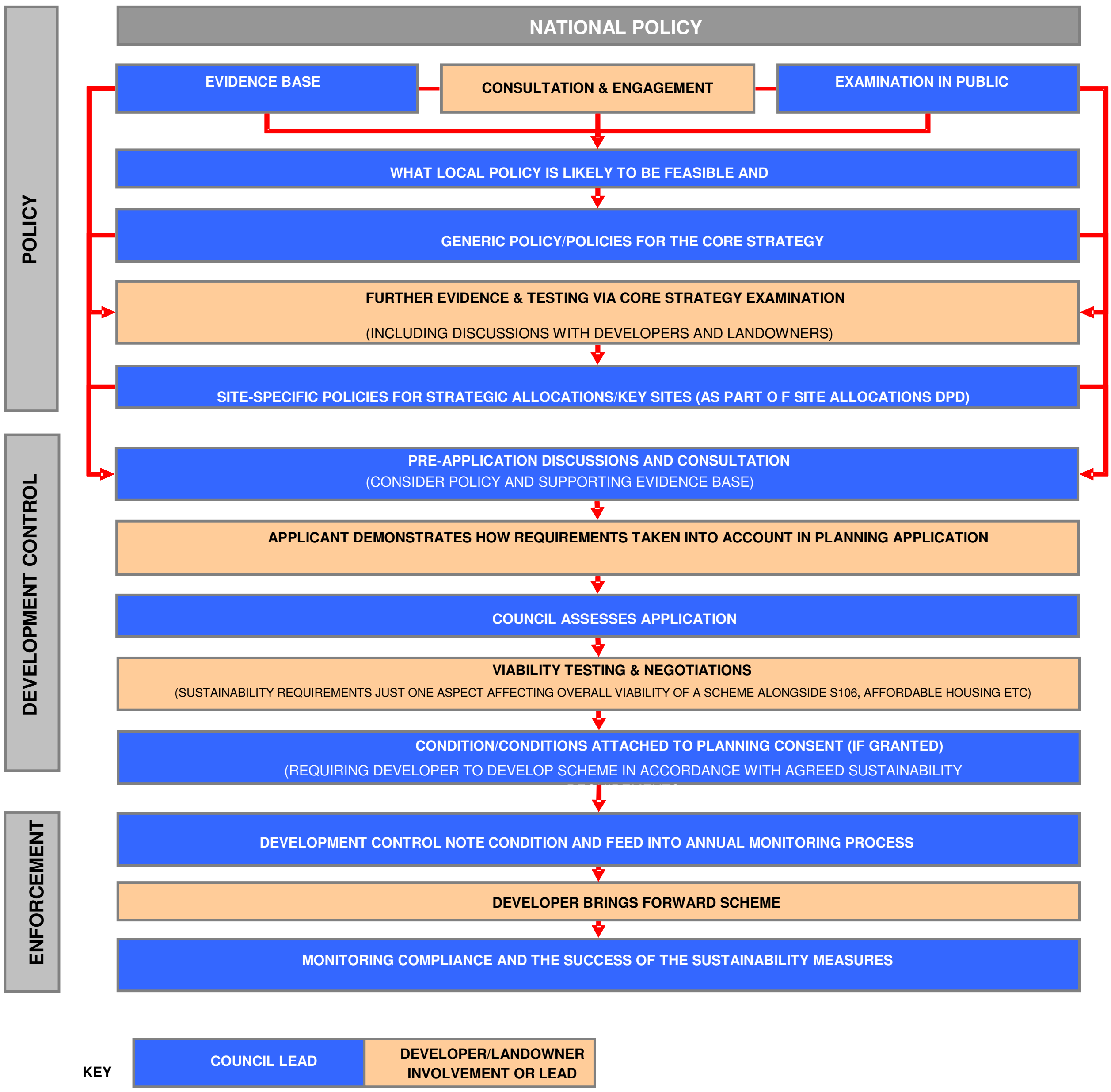
Figure 9.4 presents a flow chart for implementing, enforcing and monitoring the draft policy presented in Box 8. The level of monitoring and enforcement will ultimately depend on how far the Council' want to go and the resources at its disposal. Possible indicators to monitor the success of the policy include:

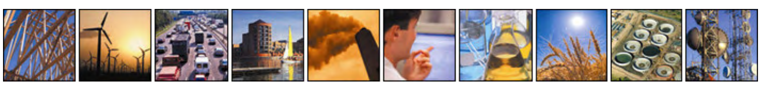
- the standards to which new buildings are built linking with the Building Regulations approval process (including Code/BREEAM certificates);
- the number of planning applications in a year and level of performance achieved (e.g. could use Code pre-assessments and final certificates as indicators); and
- renewable energy installed capacity across the County.

Where renewable energy is installed alongside new developments the Council could choose to monitor the effectiveness of these installations to meeting a development's energy needs, though this is more commonly done in relation to monitoring a percentage based target (for example the data logger approach pursued by authorities such as the London Borough of Merton[15]).

[15] http://www.building.co.uk/new-on-site-measurement-system-launched-in-merton/3112393.article

Figure 9.4 Policy Development and Application Flowchart



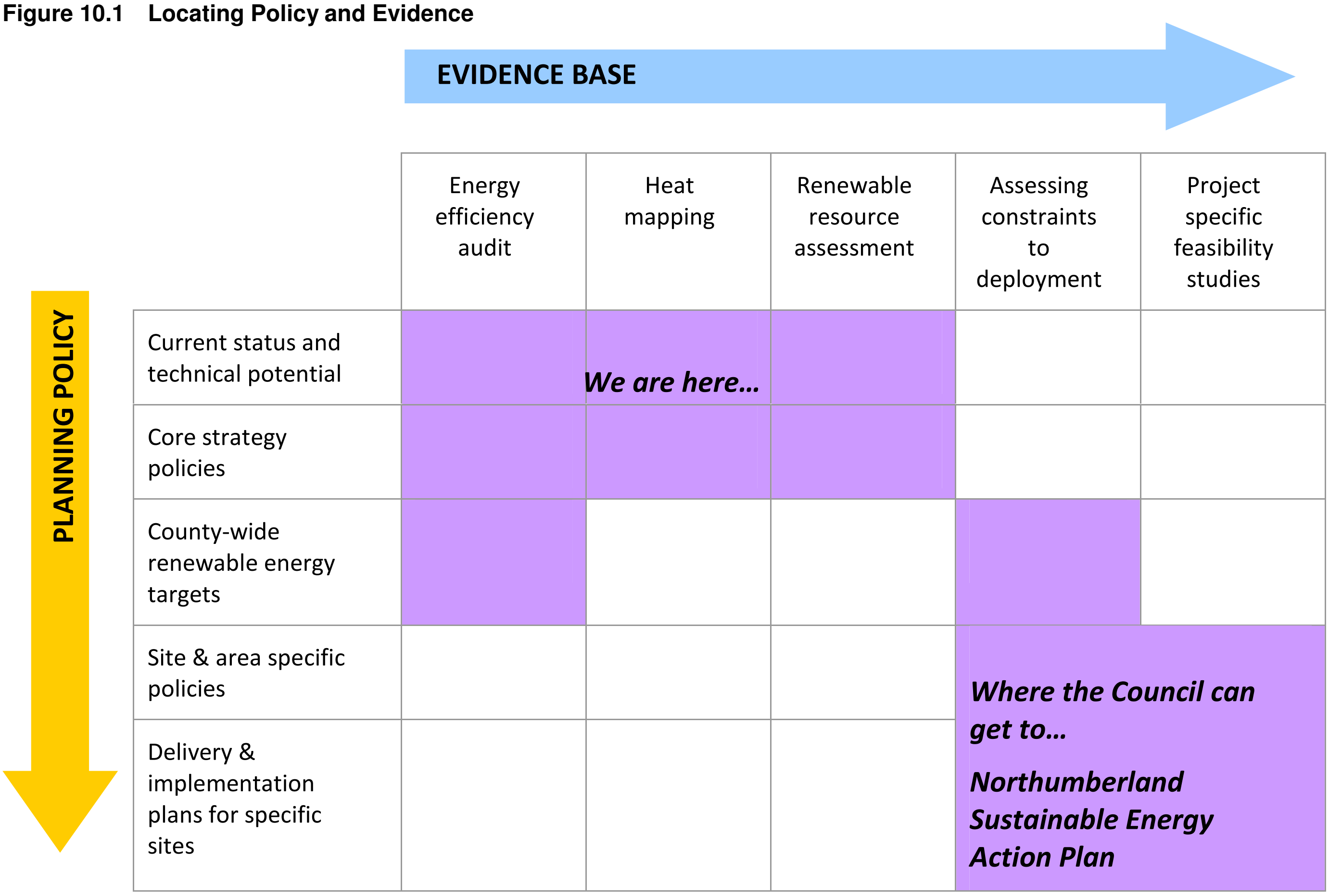


10. Delivering Energy Efficiency and Renewables

10.1 Overview

This section considers the way in which energy efficiency measures and renewable energy technologies might best be delivered across Northumberland. The starting point is a summary of the relationship between evolving policy and the supporting evidence base, as summarised in Figure 10.1. Here, the definition of Core Strategy policies forms the basis for exploring how various aspects of energy use and generation might be blended to form a County-wide and site-specific response. Planning policy, however, is only one element of a range of complementary mechanisms which include Council-wide initiatives for delivering agreed targets for both energy efficiency and the cultivation of new sources of energy. Site-specific studies and their associated policies and plans will emerge from the progression of these targets.

Figure 10.1 Locating Policy and Evidence



10.2 Mechanisms and Agents for Delivery

There are three types of 'energy opportunity' available to Northumberland County Council: existing development, new development and community schemes. Each has its own mechanism, potential partners and supporting aspect of planning policy. Broadly, the contribution of each energy opportunity is as follows:

Energy Opportunity	Delivery through …
Existing Development	• Energy efficiency • Fuel switches away from high carbon sources • On-site low-carbon and renewable energy technologies
New Development	• Energy efficient new development • On-site low-carbon and renewable energy technologies • Increased on-site carbon reductions or near-site generation • Allowable solutions off-site
Strategic community-wide interventions	• Decentralised low-carbon and renewable energy using private and/or public investment through partnership • Low-carbon resource supply chains

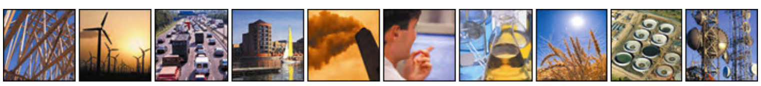
For all three opportunities, delivery is dependent upon a collaborative approach between the LPA, LSPs, developers and the community, with a common focal point being the Northumberland SEAP (as committed to under the Covenant of Mayors) and a partnership approach to delivery. Figure 10.2 sets out an overview of the delivery mechanisms, partners and planning policies associated with each type of focus for energy planning. Whilst the approaches to securing improvements in energy efficiency are reasonably clear, with the focus for efforts readily identified, this is a significant task which will demand County-wide measures, amongst which is the development of partnership arrangements between key delivery agents, led by the County. Planning policy supports this effort through benchmarking building energy performance and facilitating developments which help to fulfil this, such as micro-generation schemes.

Community-wide projects represent a significant departure from current practice, with as retrofitting existing areas or as part of new build. Various case studies reflecting on how the HCA has pushing best practice in both existing and new build are set out in Appendix F. These demand significant effort in terms of establishing appropriate mechanisms and partnerships for their delivery. Generically termed ESCos (Energy Service Companies), a variety of community-owned or public-private partnership delivery structures are being developed, typically established to install, finance and manage community energy systems to deliver improved efficiency and cheaper fuel (see Box 10 and Table 10.1).

Figure 10.2 Overview of Delivery Mechanisms, Partners and Planning Policy

Energy Focus	Delivery Mechanism	Delivery Partners	Planning Policy
Existing Development	LA support for microgeneration LDOs	Local Authority LSP Home/building owners ESCo	Incremental Improvements
New Development	Building Regulations S106 & Community Energy Fund Allowable Solutions	Local Authority LSP Energy developers Housebuilders/ developers/RSLs ESCo	Local and Code targets Policies for strategic sites Design and layout
Community-wide Projects	S106 & Community Energy Fund LDOs Public sector policy and targets Allowable Solutions	Local Authority LSP Energy developers Housebuilders/ developers/RSLs ESCo Community organisations	Generation targets Supporting policies Installation/ connection to District infrastructure Design and layout

Source: adapted from AECOM (March 2010) North Hampshire Renewable Energy and Low-Carbon Development Study



Box 10 The role of ESCos & MUSCos in delivering renewables

Delivery will almost certainly involve the creation of a legal entity to contain the commercial risk and raise capital for the DHN and energy centre. This entity is generally known as an ESCo, and its nature will shape the delivered scheme and which of the aims are prioritised. The Council and other delivery partners may take a degree of ownership/representation in the ESCo, as may the local community, or the ESCo may be a purely private sector entity.

The advantage of the former is that a local authority, or a public/private partnership, can take a longer term view of the investment and accept a lower rate of return and may also be able to take advantage of prudential borrowing. A purely private ESCo may prioritise financial return over carbon savings, community involvement, fuel poverty issues and so on, whereas, a partially community owned ESCo may focus on the social benefits and retaining the community's wealth in the area.

A large Multi-Utility Services Company (MUSCo) is a specialist organisation which has licenses to operate a number of utilities. It may be able to offer cost effective, fully serviced sites for the developers. This may include the energy centre and heat mains, gas supplies, water mains, waste water, electricity and fibre optic broadband. The infrastructure would be funded partly by the MUSCo and partly by the developers. Therefore capital investment for the developer may be minimised.

Source: AECOM (July 2010) Planning for Renewable and Low Carbon Energy: a Toolkit for Planners

Operating an ESCo

A local authority-led example of an ESCo is Woking Borough Council which has established an energy and environmental service company, Thamesway, and developed its own public/private joint venture energy services company known as Thamesway Energy Ltd (TEL). TEL aims to build, finance and operate small-scale combined heat and power stations (energy stations), of up to five megawatts electricity output, to provide energy services to institutional, business and residential customers. The council raised capital to fund the initial energy infrastructure development through energy efficiency savings. A fund mechanism was established in a benchmark year for energy expenditure, against which savings accruing from energy efficiency measures were recycled, year on year, into further energy-saving initiatives. A network of over 60 local generators, including photovoltaic arrays and a hydrogen fuel cell station, to power, heat and cool municipal buildings and social housing has been developed. Decentralising energy production in this way has enabled the council to reduce its CO2 emissions by 77 per cent since 1990

(http://www.cabe.org.uk/sustainable-places/advice/escos-and-muscos)

Table 10.1 Advantages and Disadvantages of ESCo Models

	Private sector-led ESCo	Public sector-led ESCo
Advantages	• Private sector capital • Transfer of risk • Commercial and technical expertise	• Lower interest rates on available capital can be secured through Prudential Borrowing • Transfer of risk on a communal heating network through construction contracts • More control over strategic direction • No profit needed • Incremental expansion more likely • Low set-up costs (internal accounting only)
Disadvantages	• Loss of control • Most profit retained by private sector • Incremental expansion more difficult • High set-up costs	• Less access to private capital and expertise though expertise can be obtained through outsourcing and specific recruitment • Greater risk

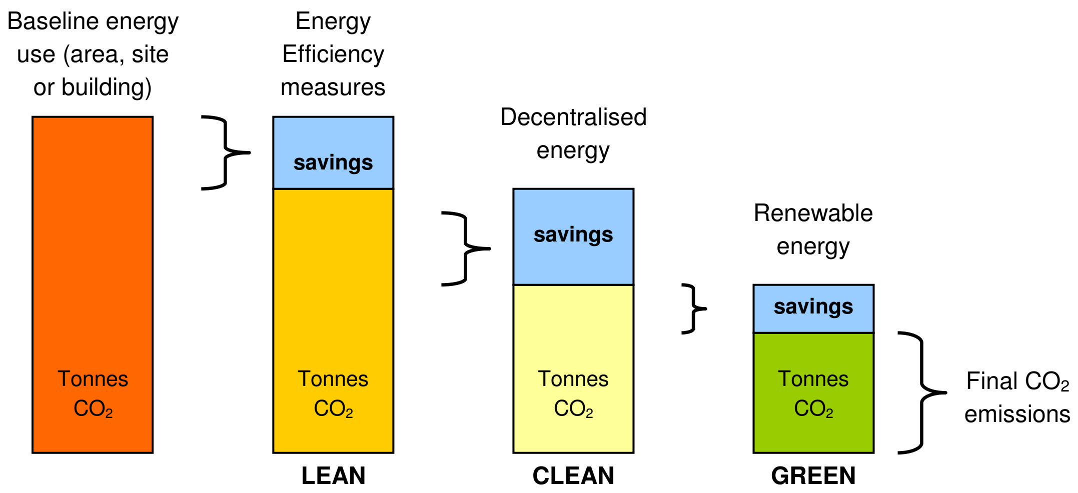
Source: AECOM (March 2010) North Hampshire Renewable Energy and Low-Carbon Development Study p.102

11. Conclusions On Realising Energy Efficiency And Renewables In Northumberland

11.1 Overview

This study has identified the scale and location of the potential for energy efficiency improvements and the delivery of renewable energy schemes across Northumberland. The approach to energy efficiency and the development of renewable sources of energy needs to be part of a hierarchical approach which progressively reduces CO_2 emissions as part of a low-carbon strategy which is applicable at all scales, from the County to the individual site or building. The approach is illustrated Figure 11.1.

Figure 11.1 The Hierarchy of CO_2 Reduction



Source: GLA and London Climate Change Agency

Planning is but one part of a wider effort to recast the County's energy sources and uses, linked by the County's Sustainable Energy Action Plan. This will require a blend of responses in type and scale, with land use planning acting as an enabler particularly in the delivery of development which is low-carbon/carbon-neutral, but also in the retrofitting of existing development to help improve its energy efficiency performance and create alternative sources of energy.

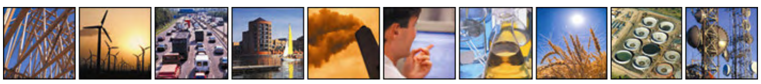
11.2 Approach

Figure 11.1 provides an overview of the key tasks that have been undertaken as part of this study.

Table 11.1 Study Tasks and Outputs

STAGE	TASKS
PART A: REDUCING DEMAND – ENERGY EFFICIENCY AND SUSTAINABLE DESIGN & CONSTRUCTION	
Section 2. Energy Demand and Energy Efficiency in Northumberland	Quantify current CO_2 emissions associated with the built environment using figures from DECC Estimate CO_2 emissions associated with the built environment at 2021 as a result of planned growth
Section 3. The Contribution of Energy Efficiency to Reducing CO_2 emissions in Northumberland	Appraise the opportunities and benefits of a range of energy efficiency measures, including: cavity/solid wall insulation, roof insulation, high performance windows, condensing boilers, advanced building controls and other measures Consider costs and uptake scenarios and what can realistically be achieved
Section 4. Realising Energy Efficiency in New Development: Site and Building Design	Identify site design principles that could form the basis for a future sustainable design and construction SPD Appraise the impacts of the Government's national timetable for delivering zero carbon developments
Section 5. Conclusions on Energy Efficiency in Northumberland	Summary on the potential opportunities that exist to reduce emissions via energy efficiency measures alone
PART B: ENABLING DELIVERY OF A LOW CARBON NORTHUMBERLAND	
Section 6. Approaches to Realising Renewable Energy in Northumberland	Overview of the available technologies that can be considered and their typical scale of application
Section 7. Northumberland's Capacity for Renewable Energy Generation	Assessing the existing contribution that renewables make in Northumberland Considering the potential for additional renewable capacity based on a comprehensive 'renewable resource assessment'
Section 8. Feasibility and Viability of Renewable Energy Schemes	Considering the feasibility and viability of stand-alone renewable energy schemes Appraisal of opportunities for development integrated renewables alongside new development schemes (including Growth Point sites) using a 'Renewable and Low Carbon Technology Appraisal Model'
PART C: POLICY DEVELOPMENT AND DELIVERY	
Section 9. Policy Development for Energy Efficiency and Renewables	Setting out strategic policy considerations for the Core Strategy with respect to the spatial strategy and key sites Review and appraisal of policy models for requiring new developments to reduce emissions/use on-site renewable energy
Section 10. Delivering Energy Efficiency and Renewables	Delivery strategy with respect to both planning policy and the Council's wider activities and programmes
Section 11. Conclusions on Realising Energy Efficiency and Renewables in Northumberland	Summary conclusions and recommendations of key findings from the study and the next steps

Note: specific methodologies for each stage and task are outlined in the relevant section of the report or supporting appendices.



11.3 Overview of Main Findings

11.3.1 Baseline and Future CO_2 Emissions from the Built Environment

Reducing CO_2 emissions from Northumberland's built environment is a significant challenge - as at 2008 the demand to heat and power the County's homes, schools and other buildings accounted for 1.5 million (M) tonnes of CO_2 per annum. The largest concentration of these emissions comes from the former authority areas of Blyth Valley, Tynedale and Wansbeck, which each have a demand for heating of beyond 500 Gigawatt hours (GWh) per annum.

Projected development over the next ten years is unlikely to have a *significant* impact on emissions, with the 10,000 homes estimated to be provided by 2021 only resulting in a net increase in emissions of some 5%. This is because the proportion of new growth to existing (10,000 homes vs. an existing building stock of well over 145,000 homes at 2009) is small but, crucially, new homes will be built to higher standards of energy efficiency; standards which are being implemented through national building regulations.

11.3.2 Reducing Emissions in the Existing Built Environment

At a national level the government recognises that responding to emissions arising from the existing built environment is a major priority, which is why they plan to implement a number of initiatives including the recently announced Green Deal which aims to drive the take-up of energy efficiency measures. The role of the planning system and the Northumberland LDF in delivering the range of energy measures necessary to reduce emissions associated with the existing built environment is clearly limited, since planning has most of its influence on new build development. However, there is an important opportunity to consider where planning policy could have a role to play; that is developer contributions towards efficiency schemes within existing buildings to 'offset' emissions associated with new developments. This is likely to have a key role to play in order to achieve the zero carbon standards that new homes are expected to be built to from 2016.

11.3.3 Northumberland's Renewable and Low Carbon Resource

Alongside energy efficiency measures this report explores the range of opportunities for bringing forward renewable and low carbon energy projects to serve both the existing and new built environment. Renewable and low carbon energy projects will be fundamental to reducing CO_2 emissions in response to local commitments and the drive for a low carbon Northumberland.

At the outset it is important to note that Northumberland already has significant potential from renewable energy schemes in the pipeline, from wind farms in particular. As at January 2011, almost 290 Megawatts (MW) and over 100 turbines has planning consent across the County on top of the 5MW that is already operational at Kirkheaton and Blyth Harbour. Alongside wind, biomass also makes a contribution, most notably from the Egger plant at

Hexham with an installed capacity of some 50MW (heat). In addition, there is around 8MW installed capacity (electricity) for biomass. At a smaller scale there are operational hydro, landfill gas and solar schemes generating electricity across the County, typically serving specific buildings and developments.

What NCC needs to understand is what further potential exists for renewable and low carbon energy schemes and how they can provide the supportive policy framework to encourage its take-up in response to the Climate Change PPS. This is one of the primary focuses of this study, underpinned by a comprehensive Renewable and Low Carbon Resource Assessment (Appendix A).

Tables 11.2 and 11.3 show that there is significant 'technical potential' to supply energy from renewable and low carbon sources, from biomass, waste, wind, hydro and micro-generation. The aim of identifying this technical potential is to provide a comprehensive overview of what potential exists across the County to guide NCC, developers, landowners and local communities. At a practical level only a proportion of this potential is likely to be delivered which will depend on a range of factors, not least the market, developer interest, political will and the future direction of national energy policy. What this study shows however is that the opportunities exist from a range of sources which could have a major role to play as part of an overall strategy for reducing the County's CO_2 emissions, reducing the reliance on fossil fuels, providing greater energy security and to help to support the Council's wider economic ambitions for a low carbon Northumberland.

This technical potential has been estimated from a desk-based analysis reflecting the availability of the resource (e.g. wind speeds, biomass fuel and water flows for hydro) and key constraints such as environmental designations. The aim of this assessment is *not* to identify particular areas as suitable in planning policy terms (e.g. for allocation in the LDF) because this will depend on a range of factors at a project specific level, including consideration of social, economic and environmental impacts. The implication of this is that where potential has been identified in relation to particular areas (e.g. least constrained areas for wind) this does not mean that proposals should be considered favourably by the Council, nor does it mean that proposals for other areas should be rejected as unsuitable.

Table 11.2 Summary of Technical Potential for Renewable and Low Carbon Electricity

Resource	Potential electricity supply (MWh per annum)	Installed Capacity (MW electrical)	Approximate proportion of electricity demand in 2008*
Biomass	1,170,000	170	73%
Waste	50,000	10	3%
Wind	44,700,000	17,020	2779%
Hydro	250,000	60	15%
Micro-generation	70,000	n/a	4%
Total	**46,240,000**	**17,260**	**2874%**

Source: Entec

*DECC energy consumptions figures from 2008 show an existing electricity demand for 1,608,000MWh across the built environment

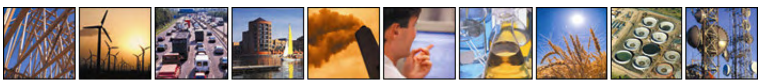


Table 11.3 Summary of Technical Potential for Renewable and Low Carbon Heat

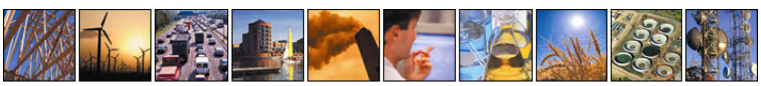
Resource	Potential heat supply (MWh per annum)	Installed Capacity (MW thermal)	Approximate proportion of heat demand in 2008*
Biomass	3,680,000	660	135%
Waste	180,000	30	6%
Wind	0	0	0%
Hydro	0	0	0%
Micro-generation	290,000	n/a	11%
Total	**4,150,000**	**690**	**152%**

Source: Entec
*DECC energy consumptions figures from 2008 show an existing electricity demand for 1,608,000MWh across the built environment

In considering technical potential the report also identifies some of the key challenges that NCC and others will need to overcome to bring this potential forward, challenges that are in some cases beyond the scope of planning policy (Table 11.4).

Table 11.4 Overcoming Challenges to Delivery of the Renewable and Low Carbon Resource

Technology	Overcoming key challenges to delivery
Wind turbines	Land ownership and developer interest: *availability of land and whether or not there is developer interest is crucial to understand at the outset* Perceived community impacts/opposition to wind developments: *can be addressed through early engagement/education, as well as exploring opportunities for community ownership/shares in wind farm schemes* Grid connection and capacity: *early liaison with NEDL (distribution network operator) and National Grid for larger schemes* Physical constraints, including highways, access and design (construction & operation): *undertake access feasibility studies when sites identified. Transport Assessment (TA) will be required at planning application stage* Views of stakeholders (MOD, Nats En Route Radar Ltd, microwave link operators, Newcastle Airport, HSE, National Grid - note, list not exhaustive): *early engagement as part of feasibility studies and pre-application discussions* Impacts on landscape, cultural heritage and biodiversity (including cumulative impacts): *likely to be addressed in detailed as part of Environmental Impact Assessment (EIA) process though early understanding of the issues essential. Discussions with Natural England, English Heritage and NCC encouraged at the outset and will help to understand the risks involved*
Biomass, waste and other combustible fuel	Availability of fuel: *although there is locally available biomass and waste, larger scale projects may require fuel to be imported from other regions. The supply of biomass, waste or other fuel is not seen as an overall constraint to development however – where the demand exists the market should be there (locally or further afield)* Impacts associated with heating networks: *biomass, waste and other combustible fuels typically used to serve heating networks, which are associated with a range of challenges to delivery (see below)*



Technology	Overcoming key challenges to delivery
Heating networks with combined heat and power (CHP)	Environmental impacts (e.g. air quality, noise and visual effects): *air quality is a particular issue associated with a high concentration of heating networks/plants in urban areas and unlikely to be a major issue in Northumberland, however where networks are planned air quality and a range of other impacts will need to be addressed, with EIA likely to be required for larger schemes* Costs and delivery (who pays?): *the upfront capital costs associated with the plant and infrastructure are a key issue, particularly for developers of mixed use schemes where heating networks are considered. However many developers are now recognising the need to plan for such networks - in anticipation of higher standards being introduced via Building Regulations - and forming partnerships with energy developers and Energy Services Companies (ESCO) to take these projects on*
Micro-generation in existing development	Funding and financial incentives: *to retro-fit micro-generation within existing housing requires the financial incentive to do so. In some cases individual households are doing so in response to green aspirations, reduced energy bills and financial incentives such as the Feed-in-Tariff. How this can be delivered at a more 'strategic' scale (e.g. across a neighbourhood) is something that needs to be considered alongside energy efficiency schemes which may be cheaper/more effective in terms of reducing emissions. There are examples in the UK of where retrofit schemes of this type have been implemented, such as Birmingham City Council's proposal to fit solar panels to 10,000 Council-owned properties (see main report for further detail). There is also a role for developers of new schemes to contribute to schemes such as this as part of a wider package of measures to 'offset' the emissions associated with their schemes, particularly as we move towards the target of zero carbon homes by 2016* Impacts on historic environment: *the historic nature of Northumberland's towns and villages, which includes designated Conservation Areas and Listed Buildings means that proposals for technologies such as solar PV and solar thermal on roofs of buildings would need careful attention.*
Other opportunities	Identifying specific projects: *for projects such as hydro schemes, solar farms and geothermal opportunities it is much more challenging to identify specific site opportunities as part of a County-wide desktop study such as this. In practice, site investigations and fieldwork will be required to identify specific projects, work which could be pursued by NCC, the private sector or in partnership.*

Spatial Implications for the Core Strategy and wider LDF

Significant growth is planned for Northumberland over the next ten years, including the provision of an estimated 10,000 new homes, employment and supporting community infrastructure. Whilst the spatial strategy and distribution of this growth is yet to be determined (it is for examination via the LDF process) it is expected that the South East Northumberland Growth Point will be one of the key areas where this growth will be delivered, comprising several strategic extensions to settlements including Morpeth, Blyth and Ashington. In addition there will be growth across the County's rural areas in response to local needs.

Within this growth context it is crucial to note the current government target for all homes to be 'zero carbon' from 2016 - that is, the energy used to heat and power a dwelling over the course of a year results in no net increase in CO_2 emissions (note: there is also a target for non-residential development to be zero carbon by 2019, but work to support this at a national level is less advanced). Recognising that this is a challenging target, the previous government set up the Zero Carbon Hub to help facilitate discussion and undertake research in order to achieve this ambition. Currently the Zero Carbon Hub are working closely with the government to develop a consistent definition of zero carbon which can be applied consistently via planning and building regulations, focussing in particular on the level of carbon reduction that can be achieved on-site and the off-site measures (most likely financial) that developers will be allowed to pursue.

It is clear that the next five years are hugely significant if this zero carbon standard is to be achieved and the Core Strategy and wider LDF can have a significant role to play in making this happen in Northumberland. Whilst there is a reliance on building regulations and national policy to ultimately drive the housebuilders to this level of performance there is policy that NCC can adopt now to help ensure that zero carbon is taken into account at the outset in the planning and design of new developments.

This study appraises a number of Growth Area sites, setting out what different technologies could achieve and what level of CO_2 reductions could be secured based on current information regarding the level and mix of development. This exercise - along with a similar appraisal of ‘typical’ developments that are likely to come forward over the next ten years - is intended as a helpful guide for NCC and developers to understand how higher national standards can be delivered.

11.4 ‘Key Priorities’ for the LDF

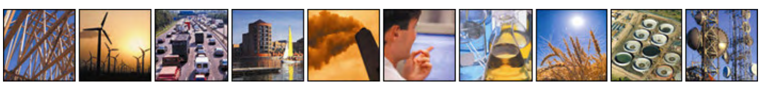
In response to the main findings the study proposes two ‘key priorities’ for action in the LDF which are outlined as follows:

11.4.1 Key Priority 1: Develop an Overarching Policy Supporting Renewable Energy Projects

The Climate Change PPS requires planning authorities to provide a positive policy framework for renewable, with the ‘need’ for schemes not to be questioned. In providing this policy framework in the LDF, particularly for strategic scale and stand-alone schemes, it is important to note the central conflict that the Council faces: responding to national and local commitments for delivering renewable energy projects in response to the global challenges posed by climate change versus the local impacts that these schemes can have on local communities as well as the historic built environment, ecology and landscape. As highlighted in Box i Northumberland is particularly sensitive in terms of its environmental assets. This conflict is something that the Council is already dealing with (as are planning authorities across the country) and demonstrated most notably in relation to planning and appeal decisions relating to wind farm proposals in particular.

Whilst the merits of planning proposals can be assessed on a case-by-case base via the development control system, including Environmental Impact Assessment (EIA) where required, it is considered important that the Council has a policy setting out the criteria against which proposals for renewable and low carbon energy schemes will be assessed. Without a regional policy framework[16] and in the likely absence of detailed national policy[17] a locally

[16] Although currently still part of the Development Pan for Northumberland it is likely that the North East Regional Spatial Strategy (RSS) will ultimately be revoked as part of government changes to the planning system. Crucially, the RSS included policy criteria against which renewable energy schemes will be appraised, similar to those identified in Box ii.



adopted policy setting out how proposals should be assessed is crucial. What is also essential however is that this policy is not overly *restrictive* since NCC still needs to be positive regarding the overall potential of schemes a provide a supportive policy 'hook' in the Core Strategy for developers to respond to. To this end, draft policy wording for testing, consultation and refinement via the LDF process is presented in Box 11.

Box 11 Draft wording for renewable and low carbon energy generic policy

Policy wording and criteria for further testing via the LDF process (emphasis added solely for the purposes of this report)

Proposals for the development of renewable and low carbon energy projects will be supported and encouraged and assessed against the following criteria:

- anticipated effects resulting from development, construction and operation such as air quality, atmospheric emissions, noise, odour, water pollution and the disposal of waste;
- acceptability of the location, and the scale of the proposal and its visual impact in relation to the character and sensitivity of the surrounding landscape;
- effect on national and internationally designated heritage sites or landscape areas, including the impact of proposals close to their boundaries (including Northumberland National Park, Northumberland Coast AONB and North Pennines AONB);
- effect of development on nature conservation sites and features, biodiversity and geodiversity, including internationally designated and other sites of nature conservation importance, and potential effects on settings, habitats, species and the water supply and hydrology of such sites;
- effect of development on cultural heritage and archaeological features, including designated Listed Buildings, Scheduled Ancient Monuments, Registered Parks and Gardens, Conservation Areas, historic settlements and undesignated features where these are considered as having local importance;
- effects on the openness of the Northumberland Green Belt;
- accessibility by road and public transport;
- effect on agriculture and other land based industries;
- visual impact of new grid connection lines;
- cumulative impact of the development in relation to other similar developments; and
- proximity to the renewable fuel source such as wood-fuel biomass processing plants within or close to major woodlands and forests.

Policy justification & basis for supporting text

The type of policy presented here would be applicable to all proposals for renewable and low carbon energy projects, regardless of their size and scale. The level of detailed required would vary depending on the nature of the proposals, with Environmental Impact Assessment (EIA) likely to be required to assess significant effects for larger scale schemes.

The policy provides the supporting hook for developers to respond to (renewable energy projects will be 'encouraged' by the Council) alongside clear criteria to ensure that schemes respond to local impacts. Specific policies for different types of energy project are not deemed necessary - this policy allows the flexibility to respond to schemes from wind farms to solar parks to biomass heating networks.

[17] As part of changes to the planning system the government plans to withdraw Planning Policy Statements (PPS) and Planning Policy Guidance (PPG) and to replace them with a more concise National Planning Framework. Ultimately, some of the detail which is in Planning Policy Statement 22: Renewable Energy and Climate Change PPS could be lost, so local policies will become even more important.

11.4.2 Key Priority 2: ‘Future Proof’ The Spatial Strategy so that Zero Carbon Aspirations can be Achieved

In response to this challenging timetable for zero carbon development this study recommends that the Core Strategy includes minimum standards for new development reflecting the characteristics of the types of development likely to come forward in the County and its location. These minimum standards are presented in the form of a draft policy (Box 12) for further testing and refinement via the LDF process. The aim of this policy would be to go with the grain of current best practice in the County and established building regulations rather than go significantly beyond the agreed national timetable. The policy is therefore focussed more on ensuring that developers plan for these future standards to future proof their schemes at the outset. A failure to do so could mean that developers do not fully understand the viability of their scheme (i.e. the costs associated with any necessary renewable or low carbon energy) as well as the risk of having to redesign schemes where provision has not been made (e.g. the land-take to accommodate an energy centre for example).

Box 12 Draft policy wording and requirements for renewable and low carbon energy and sustainable buildings

Policy wording and standards for further testing via the LDF process

PART A. MINIMUM STANDARDS BY DEVELOPMENT SIZE AND TYPE – COUNTY-WIDE

To help ensure that developers plan for higher standards the Council proposes the following minimum standards, but in most cases will expect these standards to be exceeded where the opportunities exist to do so (note: these minimum standards may ultimately be superseded by national amendments to Building Regulations).

Development type	Minimum standard
All **new residential development, including conversions**	**Code for Sustainable Homes Level 3 overall (or future national equivalent standard)**
Non-residential development	**BREEAM ‘very good’ (or future national equivalent standard)**

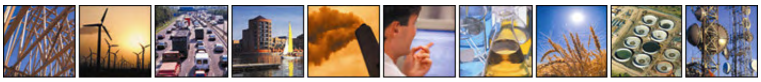
In considering the overall sustainability of schemes developers will be required to set out in the Design and Access Statement (or Planning Statement) how the development: i. uses less energy, ii. uses energy efficiently and iii. uses renewable energy.

PART B. REQUIREMENT FOR STRATEGIC SITES (E.G. GROWTH POINT SITES)

Given the size and scale of strategic site allocations (i.e. mixed use and larger developments to be phased over a number of years) developers will be expected to demonstrate how energy efficiency measures and on-site or locally connected renewable/low carbon energy will ensure that:

- Homes built post-2013 will be able to achieve greater than or equal to a 25% improvement on the 2010 DER/TER (commensurate with Level 4 of the Code for Sustainable Homes)
- Homes built post-2016 will be able to achieve greater than or equal to a 100% improvement on the 2010 DER/TER with provisions for ‘zero carbon’ (Code 6).

Provision of funds towards off-site solutions with respect to the 2016 standard is likely to be acceptable pending further guidance from government (e.g. price of carbon etc – this is expected to be announced in 2011).



Policy justification & basis for supporting text
Minimum standards The minimum standards presented in Part A of the policy are not intended to be overly onerous and will broadly align with best practice development in the County. Strategic sites The Strategic Sites considered as part of this report include those sites within the South East Northumberland Growth Point. The planning and design of these sites - and other developments which are at planning stage now and likely to be phased over a number of years - needs to address how these targets have been taken into account given land-take and cost implications in particular (particularly where communal scale systems such as heating networks are proposed). Whilst energy efficiency, micro-generation and off-site measures will all have a role to play it will be particularly important to consider the potential for heating networks as is already being considered at Blyth. The review of Growth Area sites included in this report provides a helpful starting point for developers and NCC to understand what technologies could be suitable for these sites, with the wider appraisal of 'typical' developments providing further guidance for other types of site across the County. Achievement can be tested and monitored via a Code for Sustainable Homes Pre-Assessment submitted at detailed design stage, though would need to be considered carefully at outline stage.

11.5 Working in Partnership

It is not just NCC who are responsible for the delivery of a low carbon Northumberland. There a wide range of actors alongside the Council including energy developers, residential and commercial developers, landowners and local communities. Table 11.5 therefore sets out how this report can be used by these various stakeholders, also reflecting their wider role in successful delivery and implementation.

Table 11.5 How this Report can be used

Stakeholder	How this report can be used
NCC	To support the development of planning policies and targets for CO_2 reduction in the LDF, including the Core Strategy, Strategic Site Allocations and the Infrastructure Delivery Plan To guide NCC's strategic priorities and investment decisions with respect to where the greatest potential is to deliver low and zero carbon development and renewable energy schemes To help NCC meets its corporate and wider commitments to reducing CO_2 emissions and the Council's response to climate change
Developers	To understand what opportunities exist for renewable and low carbon energy to supply their schemes to help support the achievement of national targets for zero carbon development, for example: ▪ Developers of particular types of site - from infill development to urban extensions - will be able to use the 'typologies assessment' presented in this report as a starting point to compare the types of on-site energy that could be used as part of a scheme and the levels of CO_2 reduction that could be possible (as well as key technical, feasibility and viability considerations) ▪ For developers of Growth Point sites (Cramlington South West Sector, Bates Colliery, Ellington, Cambois, and St George's Hospital), the report takes the conclusions of the typologies assessment further to identify specific recommendations on achieving higher levels of performance, particularly in terms of the opportunities and challenges associated with delivering 'zero carbon' homes from 2016 which needs to be planned for as early as possible in the planning and design process

Stakeholder	How this report can be used
Energy companies/Energy Service Companies (ESCO)	The larger energy companies and utilities providers in the region are likely to have their own understanding of what resource exists in Northumberland, however this report will still be helpful in terms of providing a comprehensive overview of the different opportunities - including wind, hydro, solar, biomass, communal heating networks and micro-generation. Alongside any existing evidence, the study can therefore be used in parallel for energy companies to identify possible opportunities for investment (including project-specific further feasibility work) With public sector finance continuing to be cut, the private sector will have an ever increasing role to play in the delivery of renewable and low carbon energy projects and exploiting the County's resource. The role of ESCOs could be particularly important
Landowners	The renewable resource presents a significant opportunity for landowners to increase the value of their assets, through accommodating renewable and low carbon energy projects to provide a fixed return over a period of time: e.g. wind farms, solar parks and biomass production. This study, whilst not identifying specific sites/ownership boundaries, will be a key reference point for landowners in the County to consider what potential exists working with developers, investors and the local planning authority to explore what may be possible
Local communities	Renewable and low carbon energy projects, particularly at a strategic-scale (e.g. wind farms), need to be sensitively planned in relation to community impacts. The planning process will be the key mechanism to balance these competing views, with Environmental Impact Assessment (EIA) to help mitigate significant community, environmental and economic effects typically required for larger projects. However, the benefits of renewable and low carbon energy schemes can be explored through working with local community groups drawing on the findings of this report (considering factors such as security of energy supply, responding to fuel poverty, responding to climate change and education regarding sustainable living). Local schools and colleges (e.g. Northumberland College) could have an important role to play here. The Localism Bill and associated proposals for Neighbourhood Plans announced by the Coalition Government - whereby local communities are to lead on the plan-making process - presents opportunities for community scale energy projects to the benefit of local people - such as a community owned wind turbine where residents buy shares in a scheme and receive discounted energy bills and income where surplus energy is sold to the grid. Crucially, this is already happening in Northumberland, as demonstrated by the Berwick Community Wind Turbine (see http://www.corecoop.net/index.php?option=com_content&task=view&id=32&Itemid=46 – page last visited February 2011)

Source: Entec

11.6 The Next Steps…

The conclusions made in this study are to help inform the emerging LDF, and specifically the Core Strategy. As the plan is still in its early stages of preparation the policy recommendations made in this study will be subject to further testing, consultation, examination and refinement as part of the LDF process. In addition, it is important to note that there are, at present, significant changes pending for the planning system which may result in a need to update and refresh the findings of this report.

There are also a range of measures that can be pursued alongside the LDF, including:

- Preparation of a Supplementary Planning Document (SPD) for sustainable design, renewable and low carbon energy to assist developers in responding to the policies presented in this study;
- Community consultation and education events, working with local schools or colleges (Northumberland College for example);

- Workshops with energy companies, developers and ESCOs active in the area;
- Training event with local planning officers; and
- Detailed feasibility and viability work undertaken in support of specific projects.

Glossary

Allowable Solutions: Allows a developer to meet targets (e.g. for zero carbon development) by making a higher provision of carbon savings than the development site would allow by taking financial contributions from the developer to fund low carbon technologies elsewhere.

Anaerobic digestion: Anaerobic digestion is a well proven renewable energy and waste management technology. It produces renewable energy in the form of biogas from organic materials such as manures and slurries, food waste and sewage sludge.

BREEAM (BRE Environmental Assessment Method): BREEAM is the leading and most widely used environmental assessment method for buildings (typically used for non-residential developments, similar to the way the Code for Sustainable Homes is used for housing). It sets the standard for best practice in sustainable design and has become the main measure used to describe a building's environmental performance.

CHP: Combined Heat and Power. The supply of both heat and power from a single generating facility. Differs from traditional generators where heat produced during the generation of power is released without deriving any benefit from it.

CERT: Carbon Emission Reduction Target. A scheme that requires energy suppliers to reduce emissions from the homes they supply. Providing free or subsidised energy efficiency measures (e.g. free low energy light bulbs) is one way that energy suppliers can meet their obligations.

Code for Sustainable Homes: the Code for Sustainable Homes (the Code) is the national standard for the sustainable design and construction of new homes. The Code aims to reduce our carbon emissions and create homes that are more sustainable. It applies in England, Wales and Northern Ireland.

The Code is not a set of regulations. The Code goes further than the current building regulations, but is entirely voluntary, and is intended to help promote even higher standards of sustainable design. The Code measures the sustainability of a new home against nine categories of sustainable design, rating the 'whole home' as a complete package. It covers Energy/CO_2, Water, Materials, Surface Water Runoff (flooding and flood prevention), Waste, Pollution, Health and Well-being, Management and Ecology.

The Code uses a one to six star rating system to communicate the overall sustainability performance of a new home against these nine categories. The Code sets minimum standards for energy and water use at each level and, within England, replaces the EcoHomes scheme, developed by the Building Research Establishment (BRE).

Carbon Reduction Commitment (now known as CRC Energy Efficiency Scheme): The CRC Energy Efficiency Scheme is a mandatory scheme to improve energy efficiency and therefore cut CO_2 emissions in large public and private sector organisations. These organisations are responsible for around 10% of the UK's CO_2

emissions. The scheme features a range of reputational, behavioural and financial drivers which aim to encourage organisations to develop energy management strategies that promote a better understanding of energy usage.

CLG: (Department of) Communities and Local Government

Decentralised energy supply: refers to that which is part of or near to a development site and locally connected.

DECC: Department of Energy and Climate Change

DEFRA: Department of Environment, Food and Rural Affairs

DHN: District Heating Network

ESCO: An energy service company (acronym: ESCO or ESCo) is a commercial business providing a broad range of comprehensive energy solutions including designs and implementation of energy savings projects,energy infrastructure, power generation and energy supply, and risk management.

Environmental Impact Assessment (EIA): An environmental impact assessment is an assessment of the possible positive or negative impact that a proposed project may have on the environment, together consisting of the natural, social and economic aspects.

FITs: Feed in Tarriffs. A Government scheme to promote the take up of small to medium scale renewable energy production by guaranteeing a rate of payment for the energy produced for a fixed term. The tariffs available differ by technology and energy output.

Green Deal: A Government scheme for reducing emissions and fuel poverty by providing financial support for efficiency measures to low income households.

GSHP: Ground Source Heat Pump. Low carbon energy technology which utilises the stable temperature found in the ground to provide heat to properties.

HCA: Homes and Communities Agency.

Installed capacity: this is the theoretical annual production capacity of a plant.

MUSCo: Mutli-Utility Service Company. Similar to an ESCO but provides a range of utility services rather than just energy.

Renewable and low carbon energy: includes energy for heating and cooling as well as electricity. Renewable energy covers those energy flows that occur naturally and repeatedly in the environment, from the wind, the fall of water, the movement of the oceans, from the sun and also from biomass. Low carbon technologies are those that can help reduce emissions. Renewable and low carbon energy supplies include, but not exclusively, those from biomass and energy crops; combined heat and power (CHP); waste heat that would otherwise be generated directly or indirectly from fossil fuels; energy from waste; ground source heating and cooling; hydro, solar thermal and photovoltaic; and wind generation.

RHI: Renewable Heat Incentive. A Government scheme to promote the take up of small to medium scale renewable heat production by guaranteeing a rate of payment for the heat produced for a fixed term. The tariffs available differ by technology and energy output and are due to be available from Summer 2011.

ROCs: Renewable Obligation Certificates. A certificate issued for every megawatt hour of renewable electricity produced by licensed suppliers so they can prove that they are supplying the amount of renewable energy they are required to.

SEAP: Sustainable Energy Action Plan. A Plan which is to be adopted by Northumberland County Council which will detail how the Council will meet its carbon reduction target by 2020.

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Appendix A
Renewable and Low Carbon Resource Assessment

A1 Estimating the Renewable and Low Carbon Resource

The focus of this assessment is to estimate the potential contribution from renewable and low carbon energy in Northumberland informed by a desktop appraisal of opportunities and constraints, identifying the broad areas of potential.

A2 Methodology Overview

Our methodology applied to determine the technical potential aligns with Stages 1 - 4 of the DECC *Methodology for the English Regions* (2010), and goes beyond this guidance in a number of areas. This methodology approaches the resource review first from a position of estimating the maximum unconstrained potential and then applies the constraints of technical accessibility, physical environment and planning/regulatory constraints. However for a number of technologies our work goes beyond this to consider constraints in more detail and use our own internal knowledge and industry contacts to ensure the resource assessment is as accurate as possible. The detailed findings are presented in this appendix.

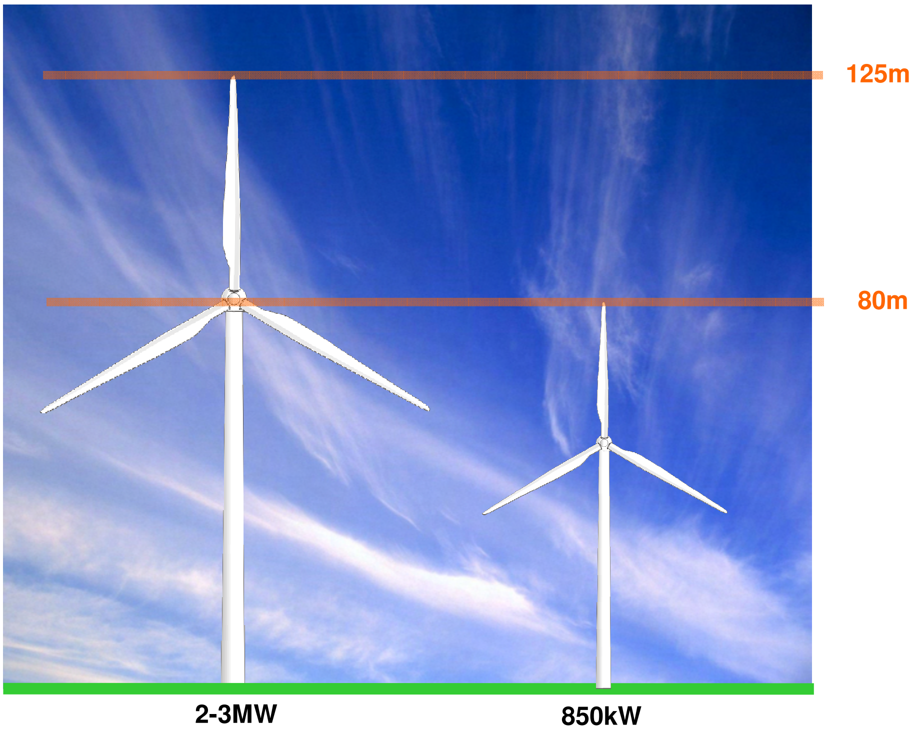
A3 Wind

Introduction & Scope of the Assessment

This section sets out Entec's assessment of the potential for bringing forward new on-shore wind development across Northumberland, focussing specifically on larger scale turbines rated at 2-3MW installed capacity. Figure A1 provides an *indication* of the size of a 2-3MW rated turbine (alongside an 850kW turbine for comparison) however the exact height can vary depending on a number of site specific variables, not least local topography as well as the need to response to any planning considerations (landscape and visual impacts for example).

As stated in section 1, the study area covers land within the administrative boundary of Northumberland Borough with respect to on-shore wind energy. The potential contribution from off-shore wind turbines is therefore not considered.

Figure A1 Typical Rating and Relative Height of Available Wind Turbines



Source: Entec (note that the dimensions of the 3MW turbine are broadly the same as for a 2MW turbine for the purposes of this study).

Overview of Wind Speeds

In order to consider the potential for wind turbines in Northumberland we firstly look at wind speeds, using the government's National Wind Speed Database (NoABL[18]). As a general rule wind speeds in excess of 6 metres per second at 45 metres above ground level are likely to be the *least* that is required for a viable wind turbine. Figure A2 demonstrates that there are likely to be sufficient wind speeds across the majority of the County showing that there is clear potential (notwithstanding that there are some areas with less than 6 metres per second).

NoABL data is just the *starting point* however - just because the wind speed appears to exist does not mean that it is necessarily deliverable. In addition, where wind speeds are lower than 6 metres per second they may still be suitable pending the results of local wind speed monitoring (as well as being potentially suitable for smaller turbines). The key issue, and the focus for the rest of our analysis, is therefore to identify how 'accessible' the wind resource based on a range of technical and environmental constraints.

[18] http://www.bwea.com/noabl/index.html

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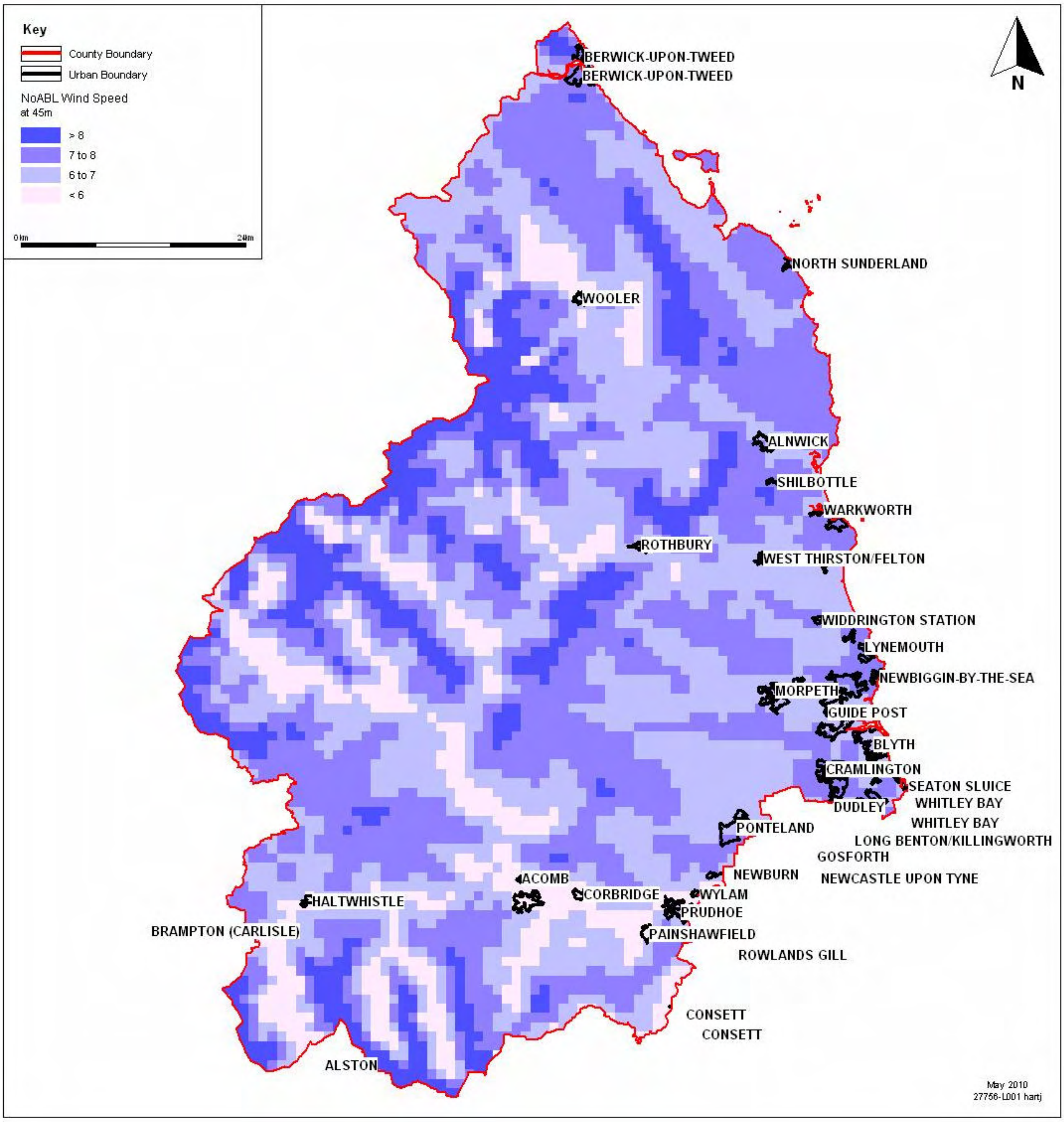
Figure A2 **NoABL Wind Speed across Northumberland**



Appendix A

Identifying the 'Accessible Wind Resource' in Northumberland

Entec has undertaken a desktop review to identify Northumberland's accessible wind resource based on Geographic Information System (GIS) mapping of key constraints. Our approach is based on a robust tried and tested methodology employed in our work with clients including local planning authorities, the Partnership for Renewables and wind farm developers.

At the outset it is important to note that the identification of the accessible wind resource is simply to demonstrate what potential exists. The purpose is *not* to recommend areas as suitable in planning policy terms. Our assessment does not therefore mean that proposals for locations identified as constrained should be rejected as unsuitable, nor does it mean that those least constrained areas should be considered favourably. Site specific characteristics may mean that it is possible to mitigate the effect of particular constraints.

The accessible wind resource is therefore defined as that which could come forward pending site specific work reflecting:

- the identification of specific sites via discussions with landowners regarding their availability and developers regarding their interest;
- the detailed application of PPS22 and local policy criteria at a site-specific level';
- the statutory planning process - including requirements for Environmental Impact Assessment (EIA) - reflecting any significant effects on local communities, ecology and landscape (as well as the potential for community effects);
- stakeholder consultation and discussions between the local planning authority, community groups, town and parish councils, Ministry of Defence, NATS En Route Radar Ltd;
- modelling and monitoring of wind speeds at a site specific level; and
- physical constraints and barriers to development, including topography and achieving vehicular access for example.

Box A1 sets out the constraints considered in order to identify the accessible wind resource.

Box A1 Constraints considered and their treatment when assessing the 'accessible wind resource'

Nationally designated environmental sites[19] (landscape, ecological and archaeological): for the purposes of assessing the potentially accessible wind resource environmental designations are considered a constraint, though it is important to note that planning policy (PPS5, PPS7 and PPS22) *does not* prevent wind development within such areas, subject to the application of policy criteria reflecting potential effects, including cumulative effects (e.g. landscape and visual).

Locally designated environmental sites (landscape, ecological and archaeological): areas identified, though potential from these areas still considered in order to identify the accessible resource

Noise: mapped a buffer of 500 metres to dwellings and settlements identified from the OS code point postcode data and brief inspection of aerial photography. The ETSU R-97 report, written by the Wind Noise Working Group, recommends a night time noise limit of 43dB(A) to ensure no sleep disturbance (measured from the nearest opening of a house). Noise modelling of a single 2-3MW turbine shows that at 360 metres from a house noise from a turbine does not exceed the recommended 43dB(A) limit. Under Entec's approach we apply a buffer distance of 500 metres, which also accounts for multiple turbines (note that two turbines would not double the noise experienced). At 500 metres and beyond noise levels are expected to be 40dB(A) or lower so significantly below the limit of 43dB(A) recommended by ETSU (excluding consideration of any background noise levels). 500m is therefore considered a reasonable buffer distance to apply for the purposes of our assessment of the accessible wind resource. See Appendix B for further details on Entec's treatment of noise for the purposes of estimating the accessible wind resource.

Wind speed: combination of NoABL and Carbon Trust Model to consider any site experiencing wind speeds of more than 6 metres per second (m/s) at 45m

Existing infrastructure: mapped 140m buffer around roads, rail lines and power lines where wind development may be precluded

Topographical features: mapped 30m buffer around rivers where wind development unlikely to come forward

Airports: mapped 30km from safeguarded airports, if the 30km buffer is the only constraint in a certain area it is not considered 'hard'

MoD sites: noted if within 30km irrespective of activity

Radar: level of likely interference identified

Microwave communication links: mapped microwave links from 2003 OFCOM database with 100m buffer – areas excluded as potential interference may preclude development

Landscape and visual: landscape sensitivity and capacity not considered within Entec's approach though it is identified as an area that needs to be addressed in terms of *realising* the potential of the 'accessible wind resource'

For convenience the constraint plans produced for the County have been split into Environmental and Technical constraints (Figure A3 and A4 respectively). This split is arbitrary and is only to allow a clearer view of the constraints identified.

The constraints considered as part of our analysis are based on established technical judgements based on Entec's view of good practice. The constraints are not all firm constraints. For instance it is technically possible to move a microwave link and reroute it around or through a wind farm. It is also possible to site turbines nearer to roads and rails if the engineering allows. We therefore choose these separation distances to ensure that we reach a realistic overall estimate of potential in the area.

[19] Including National Parks, Areas of Outstanding Natural Beauty, Special Areas of Conservation, Special Protection Areas, RAMSAR sites, National Nature Reserves and Sites of Special Scientific Interest for example

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Figure A3 Environmental Constraints

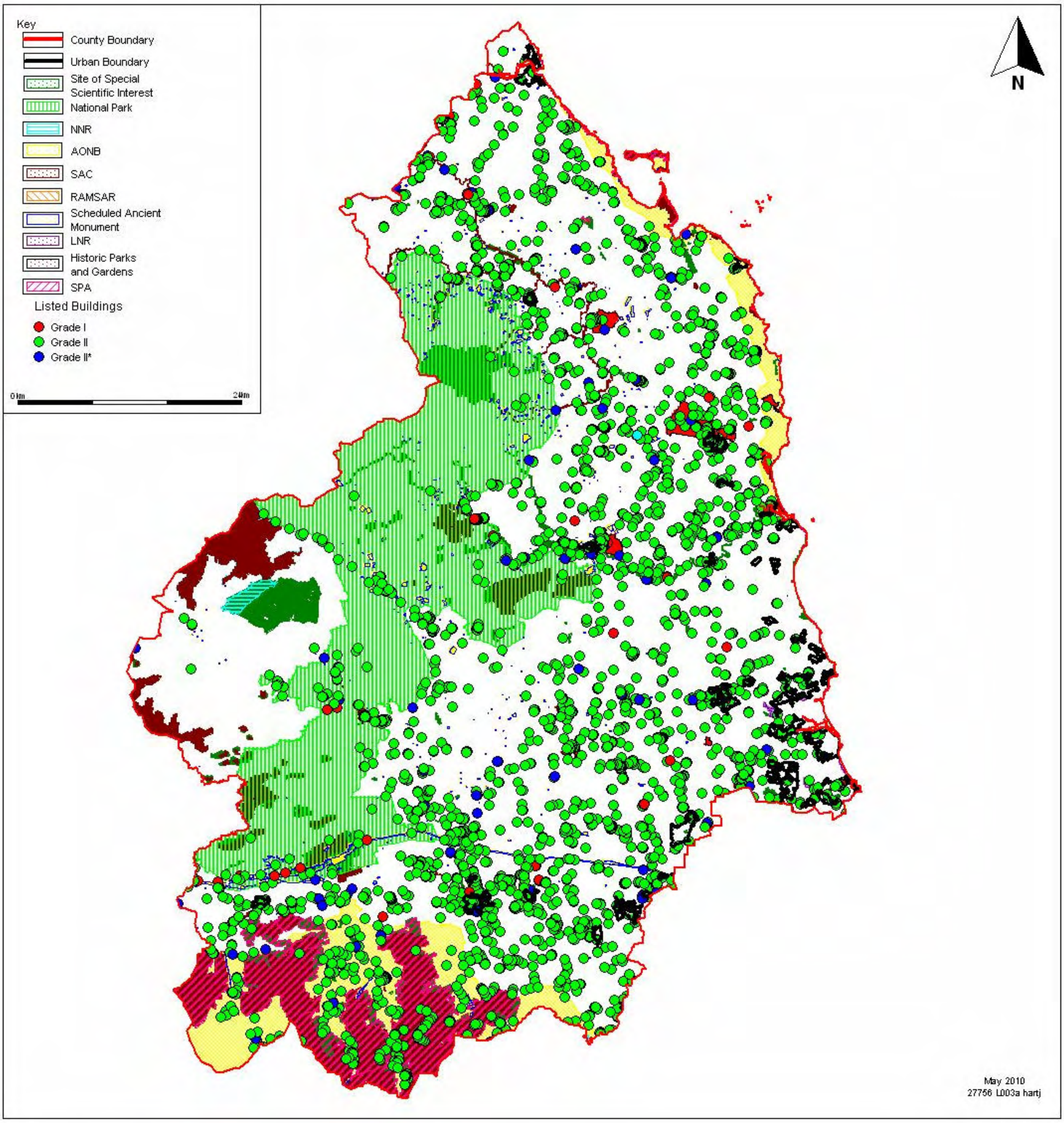
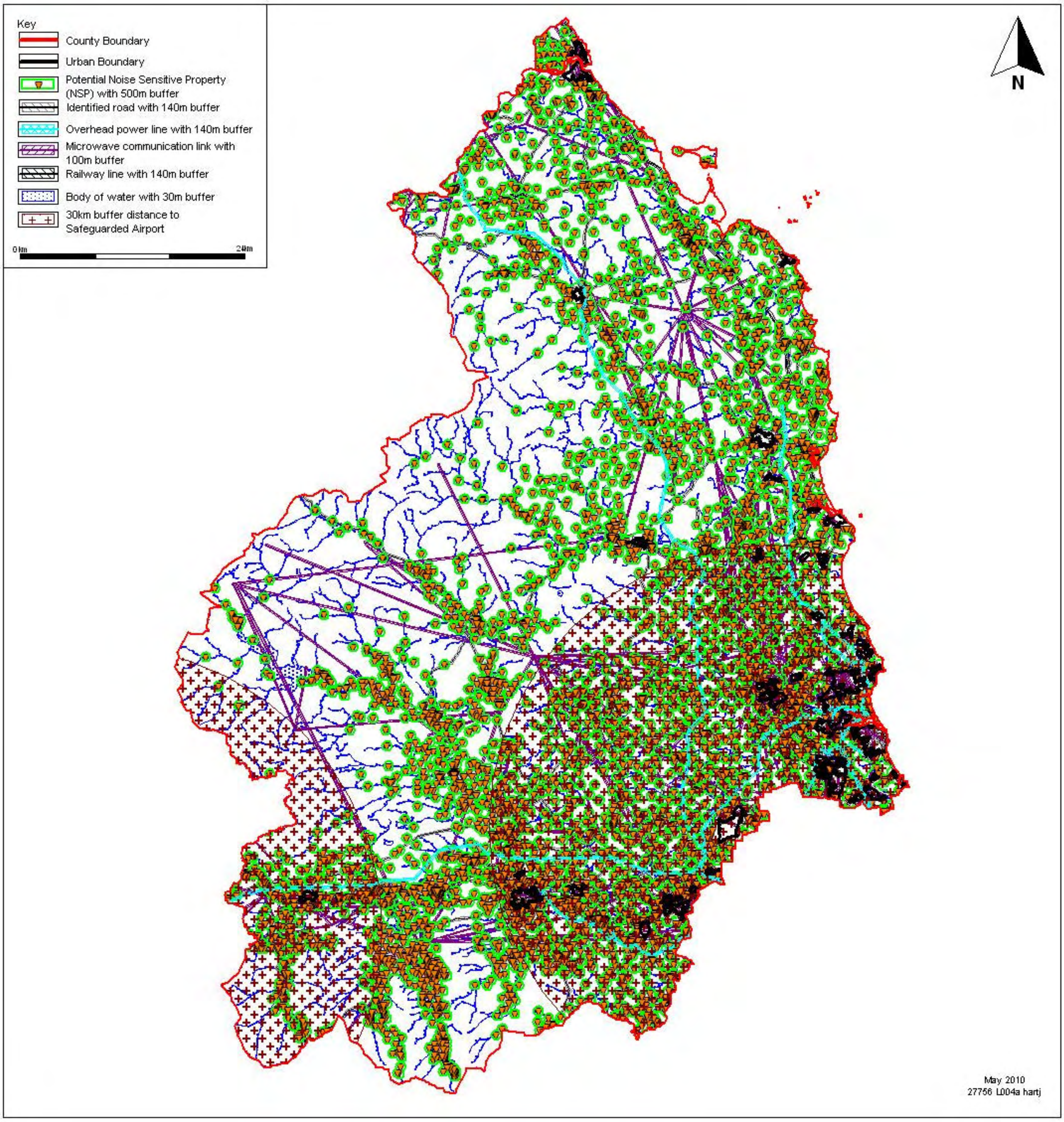


Figure A4 Technical Constraints



Mapping all of the constraints set out in Figure A3 and A4 as a single 'layer' it is possible to identify the least constrained area identified in Figure 7.3 in the main report.

The least constrained area identified in Figure 7.3 in the main report represents approximately 680 square kilometres of Northumberland's land area (around 14% of Northumberland's total area – circa 5,000 square kilometres). 680 square kilometres equates to an approximate total of 6,807 large wind turbines (2-3MW) and a total installed capacity of circa 17,000MW.

A4 Biomass

The term 'biomass' refers to any solid organic matter derived from plants (e.g. wood, straw). Energy can be released from direct combustion, or the material can be converted to gas or liquid for subsequent combustion or conversion to other products. Biomass is approximately carbon neutral as the CO_2 emitted is absorbed during the growing process, providing it is replenished at a similar rate to being used.

Biomass as a fuel offers advantages over other renewables as it can be transported and stored and as such can offer a secure, reliable supply. Heat recovered from the combustion process can be used directly for heating, for generating electricity or both in a combined heat and power (CHP) plant. However, when compared to fossil fuels it is bulky and more difficult to transport and store. The resource, supply chain and deployment options in Northumberland are considered in this section.

Part 1 - Biomass Resource in Northumberland

Biomass for energy purposes can be obtained from a number of sources. The following are considered in this appraisal:

- Forestry and woodland management – a significant and underused existing resource;
- Park and gardens – a potential source of woodchip;
- Agricultural arisings – straw and animal manure in particular; and
- Energy crops – crops specifically grown for energy purposes.

A further significant resource is waste wood, but as the primary source of this material is municipal and commercial waste this has been considered separately in the waste resource assessment.

Forest and Woodland Management

Northumberland has extensive forested and woodland areas, particularly within the National Park boundaries. The Kielder forest is the largest forest in England covering an area of 250 miles and there is a large potential woodfuel resource.

In addition there is known to be a small resource even in the more densely populated south east of the county. A Northwoods study[20] identified some 3,032 tonnes of wood that is available from existing woodland thinnings in South East Northumberland.

Despite the significant quantities of biomass, there is competition for various other uses. Energy production is generally the lowest value, so it tends to be the surplus material for which there is little demand that can be used for producing energy.

Forestry Commission Resource

The North East Forestry District is home to some 73,000ha of publicly owned woodland area – all owned and managed by the Forestry Commission (FC).

There is approximately 70,000ha of privately owned woodland area within Northumberland. There are many reasons for ongoing ownership, some of which support active forest management and supply of wood to the open market; some owners do not support tree felling for commerce. The current arrangement of wood availability from the Forestry Commission's 73,000ha of wooded area is as follows:

Within the National Park, the Kielder Forest is currently managed by the Forestry Commission who operates several long-term contracts supply an estimated 500,000m^3 of roundwood and sawn wood to a range of buyers. Some of this resource may be suitable to process as biomass fuel, if new entrants can establish new long-term supply contracts with the Commission[21].

500,000m^3 is felled each year from Kielder and the other large forested areas owned by the FC. 250,000m^3 of this is tied up in long-term supply contracts to a range of market players including timber merchants, sawmills, and so forth. Some is sold in the round (felled and stacked for sale at roadside/site) and some is sold standing. In the latter case, the buyer uses its own contractors to fell, cut and remove the wood from the site.

The other 250,000m^3 goes to the open timber market by competitive tender around five or six times a year. Buyers obtain this wood under agreements spanning three months to one year. In this way, this volume of wood is sold to a wide range of market players including those types listed above and several more. Each year a proportion of the wood on this market will end up being sold and used as wood fuel for biomass systems as the product trickles down the product hierarchy (with standing trunks at the top and chips for chipboard and wood fuel at the bottom).

It should be noted however the existing timber market under the FC's managed area only has room for short-term supply contracts until the long-term contracts at the current time. Therefore any new operator wishing to establish

[20] Northwoods, South East Northumberland Woodfuel Resource Study, 2005

[21] Estimate provided by Euro Forest's North Eastern Manager

a new supply of wood fuels for biomass systems would have to seek long-term supply contracts with the existing players currently active in the Northumberland area.

Privately owned Woodland Resource

As for the remaining 70,000ha of privately owned wooded areas – it is not known what proportion of this is managed and available on the timber market, however the FC states that around half of England's privately owned woodlands (by number) are not actively managed. We have used a high-level rule of thumb estimation method to obtain the following 'technical maximum' timber yield from the quoted figure of 70,000ha. The results are presented in A1. It should be noted that it is difficult to estimate the quantity of timber yield which ultimately becomes wood fuel.

Table A1 Technical Potential from Forest and Woodland Resources In Northumberland

Parameter	Value	Commentary
FC Wooded Areas		
Existing FC timber yield available on the open market (annually)	250,000 m^3	A *small proportion* of this is available as biomass/wood fuel. NB: there is no coherent method for converting this total timber yield into the quantity expected to end up on the biomass fuel market.
Privately Owned Wooded Areas		
Technical maximum yield from privately owned land (annually):	428,000 m^3	Note: this may be an over-estimate seeing as FC areas are generally likely to cover larger areas
Assumed total area currently unmanaged:	50%	
Therefore additional yield potential if remainder of privately owned areas become managed:	214,000 m^3	
Total Potential		
Total 'technical maximum' potential timber yield in Northumberland before physical/economical/social constraints are applied:	678,000 m^3	NB: there is no coherent method for converting this total timber yield into the quantity expected to end up on the biomass fuel market.
Approximate equivalent energy content	1,140,000 MWh	
Equivalent thermal output	910,000 MWh	Assuming 80% efficiency
Equivalent electrical output	284,000 MWh	Assuming 25% efficiency

Commentary regarding the barriers to exploiting this resource and how they may be overcome is provided in Box A2.

Box A2	Current barriers to increasing timber yield from privately owned woodlands

ConFor represents the membership base from across the timber supply chain from growers (private owners of woodland) to woodland managers, merchants, chippers and so forth. ConFor's position is that there is tremendous opportunity to bring further large volumes of timber to market, and that there are likely to be several private owners of woodland in Northumberland who would like to bring timber to market but for some support. There are a number of aspects holding up the move from private woodland to market and these include certification requirements, availability of grants, the practicalities of entering the market as a new roundwood supplier (such as acquisition of felling licences), and the (volatile) market price of timber.

The other key barriers (aside from physical constraints such as scale of small wooded areas, accessibility and terrain), preventing additional timber coming to market from privately owned woodlands are:

- perception - many owners of wooded areas do not see themselves as 'owners of woodland'; the purpose of the wooded area is not for felling and the wood is considered not for sale;
- lack of knowledge - for example that in many cases thinning of wooded areas can improve the biodiversity and timber yield of the site; and
- lack of cooperation/coordination between owners of smaller wooded areas, where individual areas would be economically unviable to manage.

There are several entities currently active in the process of addressing these barriers. Some suggested actions/strategies that NCC could adopt to aid in the growth of the timber availability would be:

- support and promote grants and incentives for thinning of privately owned wooded areas, such as the FC's 'Woodland improvement grant';
- support and promote information dissemination amongst woodland owners as to the benefits of thinning and bringing wood to market; and
- support and incentivise informal cooperatives which would enable economically viable felling across a collection of smaller woodlands.

The Wood Fuel Strategy document prepared by the FC highlights some key actions which could help to stimulate the market to access the timber within under-managed woodland areas. These are: capital investment and support with practicalities like certification, outreach and facilitation, and awareness raising by engaging and advising woodland owners.

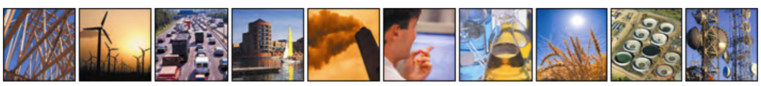
For woods that have not been in management for many years, a number of factors in addition to low timber prices combine to act as barriers to management. These include lack of awareness, disinterest, and lack of knowledge to access grants and licenses. □

Park and Gardens Arisings

A significant quantity of wood is produced in the form offcuts from arboriculture. This material is typically either chipped, where it can be used for various purposes including energy production, or simply landfilled. The potential resource for energy purposes is difficult to estimate accurately, but a high level estimate can be made based on a national survey and applying appropriate assumptions; in this case we simply assume that the arisings are proportional to the population (the population of Northumberland being 0.5% of the total for Great Britain).

Table A2 Resource from Parks and Gardens

Parameter	Value	Unit
Total arisings in Great Britain	492,000	tonnes/year
Total arisings in Northumberland	2,550	tonnes/year
Total energy potential	13,459	MWh/year
Available energy potential estimate	6,730	MWh/year



The available resource is much lower than other sources of biomass considered in the study, but as a potential 'quick win' and the additional benefits of avoiding this material going to landfill it represents a resource worth exploiting.

Agricultural Arisings

The potential energy from agricultural arisings has been assessed based on the DECC methodology. Two key resources have been considered; straw and animal manure. Estimates of arisings are based on figures published by Defra.

Straw

Straw is produced in large quantities in Northumberland, and although much of this material is recovered for non-energy uses such as animal bedding it can be combusted to generate electricity and heat. This is only likely to be viable in regions of the country that have a surplus rather than a shortfall of straw, of which the North East is one. Hence an assessment of this potential has been undertaken. The accessible technical potential in the final column of Table A3 represents a theoretical maximum and is assumed to be half the total arisings as per the DECC methodology. However in practice it is likely to be more economically viable to use much of this material for animal bedding and feed due to its higher value for these purposes.

Table A3 Potential for Straw in Northumberland

	Total Arising			Accessible potential	
	Total arisings (Tonnes/year)	**Energy content (MWh/year)**	**Installed capacity (MWe)**	**Energy content (MWh/year)**	**Installed capacity (MWe)**
Wheat straw	121,019	453,900	20.2	60,509	10.1
Oil Seed Rape	59,851	224,400	10.0	29,926	5.0
Total	**180,870**	**678,262**	**30.1**	**90,435**	**15.1**

Source: Entec

Manure and Slurry

Northumberland has a strong livestock farming industry and an inevitable by-product of this is large quantities of manure. This material is well suited to treatment via anaerobic digestion.

The total technical potential is summarised in Table A4, which demonstrates the very significant potential to recover energy from cow manure in particular. In reality it will only be viable to recover a proportion of this (that collected centrally in cow sheds for example), but this is still a greatly underused resource.

Table A4 Animal Waste Arisings

Livestock	Number of animals in Northumberland (2009)	Total arisings (Tonnes/year)	Biogas potential (m^3/year)	Energy content (MWh/year)
Cattle	153,090	2,793,893	55,877,850	310,433
Pigs	17,188	94,104	1,882,086	10,456
Poultry	71,486	2,609	n/a	n/a
Total			**57,760,000**	**320,900**

Source: Entec

Energy Crops

The exploitation of existing resources will provide significant quantities of biomass. However, there is potential to go beyond this by growing crops specifically for energy purposes. The main energy crops grown in the UK are short-rotation coppice (SRC) willow and miscanthus, a tall grassy crop. In addition crops can be grown as the raw material for vehicle fuel, but the potential to do so is not considered in this study. SRC has been identified as better technically suited to Northumberland, however Miscanthus can provide a higher energy yield per tonne and is harvested on a yearly basis; making it easier start up new supply chains.

Energy crops offer several advantages over other types of biomass resource: the crop is grown *for* the end user, thus security of supply is not an issue. Additionally, energy crops are grown as part of a long-term contracted supply as growers require the long-term security of their growing investment. Further, it is sustainable, fully renewable and offers a stable and secure price (more so than wood from alternative sources). Energy crops are also generally cultivated within a selected radius (generally around 30km) of the end user, ensuring that haulage costs and emissions are kept to a sensible minimum. However there are downsides; there is potential competition with food crops, prices are relatively high

Defra have produced maps showing at a high level the potential yield from energy crops. For miscanthus, the entire Northumberland region is in the 'low' and 'medium' category. For SRC the majority of Northumberland is in the 'medium' and 'high' category.

The DECC methodology has been applied to calculate the technical potential for energy crops in the region, as summarised in Table A5. This assessment has been based on SRC as the most suitable crop for Northumberland.

Table A5 Theoretical Energy Crop Resource

Parameter	Value	Unit
Arable land in Northumberland	69,532	Ha
Total used for crops	88,920	Ha
Arable land with potential for energy crops	68,140	Ha
SRC tonnage if all land exploited	681,400	ODT/year
Total energy content	2,460,611	MWh/year
Equivalent installed capacity (electrical)	114	MWe
Equivalent installed capacity (heat)	225	MWth

Box 3 provides commentary on issues associated with stimulating the supply chain for energy crops.

Box 3 Stimulating the supply chain for energy crops

In attempting to stimulate new supply chains in energy crops, it will be important to learn from the lessons of those already supplying miscanthus and ensure that farmers are engaged in the most suitable way. The two key factors to successfully securing a supply of miscanthus from growers in the vicinity are: a) through demonstrating sharing of investment risk between the buyer and growers and b) and offering clear, profitable and attractive contracts to growers. Consultation with the National Farmers Union (NFU) North East and REFA will support guidelines for contractual arrangements. Northumberland CC may wish to support in information sharing to enable operators seeking to secure biomass fuel supplies to consider miscanthus as a low-risk, high yield alternative fuel source.

Seeing as Northumberland has much agricultural land, the county lends itself well to the establishment of miscanthus or SRC supply chains. However the climate of the region means that the yields may not be as favourable as yields further south, for example in the Midlands. There is some evidence that there are existing energy crops in Northumberland; however the data does not elucidate how many hectares are in use or annual yields in tonnes.

Resource Summary

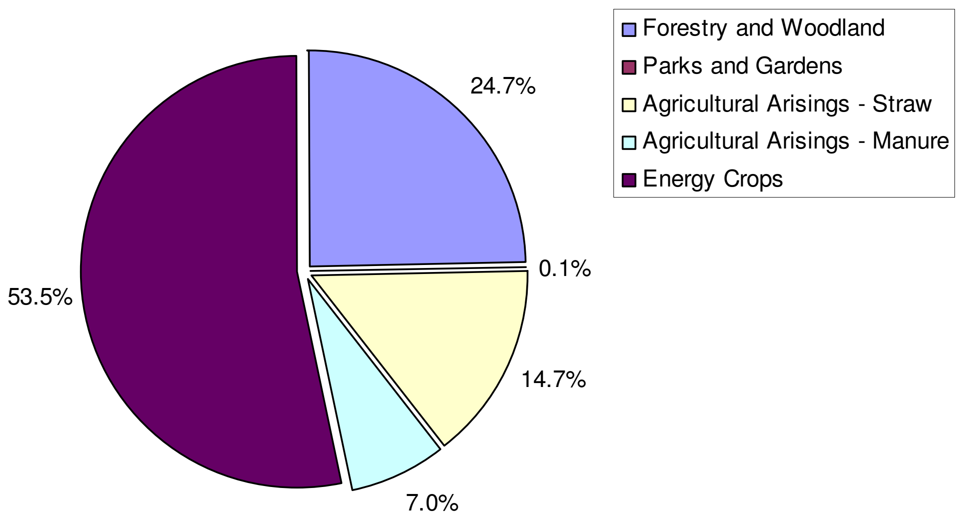
A summary of the technical potential for biomass is provided in Table A6, with the breakdown provided in Figure A5. Note that the table assumes the resource is used for heat **or** electricity, so the two figures should not be added. There is a large existing resource which if fully exploited could lead to significant CO_2 emissions reductions in the county. Approximately double this could be achieved by a high uptake of energy crops.

Table A6 Technical Biomass Resource and Energy Yield

Resource Type		Electricity		Heat	
	Energy content (MWh)	Annual output (MWh)	Installed capacity (MWe)	Annual output (MWh)	Installed capacity (MWe)
Forestry and Woodland	1,135,845	283,961	41	908,676	162
Parks and Gardens	6,730	1,682	0	5,384	1
Agricultural Arisings - Straw	678,262	169,565	24	542,609	97
Agricultural Arisings - Manure	320,889	96,267	14	256,711	46
Energy Crops	2,460,611	615,153	88	1,968,489	351
Total Biomass	4,602,336	1,166,628	166	3,681,869	657

Annual output assumes 25% efficiency for electricity generation and 80% efficiency for heat generation

Figure A5 Breakdown of Technical Biomass Resource in Northumberland



Part 2 - Supply Chain and Current Availability

Establishment of new supply chains for biomass fuels relies on several interplaying elements: availability of the wood resource, processing (chipping, palleting) capacity and room for new entrants in the supply chain. This section considers the potential resource from forestry and woodland arisings and energy crops; waste wood is considered in below.

Our experience suggests that the availability of wood resources for biomass fuel is not a significant constraint at present; if the demand exists, suppliers tend to actively respond. However the large quantities of biomass required to supply the various sites identified in this study and the large new power plants under development have potential to cause some resource and supply issues (such as bottle-necking at the pallet- or wood-chip process, or cash flow risk for a single supplier of large quantities of wood fuels).

The use of locally sourced material minimises transportation distances and reduces carbon emissions associated with production and delivery. It also helps to stimulate local markets for biomass production although to date these markets are immature due to the lack of consistent demand as the technology develops.

However despite the advantages of using a local product and significant local biomass potential, availability within the boundaries of Northumberland is limited and may be insufficient should very large plants be developed in future. In case the available local biomass is not sufficient to cover the demand, biomass can be imported from other regions, including overseas. This is a source of much of the biomass for the large power plants currently in development, which are located on the coast in order to receive deliveries from ships. Using biomass sourced overseas can be cost effective and can still have benefits in terms of carbon emission reduction particularly when required in bulk, but does not represent the environmental optimum for this technology. Also of importance is that if the biomass is imported it reduces the potential wider economic benefits for the region.

Given the potential for long distance transportation the supply can be considered effectively unlimited, however the same may not be true of local arisings. A review of biomass suppliers in the local area has been carried out and is summarised in Table A7 (not intended as a comprehensive list of all suppliers).

Table A7 Biomass Suppliers in and around Northumberland

Supplier	Area	Products	Email
Bedmax Ltd	Belford	Briquettes/Wood chips	www.bedmax.co.uk
Blyth Star Enterprises	Blyth	Logs/Pallets/Wood chips	neilhedley@hotmail.com
Colin White Tree Surgery	Hexham	Wood chips	colinwhite.ts@btopenworld.com
D&E Turf	Bishop Auckland	Logs	www.renewable-energy-store.com
JBT Waste Services	Bedlington	Wood chips	www.recycleitall.com
Land Factor	Haltwhistle	Wood chips	www.landfactor.co.uk
Lilburn Estates	Wooler	Logs	N/A
Logs2U	Bedlington	Logs	www.logs2u.co.uk
MJF Wood Energy	Hexham	Briquettes/Logs/Wood chips	www.mjfwoodenergy.co.uk
ML & JM Richardson	Stocksfield	Wood chips	enquiries@wheelbirks.co.uk
Nationwide Wood Recycling Ltd.	Hexham	Wood chips	info@woodwaste.biz
NEWFuels	Morpeth	Pallets/Wood chips	david.clubb@ruraldevelopment.org.uk

Supplier	Area	Products	Email
No 1 Woodfuel Ltd.	Shotley Field	Wood chips	www.waste-not-ltd.co.uk
Northumberland Firewood Supplies	Belford	Logs	www.northumberlandfirewoodsupplies.co.uk
Park End Farms	Hexham	Wood chips	www.parkendfarms.co.uk
Swinhoe Farm Logs.	Belford	Briquettes/Logs/Wood chips	valerie@swinhoecottages.co.uk
Toasty Heating	Alnwick	Wood chips	www.toastyheating.com
Thrum Mill Farm Ltd	Rothbury	Logs	www.northumberlandlogs.com
The Woodheating Company	Cramlington	Pallets	www.thewoodheatingcompany.co.uk

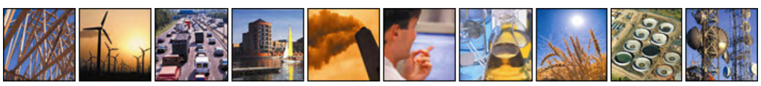
In terms of establishing sufficient processing capacity, there are several new and emerging companies within the UK which are responding to the heightened demand in the market. New entrants into the market (such as kiln operators investigating fuel-switch options, etc.) should be encouraged to take a flexible approach to establishment of new supply chains; such as partnership with emerging palleting companies or setting up three-way partnership contracts with forestry companies and chipping/palleting agents.

Part 3 – Biomass Deployment

Biomass heating technologies can be used for space heating and hot water in most types of buildings. When used in conjunction with a hot water based distribution network, almost any building can be heated from biomass as communal heating is generally compatible with standard internal heating systems. Hence it would be possible, *in theory*, to supply the majority of residential and commercial buildings in Northumberland in this way. This flexibility coupled with the current availability of fuel (and potential to import in large quantities) means the technical potential of biomass is almost unlimited.

However, carrying out such an ambitious programme of conversion from fossil fuels to biomass would be very expensive, disruptive, commercially challenging and highly unlikely to be viable in practice in the timescales covered by this study. Hence when estimating the true potential it is important to account for the numerous constraints involved, including the economics of installing and retrofitting biomass heat systems, demand profiles and suitability of buildings for biomass energy, the logistical difficulties associated with installing infrastructure and supplying fuel and a lack of willingness from many sites to convert from their existing systems.

In order to estimate the level of demand that could be realistically be met by biomass in Northumberland, we focused on the main towns and off grid housing as the key potential consumers of heat from biomass. The results of this assessment are included in the main body of this report in Section 8.2.



Heat Only Systems

Low carbon heat only systems include biomass boilers and stoves, heat pumps, heat collected from the thermal treatment of waste or surplus heat from industrial processes. Larger systems tend to generate electricity or electricity and heat instead for a number of reasons:

- it becomes more viable technologically to generate electricity which is a higher value product than heat;
- there is greater support for renewable electricity than heat at present; and
- it is more challenging to maintain high thermal efficiencies, unless supplying a large continuous base load;

Biomass heating systems could range from micro generation scale through to a centralised biomass fired communal heating scheme that provides energy to the entire housing development in the form of steam or hot water through an integrated system of insulated pipes installed throughout the development.

Combined Heat and Power

Combined Heat and Power (CHP) is the process by which both useful heat and electricity are generated simultaneously. Most CHP systems in the UK run on natural gas or diesel but there are other fuels which are technically feasible depending on the scale including biomass and biogas.

In order to optimise a CHP system, it is essential to recover as much heat as possible from the machine and to use the heat in a heating system or to provide cooling via absorption chillers. To be viable, the plant should be run for as long as possible. The application of CHP therefore requires a demand for heating and hot water to be available year round.

If the thermal load of the development is not sufficient, it is neither technically viable nor economically feasible to install CHP. However, if the occupants have a year round demand for heating and/or cooling (e.g. chilled distribution or a data centre) the viability of the system can be significantly improved. Alternatively, a CHP system could be connected to neighbouring sites with sufficient heating (or cooling) demand to become feasible.

Biomass CHP technologies are currently only commercially available at large scale (minimum 400-500kW electrical output), with small-scale generation biomass CHP systems only at the research and development stage. Small biomass CHP systems are also in development, however, such systems are not yet proven to be reliable and represent too great a technical risk for the tenant.

Development of Heating Networks

To attain higher levels of carbon emissions reductions, the distribution of heat from one or more biomass plants could supply numerous sites in the area when heat is fed into a communal heating network. Such networks transfer hot water via pre-insulated steel or plastic pipes to the point of use, analogous to the natural gas network but supplying heat directly rather than a fuel. Modern communal heating pipes are thermally efficient, reliable, can be directly buried in the ground and can supply space heating and hot water to many different types of development.

At present the main barrier to such schemes is the capital cost associated with the installation of the required infrastructure. Commercial factors and regulatory constraints can also prevent schemes progressing. The installation of pipework is expensive (with the civil works making up the majority of the costs) and so it is important to minimise the length of pipework requiring installation and to ensure that customers are willing to commit for the long term as payback periods can be relatively long. It is also preferable to install pipework in new builds within a common utilities trench to minimise costs, although existing buildings can also be converted with relative ease (but higher costs). In order to supply existing housing it is preferable for the density of buildings to be high, so flats and terraced streets are much better suited than lower density detached housing. Table A8 provides an overview of the suitability of different developments to be supplied with heat via communal heating, which takes into account technical, economic and commercial factors.

Table A8 Communal/District Heating Suitability by Development Type

Potential for communal heating scheme	**Development types**		
	Residential	**Commercial**	**Industrial**
Very Good	New build flats/apartment complexes.	Large, high intensity users such as hospitals and prisons.	Large, energy intensive process operations requiring hot water rather than steam.
Good	New build high density housing, existing flats/apartments complexes.	New build large retail and offices, large educational facilities such as universities and secondary schools, leisure centres, hotels.	Large manufacturing facilities, printing works, food production.
Average	New build low/medium density residential, high density and council owned existing housing.	Small educational facilities, local healthcare, large existing offices, small new office developments.	Light manufacturing and assembly works, business parks and trading estates.
Poor	Low density privately owned existing housing (not already connected to communal heating).	Storage facilities, small retail.	Warehouses, garages.

A community scale biomass heating plant would allow the bespoke design of fuel handling and combustion systems, therefore with greater scope for the plant to accept a variety of biomass fuel types. This could potentially result in lower ongoing fuel costs and greater security of feedstock supply due to the plant's fuel flexibility. In addition, the delivery of fuel would be required to only one or a small number of centralised locations where the biomass energy plant would be located, rather than to every building.

Some of the key issue are discussed in the case study in Box 4, produced by CABE.

Box 4 **Establishing local networks for energy supply/combined heat and power**

Remote power plants are inefficient, with over 60 per cent of the energy from fossil fuels being lost through transmission and waste heat before the electricity reaches our buildings. Capturing 'waste' heat is an important priority in cities and towns and it can be utilised by existing industries to replace increasingly expensively produced process heat. A local decentralised community energy system can help tackle these issues through decreased transmission losses and by capturing and utilising the waste heat in buildings of all uses. This is combined heat and power (CHP) serving communal heating. Systems can be:

- block-based, with each block in a development having its own communal energy system.
- site-wide, where a single energy generation source or small number of sources (to suit phased development or demand that varies over time) serves a number of buildings connected by a community energy network.
- city-scale.

The most common form of decentralised energy supply is community or communal heating. This is where space heating and hot water is delivered to multiple occupants from a local plant via a network of insulated pipes buried in the ground. The pipe network can be installed at the same time as other services (water, drainage, etc) to minimise costs in new development. It is also possible to retrofit existing buildings and there are convincing cost/benefit arguments for supplying heat to them or industry rather than new buildings where there is low heat demand. Industrial use of waste heat, not only retains such industries, protecting them from escalating fossil fuel costs, but also enables larger, more commercially efficient CHP plants to be situated in the city fringe, with short (and therefore) efficient pipework connections to serve a manageably small number of high heat-requiring customers. Local decentralised heating can also be combined with electricity production if a CHP plant is used, leading to the production and delivery of more than one service and associated prime energy efficiency gains. This uses the inevitable waste heat from the electricity generation process to heat buildings, rather than requiring additional gas, oil or electricity to generate it. The CHP unit is linked to homes and other buildings by a local district heat distribution network. The electricity produced could be exported to the national grid or transported to other users over the local electricity distribution network or over a new, community owned or part owned network.

A thermal store will allow electricity generation from CHP to be de-coupled from heat production and its delivery to end users. This is because demand for electricity does not closely match demand for heat. A thermal store allows heat to be stored during periods of peak electricity production and used later – thus avoiding the need to burn gas or oil for heat provision during those periods. The CHP plant can then be sized more cost-effectively. The options are a large central store, block-based stores, or individual stores (such as a hot water cylinder in every dwelling) or a combination of the three along with the thermal capacity of the system network, depending on the specific requirements of the development.

Community heating systems usually allow individual householders to be in control of their own heating and hot water system by the provision of a heat exchanger unit and heat meter in every home and other building on a development. Heat exchangers are also recommended to hydraulically separate parts of the system so that supply to certain parts can be isolated if necessary for maintenance or emergency repairs.

Other factors to consider are:

Fuel sources

A combined heat and power plant can generate electricity, heat and/or cooling via an absorption chiller. It can be fuelled by a variety of sources from biomass to waste. Local, sustainable wood, the biomass fraction of municipal solid waste or the agricultural waste supply is the preferred fuel to ensure there are not unintended consequences of increased carbon intensity of the fuel due to transportation or by switching agricultural land from food to fuel production. Imported fuel can be associated with rising food prices if local food production has been displaced by energy cash crops. Large quantities of liquid biofuel are required to meet the required target of the Renewable Transport Fuel Obligation of 10 per cent by 2020 Biomass and liquid biofuels can have negative effects on food production and biodiversity. The embodied carbon from their planting, fertilising, processing and transporting has to be considered along with issues of guaranteeing the sustainability credentials of the fuel delivered. Other fuels include the biomass and fossil fuel element of municipal solid waste and commercial waste, sewage/food waste wet biomass which is best suited for anaerobic digestion and specialist waste streams such as old tyres. Each scale of urban use also has to consider the traffic implications of fuel delivery, the effects on external air quality and whether the rejected heat in summer will worsen the urban heat island effect.

Scale

A communal heating system is most appropriate at the scale of a large district, neighbourhood or city. Smaller areas of 200-250 homes can be viable (see for example Mauenheim bio-energy village in Germany) although this does not preclude smaller schemes that can grow.

The phasing of development, density and heat requirement of each connected customer is key to establishing economic viability. This can be addressed by the use of temporary boiler plant until the full development justifies the full energy centre with CHP and associated plant. Similarly block-based plant can eventually interconnect to form a district network then a neighbourhood until the full city level efficiency can be achieved.

For waste to energy CHP plants the scale of application, the phasing of development and integration with suitable long-term waste management policies are key to economic viability. As a general rule, waste-fed schemes will need to be of a neighbourhood or larger scale to be viable.

Gas-fired CHP systems can be an attractive current option for smaller individual systems for buildings and neighbourhoods. Units are available for applications of one unit and upwards but can only be used for a period as gas is a fossil fuel.

The commercial viability of the required communal heating systems is affected by the heat requirements and density of available customers for heat and cooling and becomes viable at approximately 200 homes at medium density (60-80 homes/hectare). However, an ESCo partner may not be interested except at a larger scale. Meanwhile, irrespective of commercial viability, CHP (of any fuel source) may be required to meet particular regional or local planning policies, as is the case in London. An additional consideration on the scale of biomass energy plants is that they can be better audited with fewer emission control issues if fewer, larger scale plants are provided.

As a general rule minimum average housing densities of 50 homes/hectare are recommended to limit the cost of pipe work installation.

Conditions for communal heating and CHP

Communal/district heating is a strategic enabling technology in that it provides a network that a range of technologies and fuel sources can feed into. It has been recognised by the government as one of the most significant carbon saving actions. However, is not appropriate for all areas. Key determinants are:

Density. The installation of pre-insulated heat pipes is expensive. Therefore it is costly to connect widely dispersed buildings. Low temperature communal heating using heat pumps as used significantly in Holland can partially address this issue as there is so much low grade heat available in the interseasonal thermal ground stores that uninsulated plastic pipe is all that has been found to be needed. Conversely, where buildings are densely concentrated, for example with blocks of flats or terraced housing, communal heating is an attractive option.

Age of buildings. This will identify the level of thermal insulation in buildings as determined to the building regulations in force at the time when they were built. Spatial density and the thermal characteristics will combine to show the 'heat density' of buildings in an area.

Mix of uses. Different types of building occupiers have varying demands for heat. For example, domestic householders' consumption of heat peaks in the early morning and during the evening. During the daytime it tends to be lower. Commercial offices heat use peaks between 9am and 5pm. These are represented in demand or load profiles. Different load profiles complement one another and a diversity of load profiles improves the technical feasibility and financial viability of communal heating.

Presence of anchor loads. Some building users have large demands for heat that are steady over the course of a day and over a year. Typically, these users are public sector such as hospitals, universities, prisons and leisure centres with swimming pools. As public sector organisations can commit to long-term contracts they can act as 'anchor loads' for the development of a communal heating network. Such features determine the energy 'character' of an area. Further information on character areas is given in the TCPA and CHPA guide on Community energy. This includes detailed guidance and example case studies including Copenhagen's strategy. Design considerations include ensuring adequate space for the plant and flue within the wider scheme development as well as access, storage and transport implications of fuel deliveries. New communal heating systems should also connect into any existing networks so that the surplus heat is available to the existing stock with its higher heat demands. Community energy centre locations should be planned to have good access to transport routes, particularly canals and rail if available.

Cost

The average capital costs for a CHP system are as follows:

- biomass CHP on a large site: around £3,500 per kW of electricity (kWe)
- biomass CHP on a small city infill site: around £16,000 per kWe
- gas-fired CHP with a capacity of between 8kWe and 40kWe: between £1,200 and £3,400 per kWe
- gas-fired CHP with a capacity of over 400kWe: between £650 and £1,200 per kWe

These figures are from 2008 Communities and Local Government research. They reflect the capital cost of each carbon saving option when applied to a Part L1a 2006 compliant home. Present compliance with Part L 2006 assumes a concept known as displaced carbon factor where renewable electricity displaces a high carbon-emitting source like coal from the grid mix. The displaced carbon factor is therefore higher than the grid carbon factor, which may overestimate the compliance ability of renewable electricity produced, and underestimate the cost by, in some instances up to 30 per cent. Along with the lack of available smaller scale biomass CHP technology this was one of the two main issues, raised by the UK Green Building Council that led to the recent zero carbon definition consultation exercise.

The costs represent an estimate of the total costs to a contractor, including materials, plant and labour, builder's work in connection, preliminaries, overheads, contingencies, profit, and design fees. The same research also undertook an economic cost and benefit analysis of each technology. This found that the value of saving in energy costs for biomass CHP systems was £1,223 per tonne of CO2 saved, compared to £2,728 for gas-fired CHP systems. As indicated above these figures now represent a low estimate as they will require updating following the removal of the displaced carbon factor in cost calculations.

http://www.cabe.org.uk/sustainable-places/advice/local-energy-and-combined-heat-and-power

A5 Waste

Waste as an Energy Resource

Many types of waste contain a significant proportion of biomass derived material. Sources include food waste, paper, card and scrap wood for example. For post recycling household waste this figure is typically estimated to be in the region of 50%, the figure for commercial and industrial waste can vary dramatically, but often contains a high proportion of wood. Hence mixed waste is a partly renewable resource.

At present much of this waste is sent to landfill. However there is a significant move away from landfill to alternative treatment processes, some of which release energy which can be used for heating and to generate electricity. Energy can be recovered from waste by a number of processes:

- Energy from Waste (EfW) incineration - direct combustion of waste. Heat produced is used to raise steam which is passed to a turbine to generate electricity, with potential to also export heat.
- Advanced Conversion Technologies - gasification and pyrolysis are the main technologies. Waste is heated in a restricted oxygen atmosphere to break down the matter into a gaseous, liquid or solid fuel, known as refuse-derived fuel (RDF). Usually gas is produced which can then be combusted directly to produce heat and electricity, or converted to more advanced fuels.
- Anaerobic Digestion - this describes the breakdown of organic matter by specialised bacteria in the absence of oxygen, which yields biogas which can be used for heating or to generate electricity. Further there is mechanical-biological treatment (MBT) which incorporates both mechanical sorting and pre-treatment and biological treatment.

There are generally a number of waste streams which could potentially be sourced as feedstock for the technologies described above. Household waste is predominantly managed (collected, sorted, recycled, landfilled and so forth) by a single entity working jointly with the unitary authority under a PFI contract. By contrast, commercial and industrial (C&I) waste arisings are handled by any number of individual waste contractors as engaged by individual companies and industrial sites. Hence reliable waste data relating to C&I waste can be more difficult to obtain (see method of estimation for C&I wastes below) as is the waste itself.

However, the C&I sector can be engaged on waste matters in order to establish the interest for technologies such as RDF plants, as detailed in the case study in Box 5.

Box 5	**Case study – engaging the C&I sector**
In recent years the Greater Manchester Waste Disposal Authority conducted an engagement process to assess the appetite for RDF amongst the C&I community and found the response to be enthusiastic; 15 companies expressed an interest in purchasing the RDF output from a proposed CHP in Runcorn, however the RDF is now being supplied under contract to Ineos Chlor, a chemical production company . Establishment of new RDF supply chains can work well within a symbiotic partnership between the investor in the CHP and the purchasers of the resulting RDF, who can combust RDF as a renewable alternative to natural gas. For this reason, engagement with stakeholders and interested parties is necessary in order to understand the feasibility of sourcing C&I waste and establishing secure supply contracts.	

Current Activity in Northumberland's Waste Market

The approach to municipal waste management in Northumberland has undergone drastic change over the last 10 years. The signing of a Joint Municipal Waste Management Strategy between the seven district councils of Northumberland led to the agreement of a Private Finance Initiative (PFI) deal between SITA UK Ltd and Northumberland CC. This deal has seen the levels of household waste sent to landfill decrease dramatically from 96% to 12%.

The investment in infrastructure which followed the establishment of the PFI in 2006 included the construction of a Materials Recovery Facility (MRF) and waste transfer station at West Sleekburn. Residual waste unsuitable for recycling is then transferred outside the county to the Tees Valley Energy from Waste (EfW) plant in Haverton Hill, Middlesbrough, where it is used to generate electricity. The targets for improvement in waste management infrastructure included achieving only 8% of municipal waste being landfilled and achieving a 45% recycling rate of the County's household waste. There are also thirteen household waste recovery centres (WRCs) which recycle 64% of the waste delivered to them[22].

As household waste is locked into a long-term contract it is not unlikely that further energy generation from waste from this resource will be forthcoming in the county. As such it is recommended that strategic focus be placed on commercial and industrial (C&I) waste arisings. It is estimated that there are significant volumes of waste available which could be a resource for energy generation, and more flexibility to be found in contractual arrangements for procurement of that waste and developing the energy generation infrastructure.

Table A10 provides the household and C&I waste arisings for Northumberland and the wider North East region respectively. Figures for C&I waste specifically for Northumberland are not available, but estimates have been made below. Figures in this table are based on a combination of data sources, including Northumberland CC's own current overview of waste management.

[22] http://www.northumberland.gov.uk/default.aspx?page=1363 Accessed July 2010

Table A10 Collected Waste Figures for Northumberland

Waste Stream	Tonnage	Source
Total Municipal and Household Waste Arisings – Northumberland		
Total municipal waste arisings	172,727	2008/09, EA [23]
Total household waste	160,421	2008/09, EA
Total residual household waste (including household rejects)	98,107t	2008/09, EA
Total residual household waste arisings	83,229t	2008/09, EA
Household waste sent for recycling/composting/reuse	62,314t	2008/09, EA
Civic amenity site residual waste (household)	14,830t	2008/09, EA
Availability Municipal and Household Waste Arisings		
Civic amenity site residual waste (household)	14,830t	2008/09, EA
12% of household waste is now going to landfill	~ 19,250t	Extrapolated from NCC and EA figures above
Commercial and Industrial Waste Arisings – North East Region		
Animal and vegetable waste (North East)	~ 164,900t	2009 National Study C&I waste arisings[24]
Mixed ordinary wastes (North East)	~ 847,300t	2009 National Study C&I waste arisings
Common sludges (North East)	~ 32,800t	2009 National Study C&I waste arisings

The C&I waste figures in the table above are from the National Study of C&I waste arisings and are based on an extrapolation from base data collected in the North West; these figures do not represent any actual collected data for the North East as this is not available. The method used to estimate the arisings in the North East was to split the waste data collected from 981 companies in the North West by standard industrial classification (SIC) categories and into waste arisings by company size. This provided waste arising factors which were extrapolated out to the various industry sectors and company profiles across the regions. The values above reflect the estimated waste arisings which were calculated for the North East based on its profile of company sizes and SIC codes.

Plans for New Energy Recovery Plant

There are currently no EfW plants in the county and no apparent plans for further EfW sites within Northumberland. An anaerobic digester plant is a planned at Cockle Park Farm[25], which is to be part funded by the Rural Development Programme for England fund (RDPE) and is on a site operated by Northumberia University as

[23] Local authority municipal and household waste statistics 2008/09, Environment Agency

[24] See *Study into Commercial Waste arisings,* (April 2009) ADAS, http://www.emregionalstrategy.co.uk/

[25] http://www.ncl.ac.uk/press.office/press.release/item/from-manure-to-megawatts

part of a new Centre for Renewable Energy from Land. The actual capacity of the plant does not appear to be published in the public domain; however the total capital investment in the plant totals £1.85M which implies the facility will be small.

Northumberland has seen significant investment in municipal waste management infrastructure in recent years. The outcome is that energy is currently being extracted from waste, indirectly in the form of recycling (reducing the energy demand for extraction of raw materials and production of goods), and electrical and thermal energy in the case of waste sent to the Tees Valley EfW plant. The remaining reduced residual household waste stream is small and not considered to be a significant exploitable resource.

However, there are significant arisings of C&I waste with potential for treatment in thermal and AD plant. It is therefore suggested that energy from waste strategies focus on use of the commercial and industrial waste streams.

Waste Potential Summary

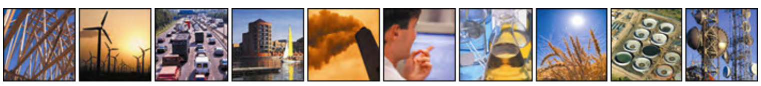
Based on the estimated missed waste arisings for the North East quoted in Table 11 above, it is assumed that 10% of the North East total is arising in Northumberland. This is based on a high-level review of the population spread and an annual business enquiry obtained from Nomis/Office of National Statistics[26]. The ONS data shows that Northumberland is home to 12% of the North east region's population and around 9-11% of companies within each SIC category.

The estimated values in Table A11 are developed using the calorific value commonly used for household waste as it is assumed that C&I waste is assumed to have a broadly similar composition to household waste. The available volumes of C&I waste are based on the values shown in Table B4 - see the commentary regarding the method of extrapolation.

Table A11 Waste Potential Summary

	Lower range – C&I mixed waste only	**Upper range - C&I mixed and food waste**
Waste arisings	84,7300 t/year	100,860 t/year
Waste net calorific value (CV)	9.3MJ/kg	9.3MJ/kg
Annual MWh/year	218,890 MWh/year	260,560 MWh/year
Electrical output	50,130 MWh/year	59,930 MWh/year
Thermal output	108,980 MWh/ye	130,280 MWh/year
Carbon saving	47,320 tCO_2/year	56,570 tCO_2/year
Approximate installed capacity – electrical	6 MW	7 MW
Approximate installed capacity – thermal	14 MW	15 MW

[26] https://www.nomisweb.co.uk - accessed July 2010



A6 Hydro

There are three existing hydropower projects in Northumberland. The largest of the three is the 6MW Kielder Hydro Power Plant[27] located within Northumberland National Park which is England's largest hydro electricity generating facility. The second largest is a plant producing 20 kW of electricity for Alnwick Castle[28]. The third plant is a 3kW micro-hydro generator supplying electricity to a heat pump system which generates heat for Whitfield Parish Hall[29]. In addition it is notable that Northumberland played a part in the development of hydroelectric power; Cragside near Rothbury was the first house in the world to be lit by hydropower.

There are also several hydro projects under development including Burnmouth Mill in the parish of Tarset, the Uplands Hydro feasibility study (seven farm holdings in and around Alwinton) and the Wooler Weir study[30]. There is also a good potential for development of a community and individual schemes within Northumberland National Park either by restoring former mill sites or by developing new hydropower plants.

The Environment Agency (EA) has recently published a study related to potential opportunities for hydropower in England and Wales[31] (based on technical report prepared by Entec) which also identifies a number of areas for hydropower development in Northumberland. The study identifies opportunities for hydropower taking into consideration the environmental sensitivity associated with exploring these opportunities. However, the identification of real potential for installation of hydro schemes in the region requires detailed survey work considering site specific technical and environmental factors. This work is beyond the scope of this study.

The study shows that Northumberland region has one of the highest potential for hydropower in England and Wales. The maximum theoretical hydropower potential in Northumberland is presented in Figure A6.

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[27] http://www.rwe.com/web/cms/en/312572/rwe-npower-renewables/sites/projects-in-operation/hydro/kielder/, accessed June 30, 2010

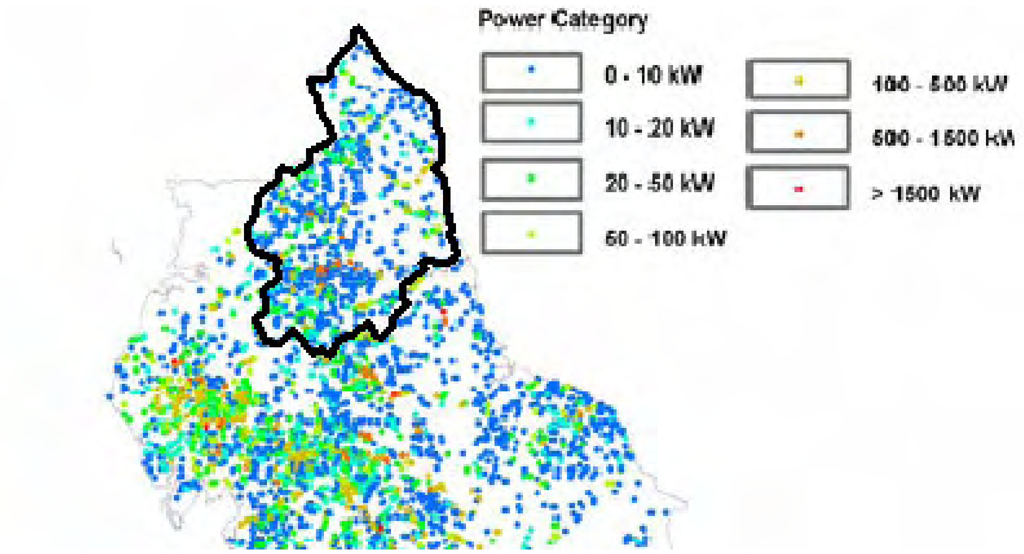
[28] http://alnwick.journallive.co.uk/news/duke-of-northumberland-opens-a.html, accessed June 30, 2010

[29] http://www.ca-north.org.uk/contray/media/community_renewable_energy/REALL_Whitfield.pdf, accessed June 30, 2010

[30] http://www.northumberlandnationalpark.org.uk/lookingafter/projects/climatechange/climatechangehydropower.htm, accessed June 30, 2010

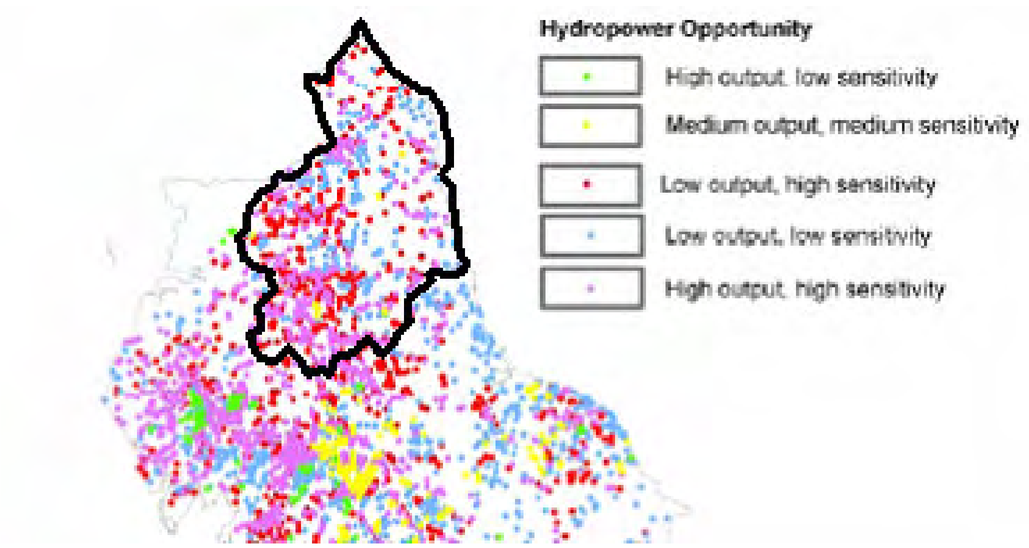
[31] Opportunity and Environmental Sensitivity Mapping for Hydropower in England and Wales, Environment Agency, March 2010

Figure A6 Theoretical Hydropower Potential in Northumberland



The identified potential sites suitable for power generation have different environmental sensitivity. The classification of identified opportunities in terms of power output potential and environmental sensitivity are presented in Figure A7.

Figure A7 Classification of Opportunities in Northumberland

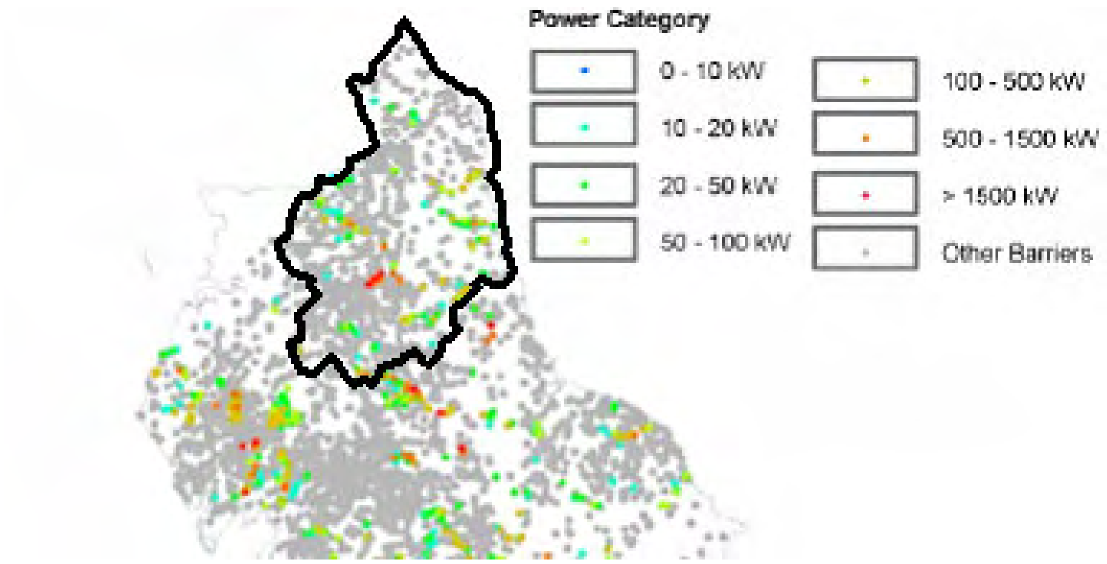


The best opportunities are identified as 'high output' with respect to generation potential and 'low sensitivity' with respect to environmental factors.

Noting that this was a high level national study these sites could be the starting point for more detailed appraisals. For example it may be worth looking at those high output sites to see what the environmental constraints are and whether or not it is possible to respond.

In addition, the study identified areas were so called 'win-win' schemes can be developed. Win-win schemes are defined as schemes that have both good hydropower potential and can potentially increase the status of the associated fish population, as a consequence of implementing appropriate mitigation measures such as improving fish passage. The potential win-win schemes in Northumberland are presented in Figure A8.

Figure A8 Potential Win-Win Schemes in Northumberland



According to the information provided in the EA report, there are 956 potential sites suitable for development of hydropower which corresponds to approximately 56 MW installed power potential. 95% of this power potential is classified as highly sensitive and 51% is classified as win-win. Clearly the true potential will be a small fraction of this, but it is not possible to evaluate whether a scheme will actually be feasible and viable without carrying out a detailed assessment including a site visit.

In order to consider opportunities for hydropower in greater detail, RENEW have commissioned a report to identify viable hydro schemes on the Tyne and Wear catchment areas and this has recently been published. The study identifies a number of potential opportunities in the south of Northumberland, and considers four potentially feasible and viable schemes in detail with site visits undertaken, which are as follows:

- Featherstone Castle – 99kW low head scheme near Haltwhistle;
- Plashetts Burn – 86-100kW high head scheme near Kielder Water;
- Blaebury Burn – 33kW high head scheme near Whitfield; and

- Blueback Weir – 48kW low head scheme near Bearsbridge.

If all four schemes were to be developed this would give a total of 200-300kW of installed hydro capacity, a much more modest amount than the true technical potential. However, the study considers only the catchment area of the Tyne (north, south and combined stretches), hence there may be other viable opportunities on watercourses located in areas of the county outside the scope of the RENEW study.

A7 Micro-generation

There is considerable potential for very small scale renewable energy systems to supply energy to existing buildings in Northumberland. However, there are limitations including the ability of systems to only supply a small proportion of the energy needs of many sites, and the inherent unsuitability of certain buildings due to site constraints.

The Government's Heat and Energy Saving Strategy aims to reduce emissions from households to close to zero by 2050, primarily by improving energy efficiency and installing renewable and low carbon energy generation. This will require a dramatic increase in the uptake of small scale, building integrated renewable and low carbon systems including solar thermal, solar photovoltaics, heat pumps and micro wind turbines. A high level estimate of the technical potential of these technologies to contribute to the energy demand of existing housing stock has been performed based on work recently carried out by Entec for the Committee on Climate Change (CCC). The exception is micro wind which is poorly suited to urban environments and the energy yield is highly site specific, so no attempt to estimate this potential has been made. The results for the solar and heat pump technologies are shown in Table A12.

Air source heat pumps have a lower performance than ground source heat pumps and do not deliver significant carbon savings when replacing natural gas boilers since the emissions from these systems are comparable. However the emissions savings are more significant when displacing more polluting heating fuels such as coal, oil and electricity.

Table A12 Estimated Micro-Generation Potential in Northumberland

Technology	Typical yield (per domestic unit per year)	Total Heat Supplied (MWh/year)	Total Electricity Supplied (MWh/year)	Equivalent Number of Homes	CO_2 Savings (tonnes per year)
Solar photovoltaics	1MWh of electricity	0	68,600	68,600	38,004
Solar thermal	1.25MWh of heat	85,750	0	85,750	15,864
Ground source heat pumps	10MWh of heat	208,600	-46,356	20,860	12,910
Air source heat pumps	10MWh of heat	285,600	-95,200	28,560	95

Notes:

Micro-wind turbines are not considered within this analysis because their success depends on site specific characteristics and local wind speeds, potential which would require detailed site survey work.

Ground source heat pumps require electricity to operate the pump, hence they increase overall electrical demand relative to a conventional gas boiler heating system

Air source heat pumps are not considered within this analysis because they have a lower performance than ground source heat pumps and therefore they do not have as significant carbon savings.

Source: Entec

This assessment applies various constraints to estimate the actual number of homes for which the technologies would be feasible, so is an estimate of the technical potential. Other factors which will restrict uptake include economics, restrictions on supply and installation capacity and public perception; these have not been considered.

A8 Geothermal

Geothermal energy is energy extracted from heat stored within the earth. The distribution of heat below the Earth's surface varies greatly from place to place. In some areas earth's heat can be found close to the surface which makes it possible to utilise it for heating and power generation.

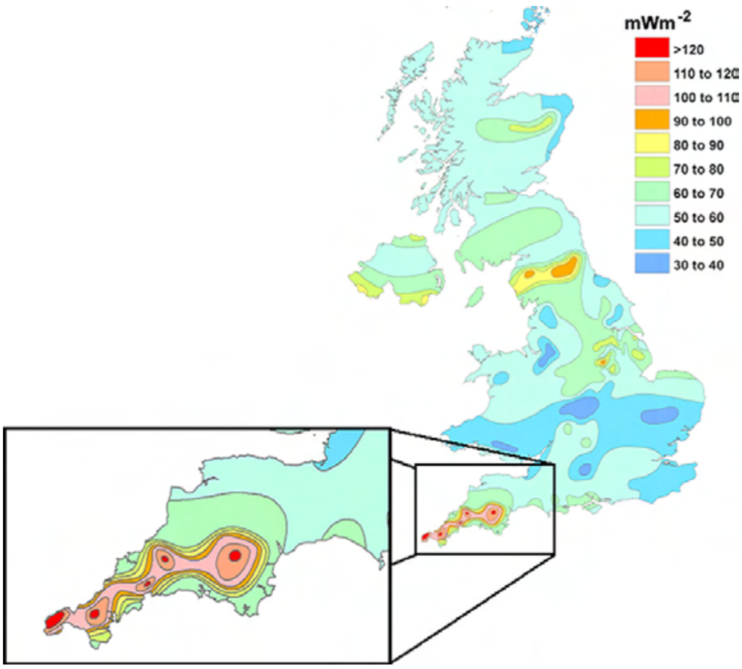
Geothermal energy can provide heating directly, while geothermal power plants take steam or hot water from geothermal reservoirs, and use this to power generators and produce electricity.

The UK's only geothermal power plant was developed in Southampton in 1986 which uses a geothermal aquifer as its energy source. The plant extracts water from a depth of about 1,800m at 76°C, and is connected to a communalheating networks delivering both heating and cooling (through absorption chillers) to a number of buildings in the city centre. Northumberland is not situated above any significant similar geothermal aquifers however,so the potential to use this technology is low.

In addition to using geothermally heated aquifers, hot rocks can be used to extract geothermal energy of the Earth. There are regions in the UK where the rocks at depth are have higher temperatures than normally expected, caused by the radioactive decay of substances found in rocks such as granite.

Some parts of Cornwall have geothermal gradients that are significantly higher than the UK average and so there is presently focus on this area for exploiting geothermal energy extraction (see Figure A9). There are plans to build the UK's first geothermal power plant that would use heat from hot rocks to generate heat and power for Eden Project and circa 4,000 households in Cornwall. In Northumberland the potential is again relatively low, falling in the light blue potential region.

Figure A9 Geothermal Potential (Hot Rocks) in the UK



Source: http://www.bgs.ac.uk/research/energy/energy_geothermal.html

In July 2009, the UK government has announced availability of six million in capital grant funding over two financial years to explore the potential for deep geothermal power and facilitate the development of geothermal energy technology in the UK.

This fund is dedicated to cover exploration expances needed to identify sites with economically viable geothermal resources. The fund's money are split bethween two phases: £4 million available in the first phase and 2 million for second phase. The first round bidding process was closed on 20 November 2009 and three projects had been awarded capital grants under the fund. Despite the first phase of the scheme has ended, it will still be possible to apply for £2 million in second phase funding in financial year 2010-11.

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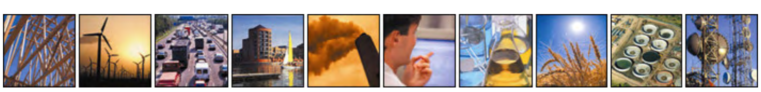
Appendix A

Appendix B
Entec's Approach to Identifying the Accessible Wind Resource



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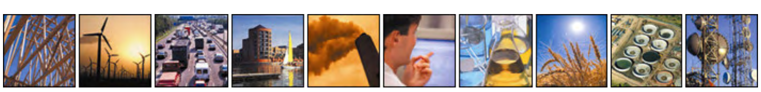

Appendix B

Identifying the 'accessible wind resource' across a site, district or region

Overview of Entec's Approach

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- Purpose and scope: a desktop review to identify the 'accessible wind resource' within an area based on Geographic Information System (GIS) mapping of the key constraints. The aim of this is to provide a local planning authority, wind developer, landowner or other organisation with a robust evidence base to demonstrate what could be achievable.

- The constraints which we apply are based on established technical 'rules of thumb' widely accepted by key stakeholders in the wind sector.

- The 'accessible wind resource' is that which could come forward pending detailed site specific consideration of national, regional and local planning policy criteria (including PPS22: Renewable Energy), the statutory planning process, Environmental Impact Assessment, site-specific wind speeds, stakeholder consultation (local planning authority, communities, town and parish councils, MOD, NATS En Route Radar Ltd and airports for example) as well as landowner and developer interest.

- This presentation summarises Entec's approach:

  o Agreeing the study area

  o Mapping wind speeds

  o Considering noise (distance to sensitive receptors including houses and settlements)

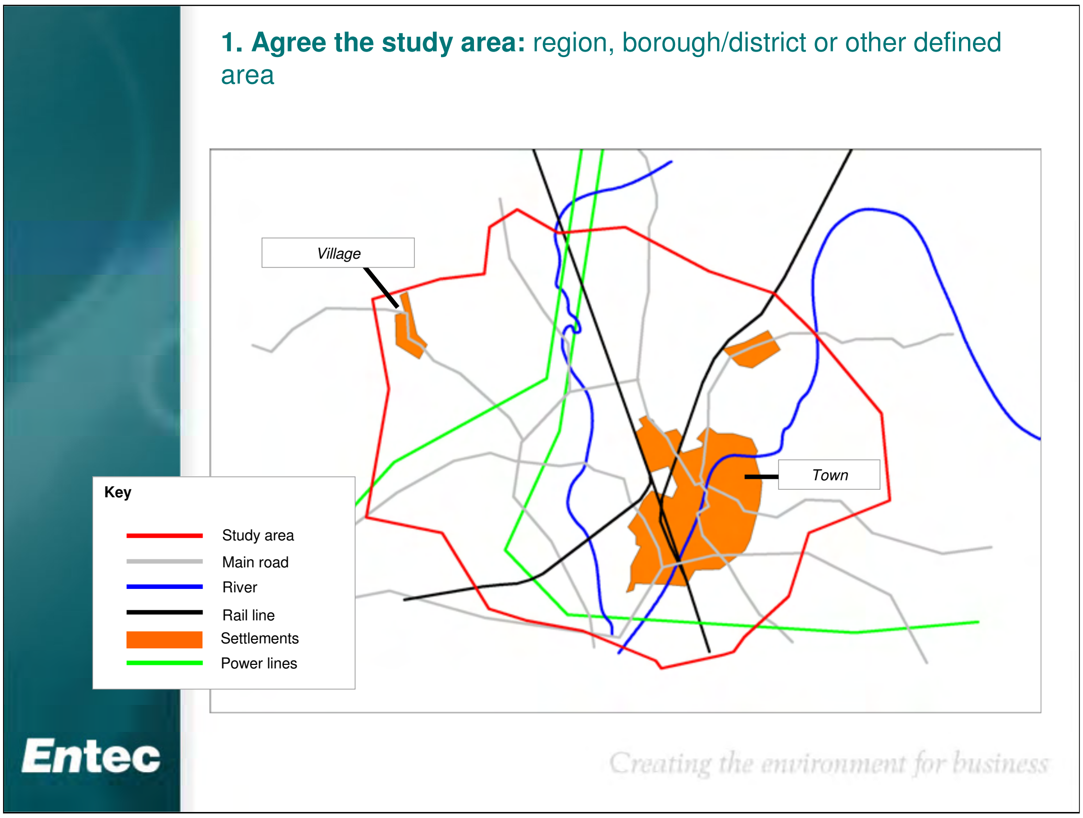
  o Applying a buffer to key infrastructure (roads, rail and power lines)

  o Identifying environmental designations: landscape and ecological for example

  o Mapping other constraints: microwave communication links and rivers

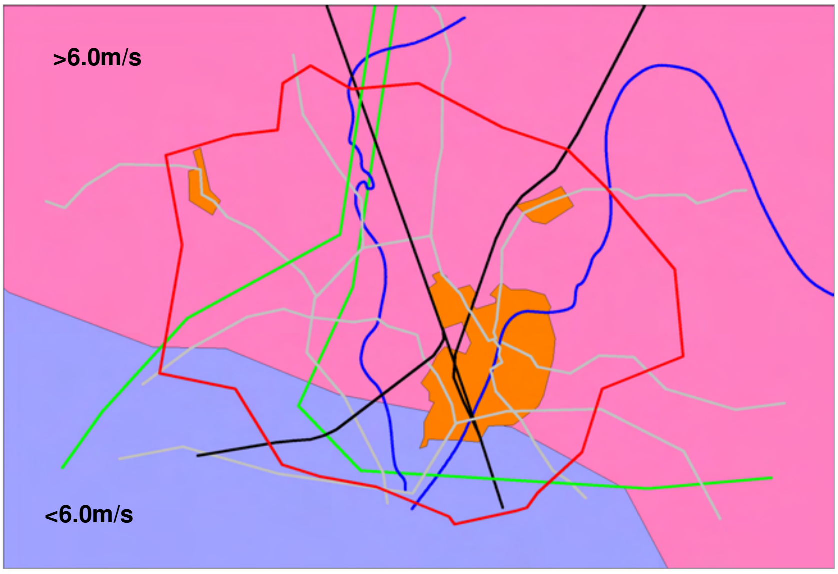
  o Establishing areas of search: areas with the least identified constraints

  o Estimating the accessible wind resource: the number of turbines that could be accommodated within the unconstrained areas



- Our approach is applicable to a specific site or landholding, through to a borough/district or region.

2. Map wind speeds: a general rule for this stage of work is a NOABL wind speed greater than 6 metres per second (m/s) at 45 metres*



*NOABL is the UK Wind Speed Database: http://www.bwea.com/noabl/index.html

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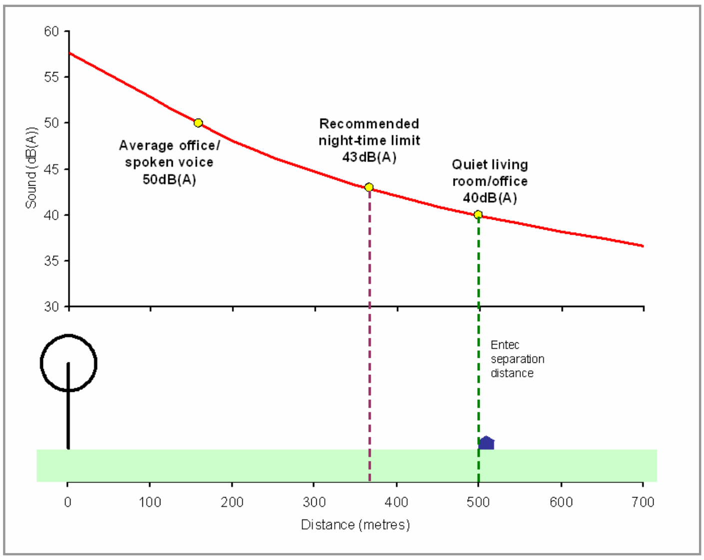
- NOABL used at the outset for an *initial* consideration of wind speeds in an area.
- *At least* 6 m/s at 45m seen as necessary for a viable wind turbine.
- More detailed data is available (e.g. Carbon Trust Model) which can also be used to assess viability.
- Wind developers will also undertake local monitoring to assess wind speeds and subsequent viability further.

3. Noise effects from a single turbine: impact of distance from sensitive areas (e.g. houses and settlements)



Note: this does not take into account background noise levels

Source: http://www.bwea.com/ref/noise.html and Resoft WindFarm (wind turbine modelling package)

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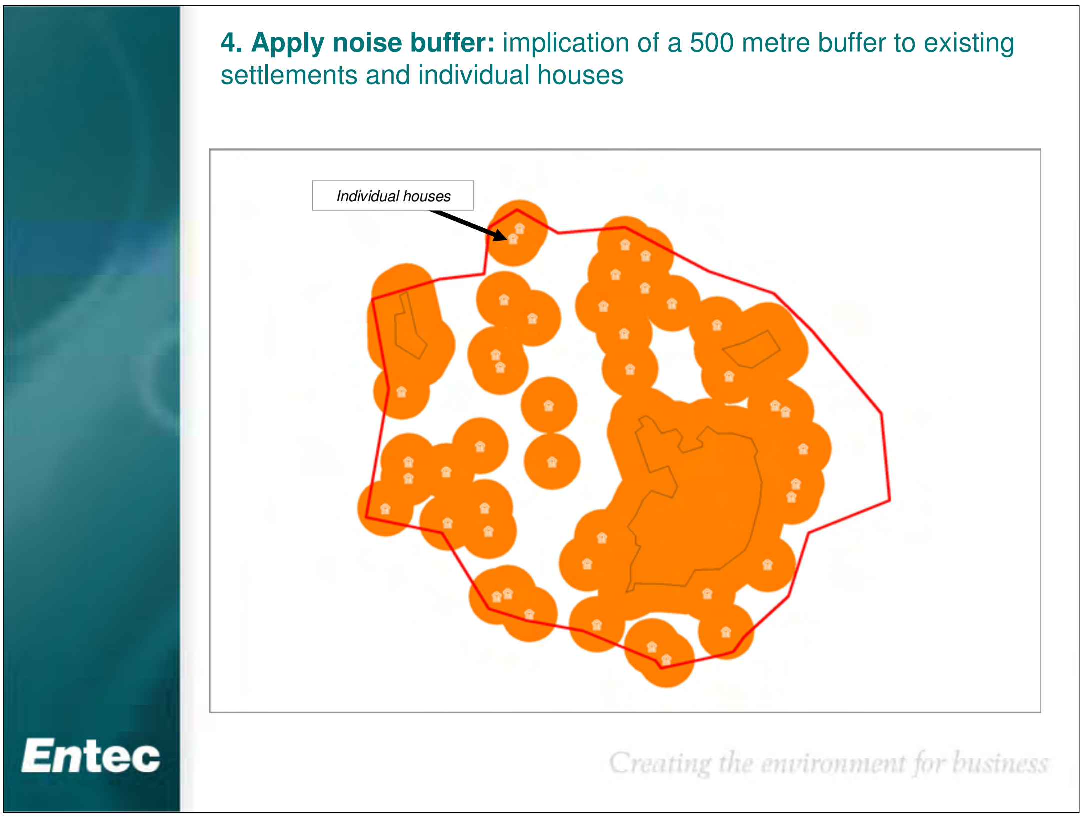
- Figure shows relationship between distance and noise experienced from a wind turbine with a hub height of 80m (2-3MW rated turbine) to a sensitive receptor such as a house or settlement.

- The ETSU R-97 report, written by the Wind Noise Working Group, recommends a night time noise limit of 43dB(A) to ensure no sleep disturbance (measured from the window or door of a house).

- The figure above shows that beyond 360 metres from a single 2-3MW turbine noise should be below the 43dB(A) recommended limit, excluding consideration of any background noise levels.

- Entec's approach applies a buffer distance of 500 metres, which also accounts for multiple turbines (note that two turbines would not double the noise experienced).

- At 500 metres and beyond noise levels will be 40dB(A) or lower, excluding consideration of any background noise levels.



- Applies the 500m buffer identified in Slide 3, with this distance the least likely to raise the noise level at a nearby noise sensitive property above the recommended 43dB(A).
- This is applied as a starting point pending noise modelling associated with a specific proposal.

5. Apply infrastructure buffer: wind unsuitable within 125 metres of roads, rail and power lines (sometimes called the 'topple distance')

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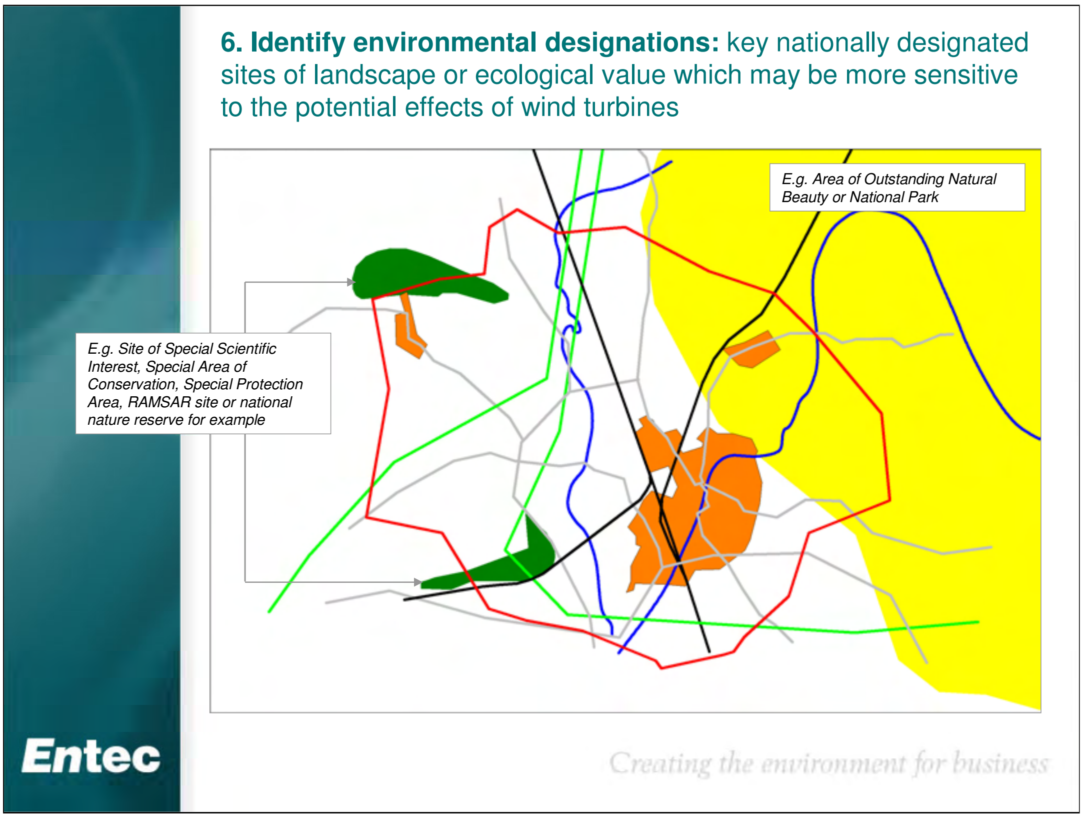
- The term 'topple distance' is simply an engineering term reflecting the need to consider the location of wind turbines in relation to key infrastructure. It is highly unlikely that a wind turbine will fall over.

- There may be site specific cases where it is possible to locate a turbine closer to infrastructure, though 125m is a reasonable buffer for the purposes of an initial assessment.



- For the purposes of assessing the potentially accessible wind resource environmental designations are considered a constraint, though it is important to note that planning policy (PPS7 and PPS22) *does not* prevent wind development within such areas, subject to the application of policy criteria reflecting potential effects, including cumulative effects (e.g. landscape and visual).

7. Other constraints: microwave links and rivers

Microwave link data from OFCOM's 2003 database

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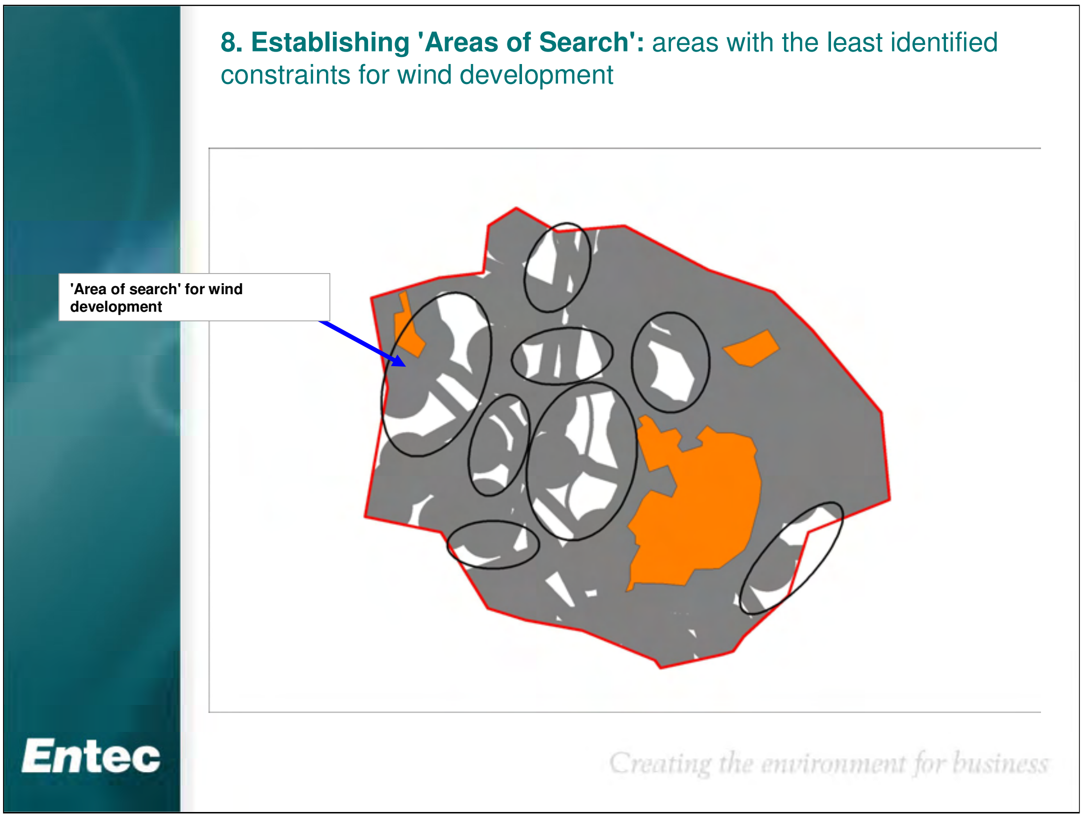
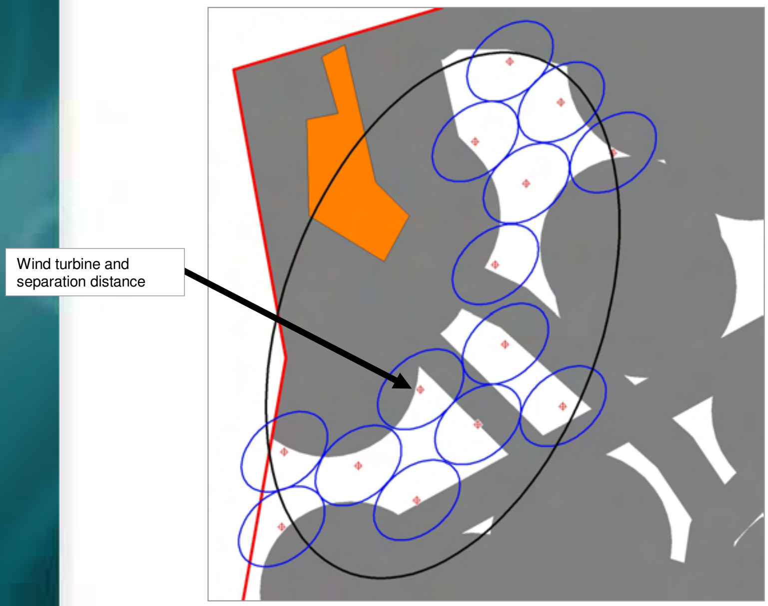


- The following slide sets out how these areas of search should be treated.

9. Estimating the 'accessible wind resource': how many turbines could be accommodated within the areas of search



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- It is possible to estimate the accessible potential by plotting wind turbines within the unconstrained areas. The location of these wind turbines is based on separation distances to account for turbulence (6 blade diameters by 4 blade diameters in the prevailing wind direction [310 degrees from north in the UK]).

- An estimate can be made of the level of electricity that could be supplied from these turbines.

- Realisation of the accessible potential within the areas of search identified will need to reflect site specific work including:

  o The detailed application of national, regional and local planning policy criteria (including PPS22);

  o The statutory planning process, including requirements for Environmental Impact Assessment, reflecting ecology, landscape and visual and community effects for example (also considering the potential for 'cumulative' effects);

  o Stakeholder consultation including with the local planning authority, community groups, town and parish councils, airports, Ministry of Defence and NATS En Route Radar Ltd for example;

  o Further modelling and monitoring of wind speeds;

  o Physical constraints and barriers to development including topography and vehicular access for example; and

  o Land ownership and developer interest in bringing forward a particular site.

- It is also important to note that the identification of areas of search for wind development and the accessible resource does not mean that proposals for other locations (where constraints have been identified) will be unsuitable or should be discounted. Site specific characteristics may mean that it is possible to mitigate the impact of particular constraints or effects.

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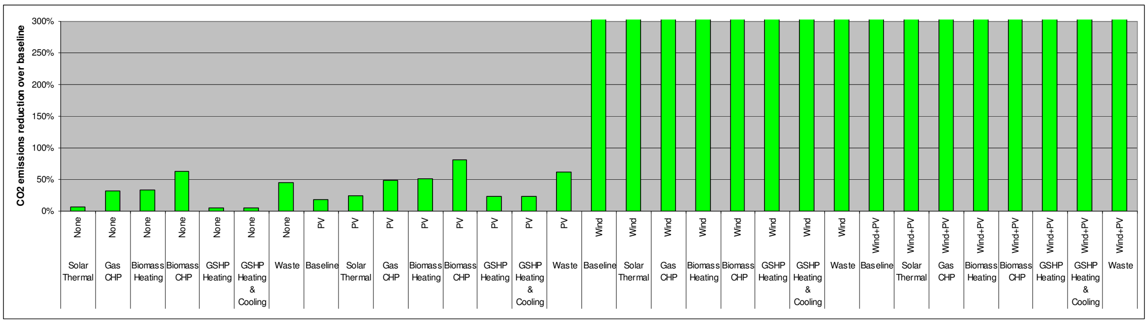
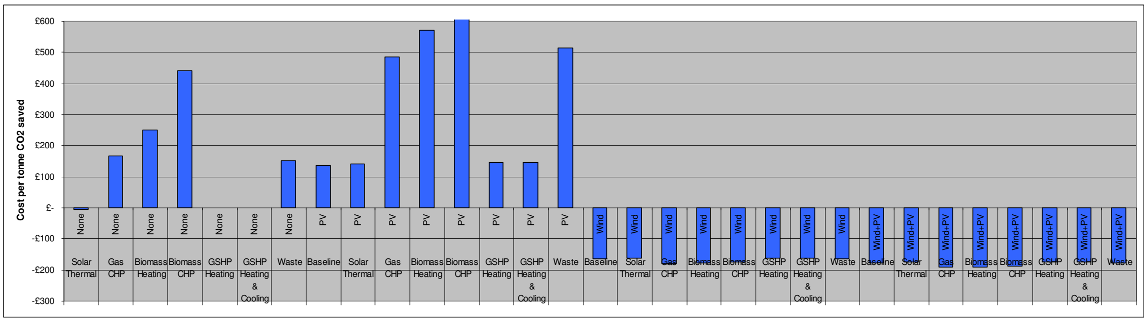
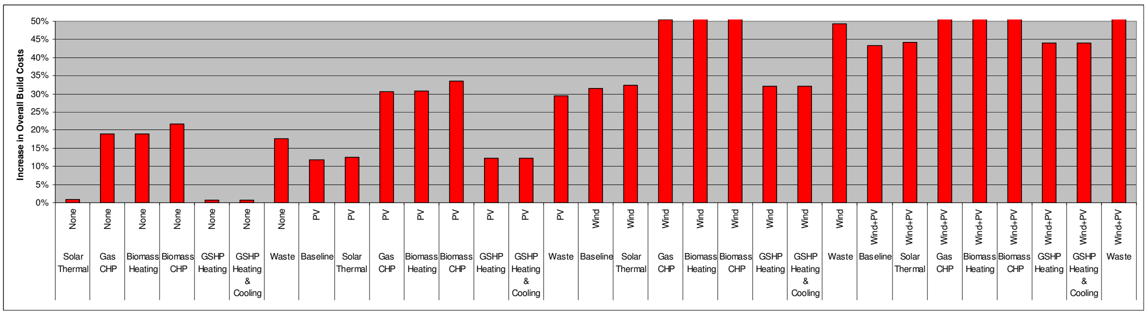
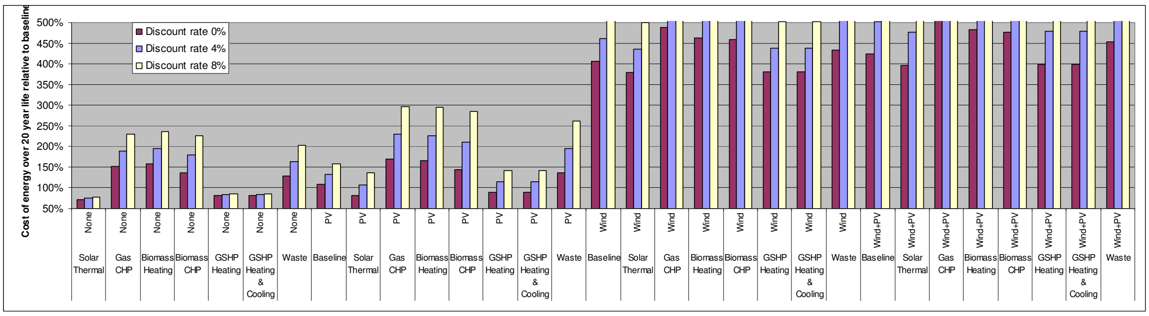
Appendix C
Renewable and Low Carbon Technologies Appraisal: Outputs for Growth Area Sites

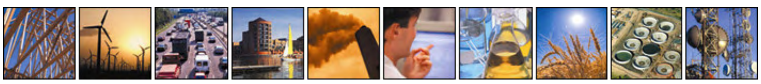
Cramlington South West Sector



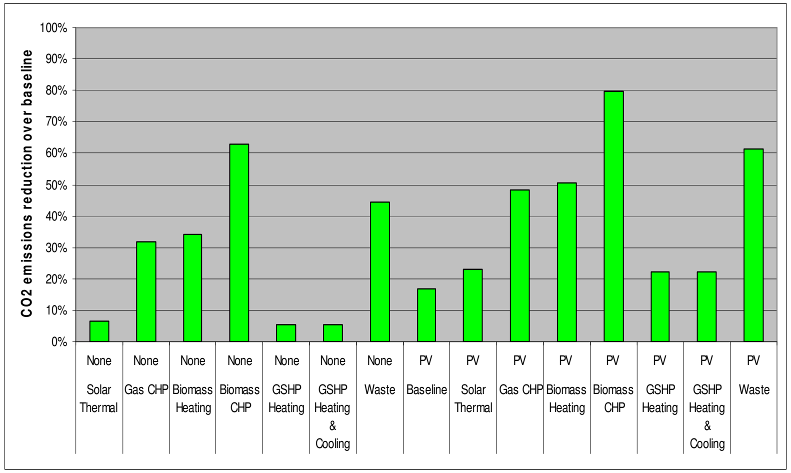


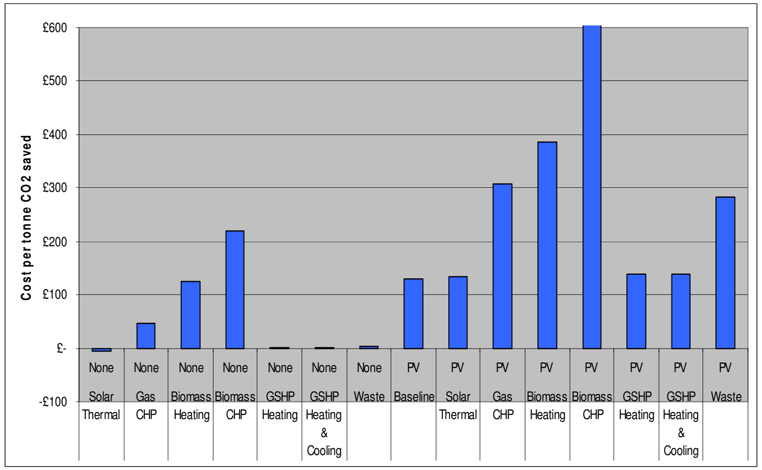


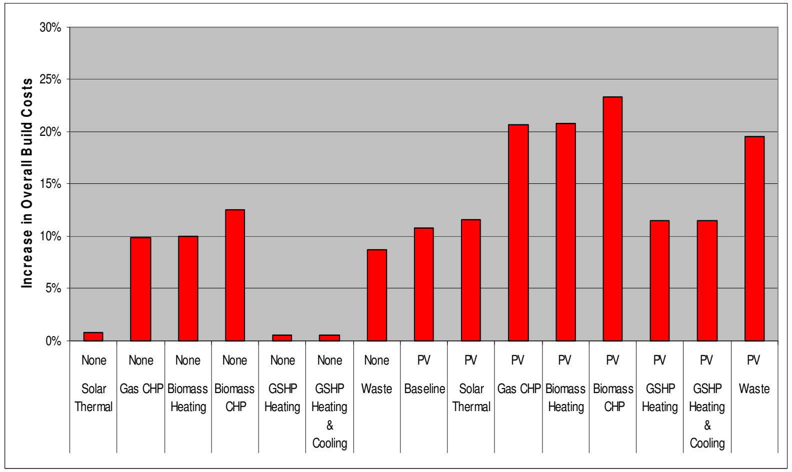


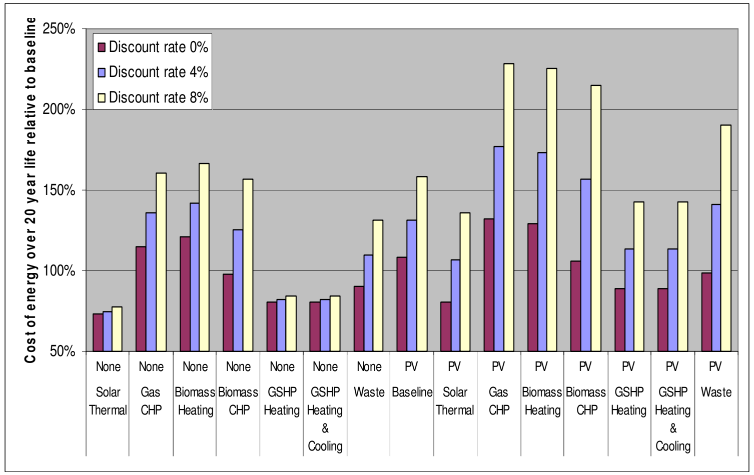


Appendix C


CO2 emissions reduction over baseline
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
None Solar Thermal
None Gas CHP
None Biomass Heating
None Biomass CHP
None GSHP Heating
None GSHP Heating & Cooling
None Waste
PV Baseline
PV Solar Thermal
PV Gas CHP
PV Biomass Heating
PV Biomass CHP
PV GSHP Heating
PV GSHP Heating & Cooling
PV Waste

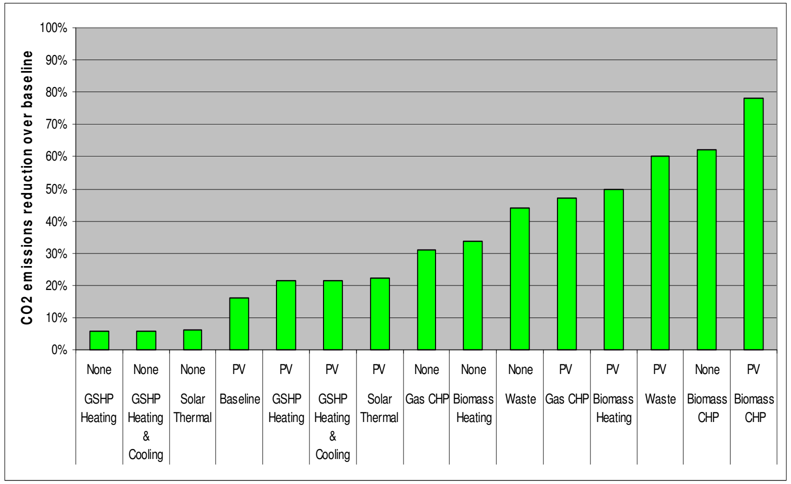

Cost per tonne CO2 saved
£600
£500
£400
£300
£200
£100
£-
-£100
None Solar Thermal
None Gas CHP
None Biomass Heating
None Biomass CHP
None GSHP Heating
None GSHP Heating & Cooling
None Waste
PV Baseline
PV Solar Thermal
PV Gas CHP
PV Biomass Heating
PV Biomass CHP
PV GSHP Heating
PV GSHP Heating & Cooling
PV Waste

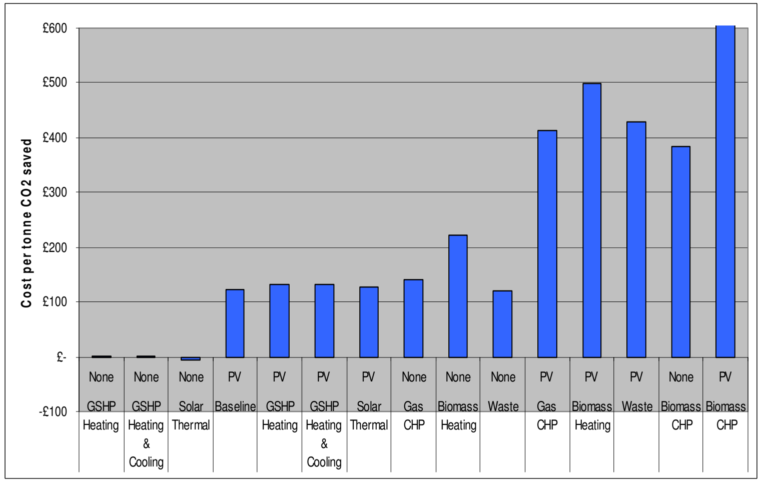

Increase in Overall Build Costs
30%
25%
20%
15%
10%
5%
0%
None Solar Thermal
None Gas CHP
None Biomass Heating
None Biomass CHP
None GSHP Heating
None GSHP Heating & Cooling
None Waste
PV Baseline
PV Solar Thermal
PV Gas CHP
PV Biomass Heating
PV Biomass CHP
PV GSHP Heating
PV GSHP Heating & Cooling
PV Waste

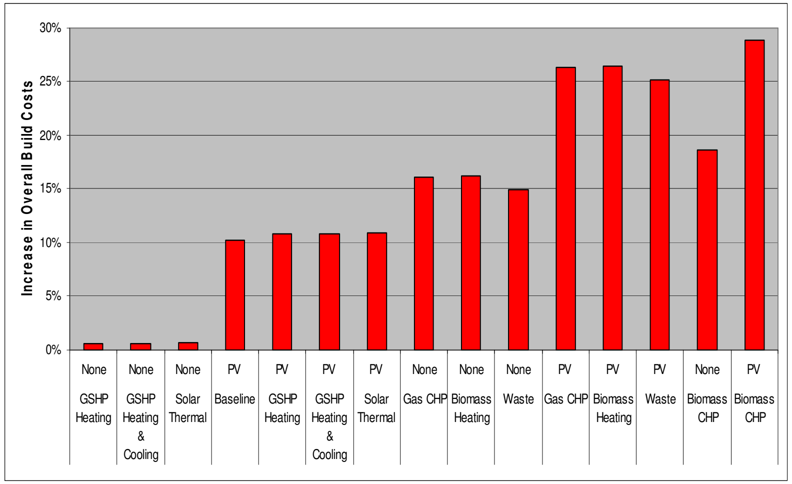

Cost of energy over 20 year life relative to baseline
Discount rate 0%
Discount rate 4%
Discount rate 8%
250%
200%
150%
100%
50%
None Solar Thermal
None Gas CHP
None Biomass Heating
None Biomass CHP
None GSHP Heating
None GSHP Heating & Cooling
None Waste
PV Baseline
PV Solar Thermal
PV Gas CHP
PV Biomass Heating
PV Biomass CHP
PV GSHP Heating
PV GSHP Heating & Cooling
PV Waste

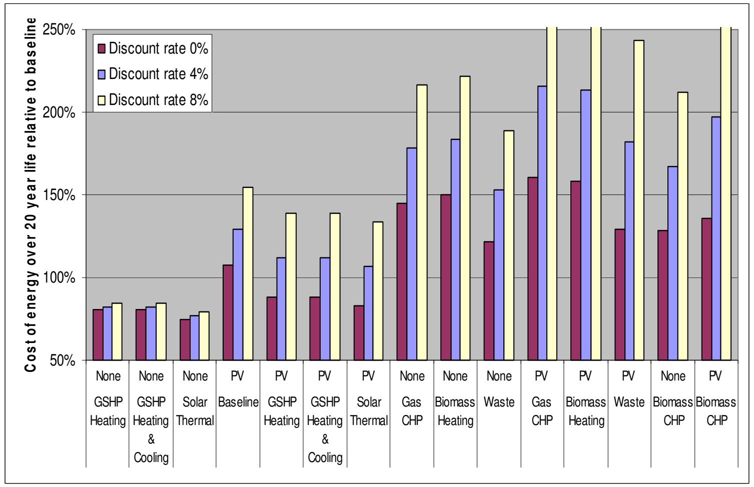
Cambois

Appendix C









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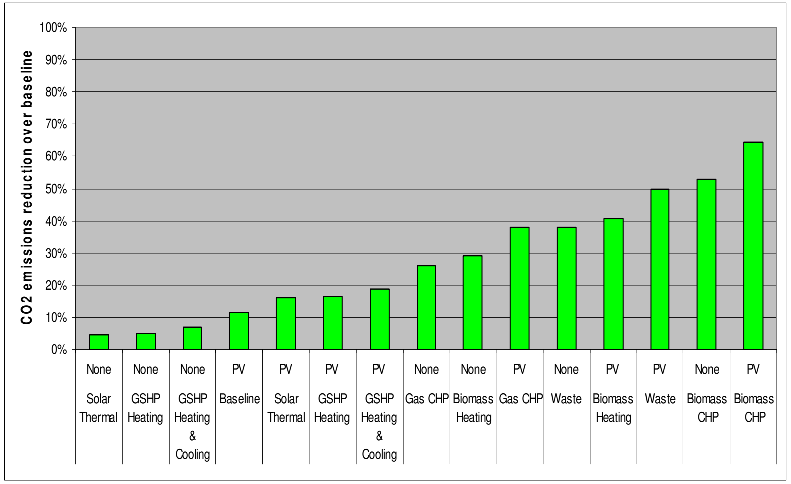

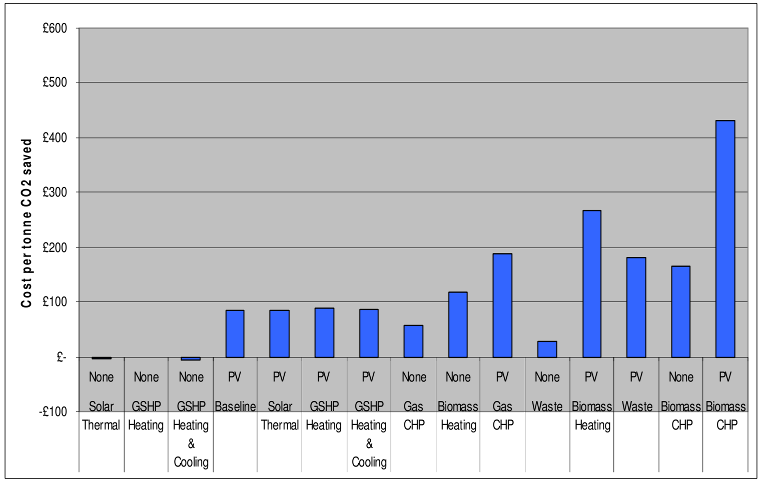

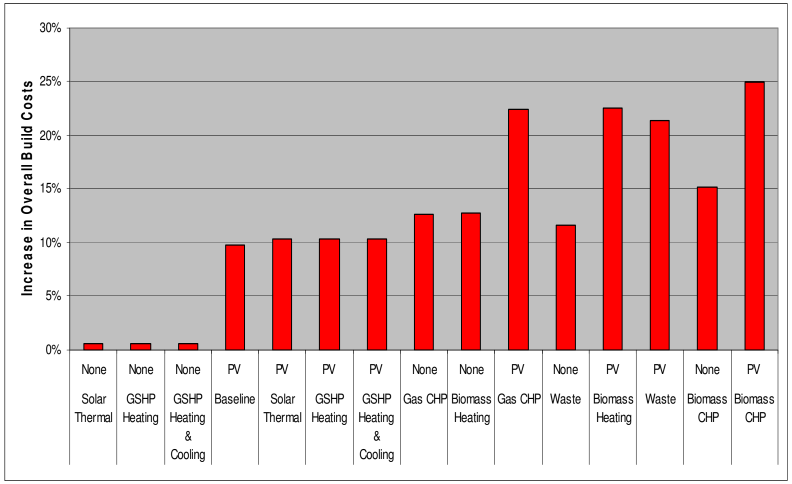

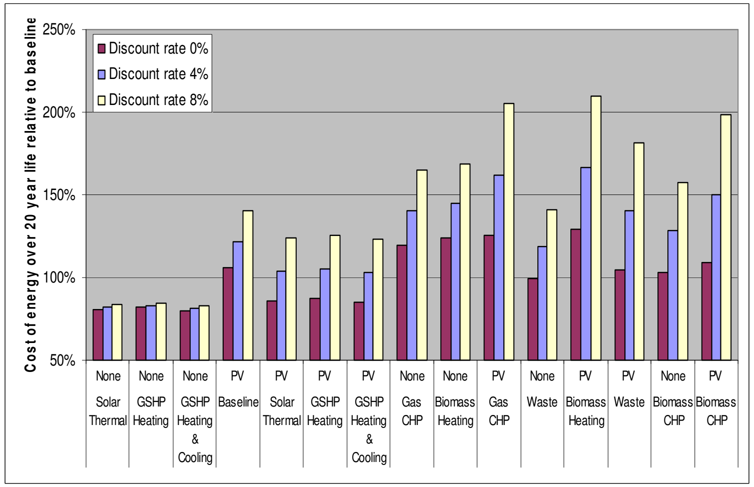

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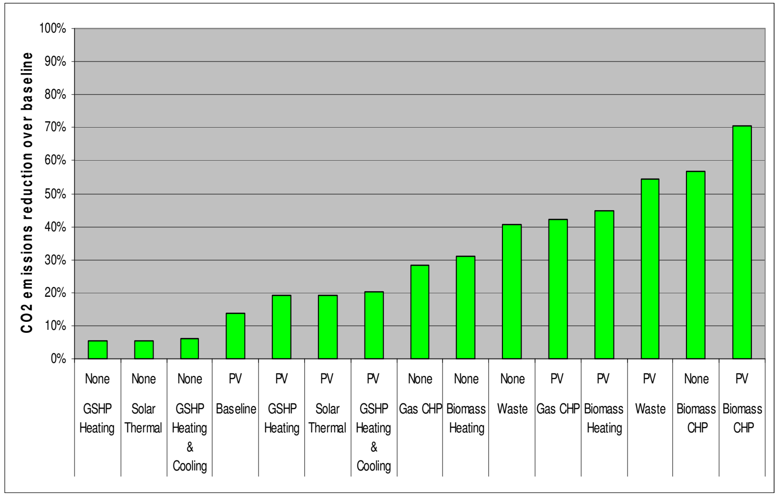

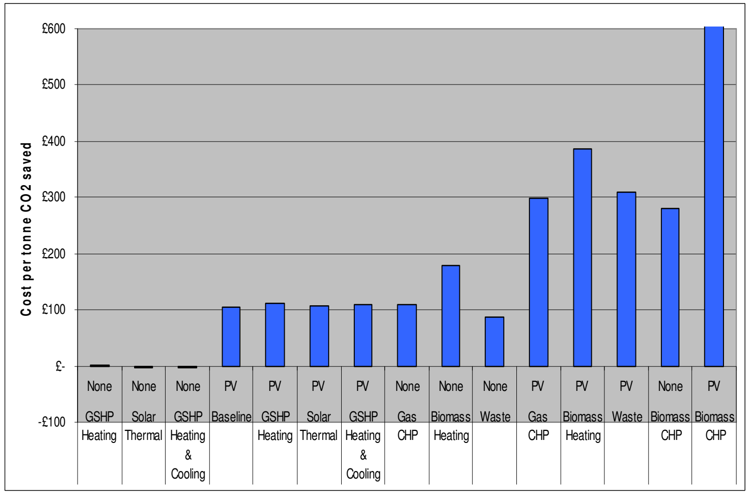

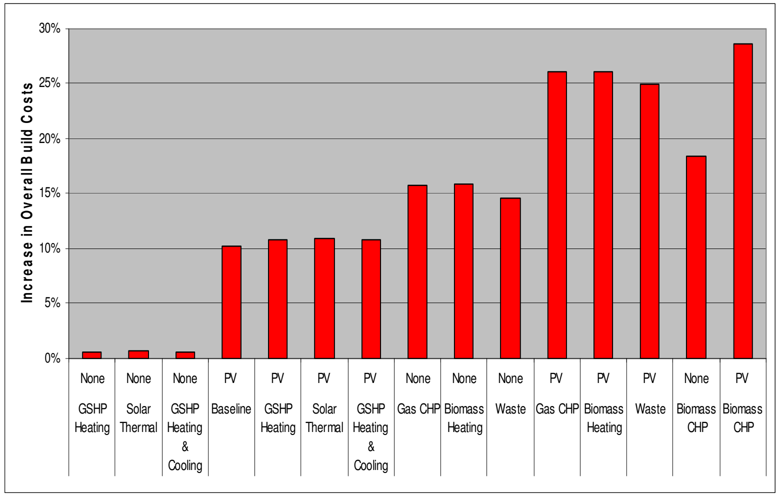

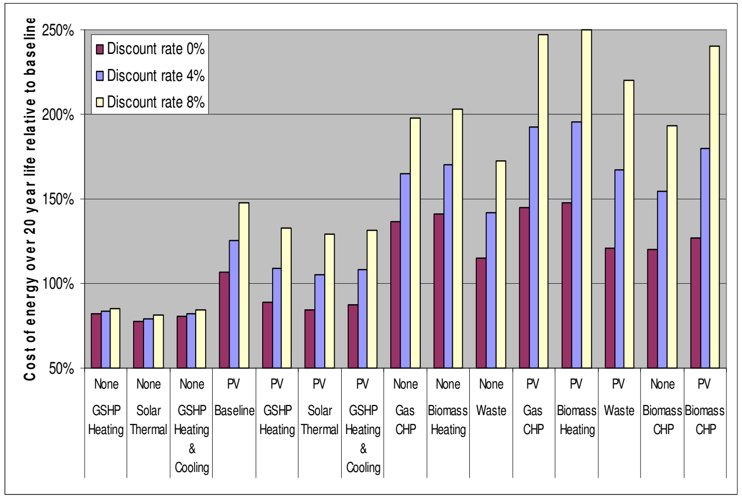

St. George's

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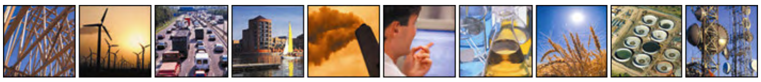

Appendix C

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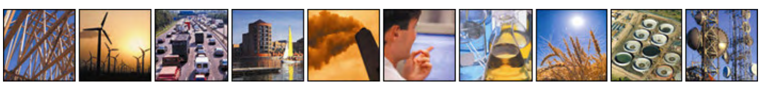
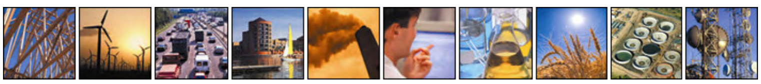
Appendix D
Renewable and Low Carbon Technologies Appraisal: Outputs for Typical Sites





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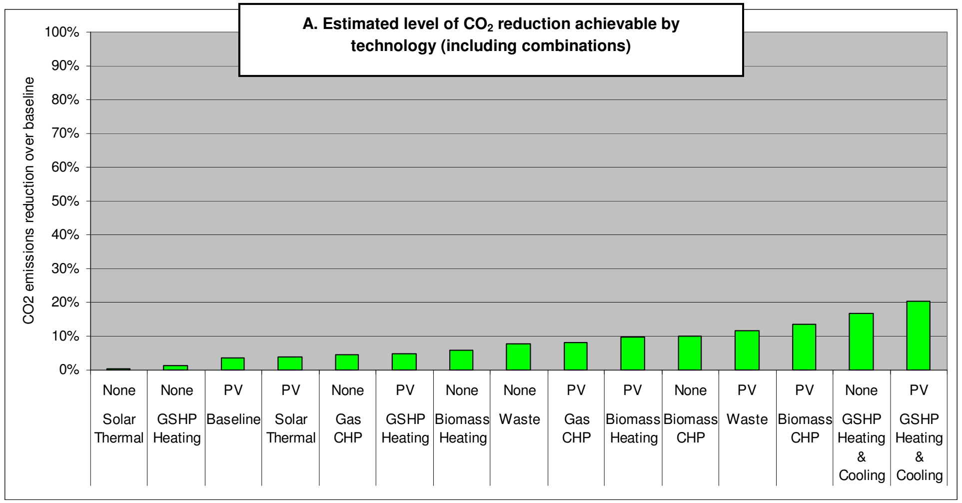
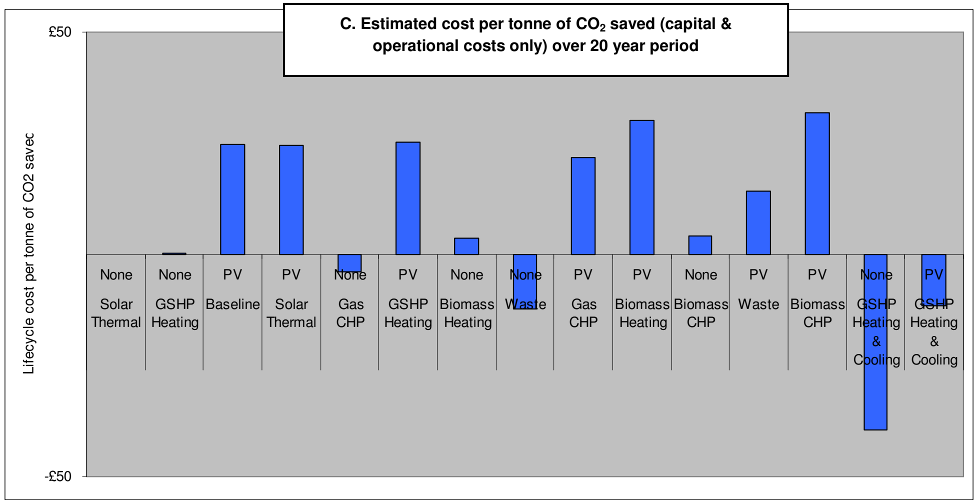
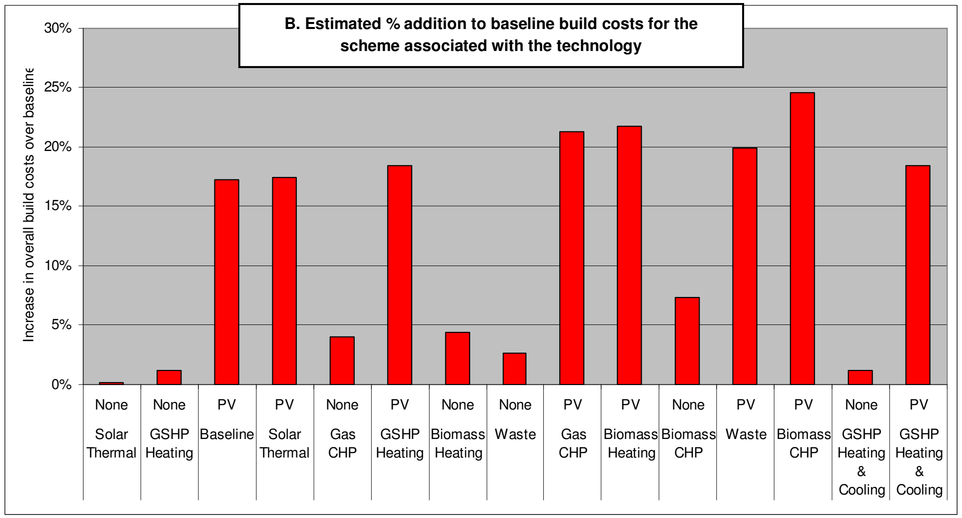
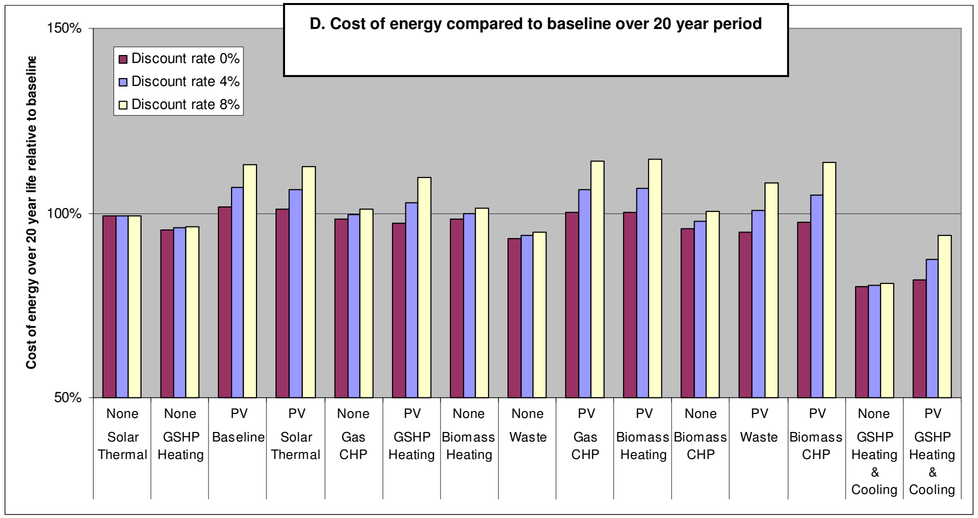
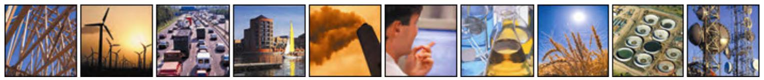
Typology 1 – Town Centre Retail











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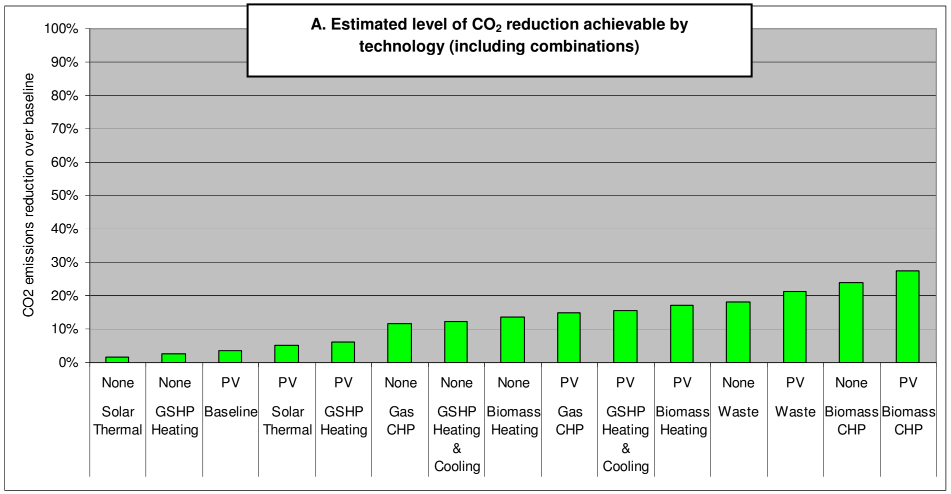
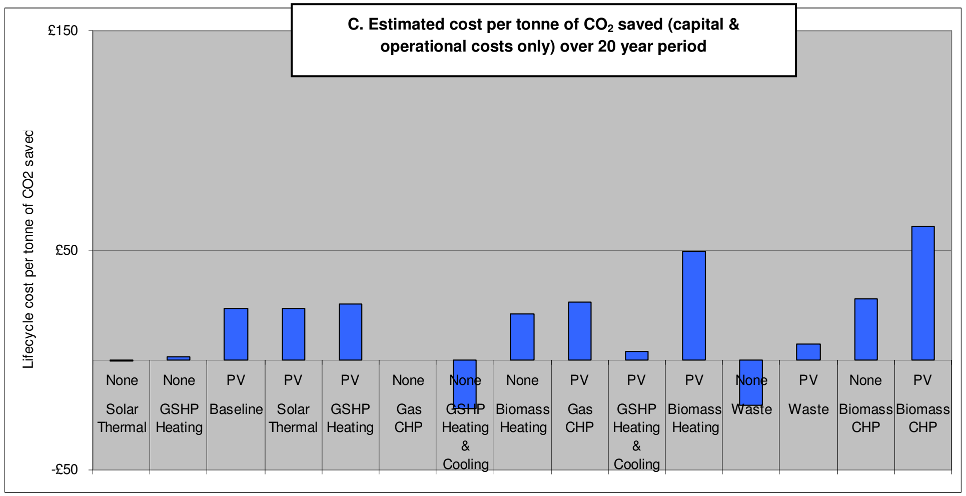
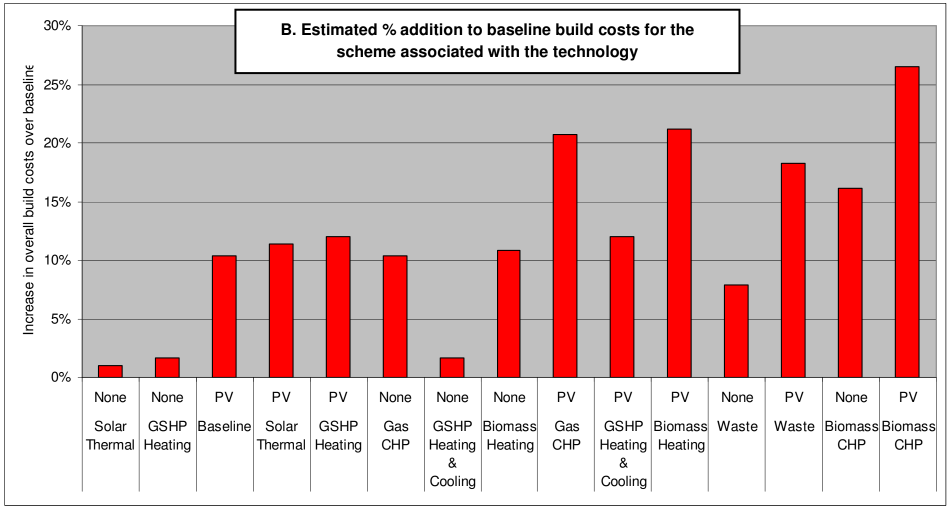
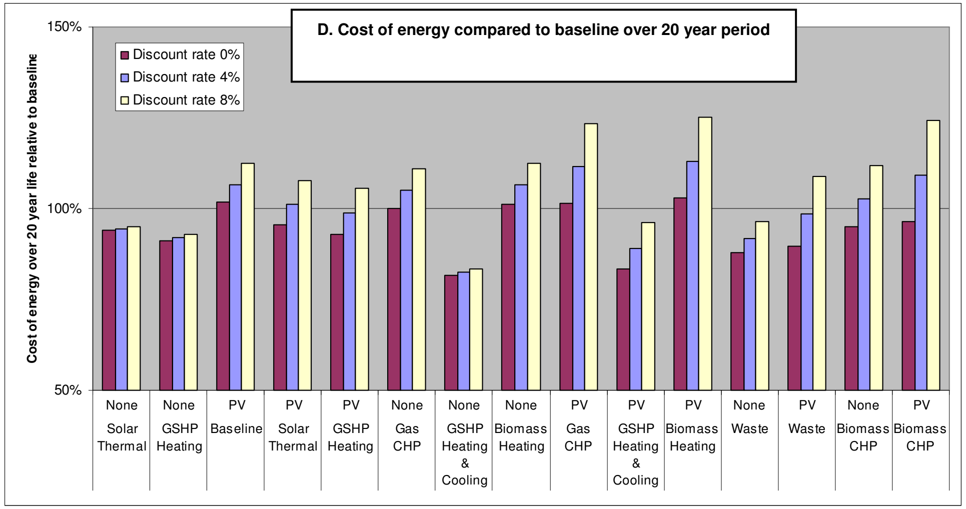
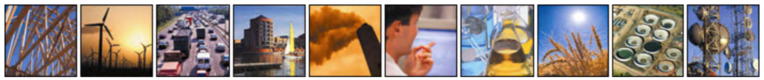
Typology 2 – Major Mixed Use











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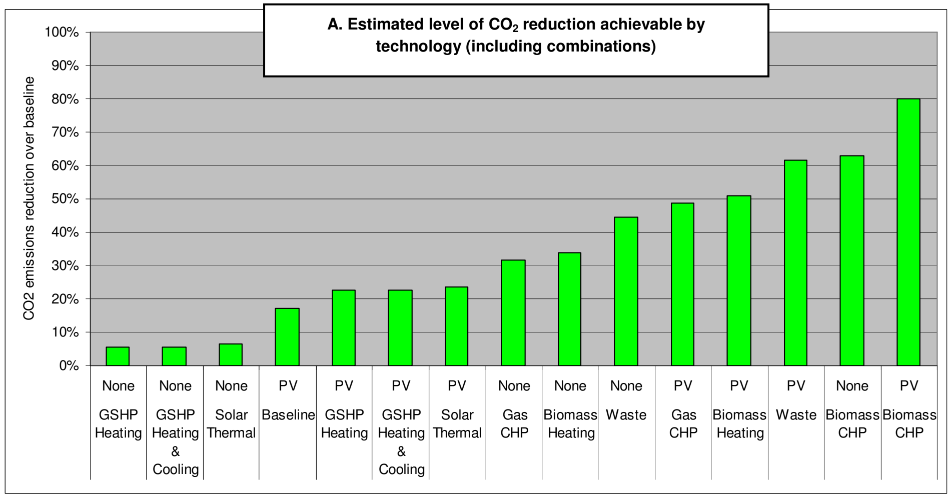
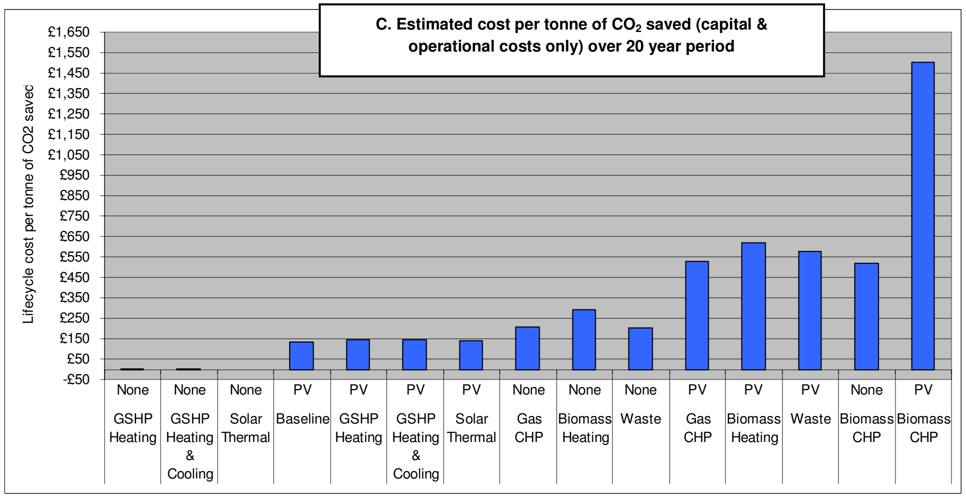
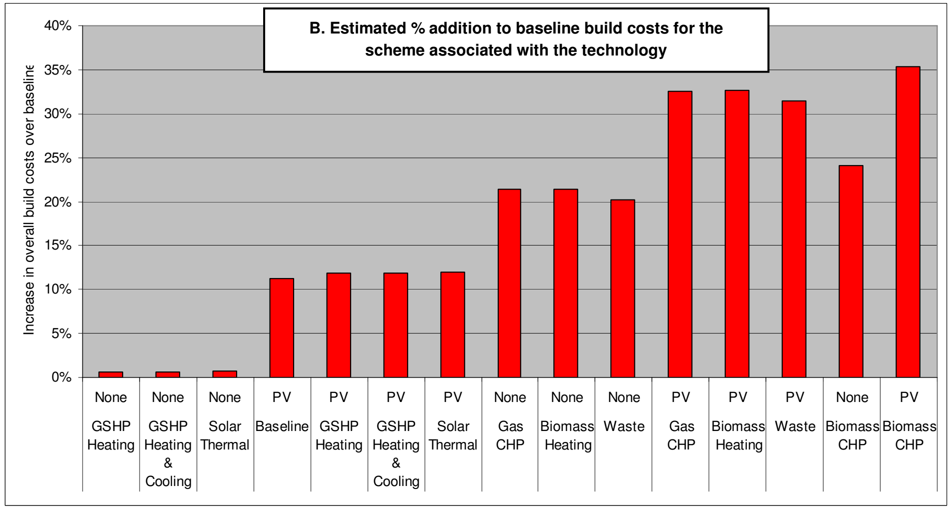
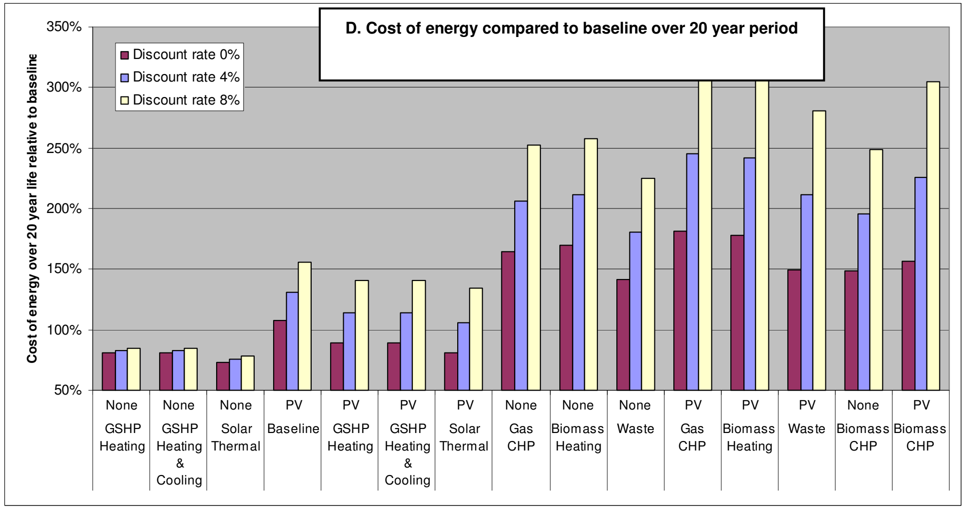
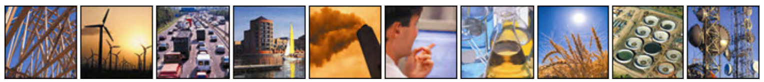
Typology 3 – Greenfield Urban Extensions











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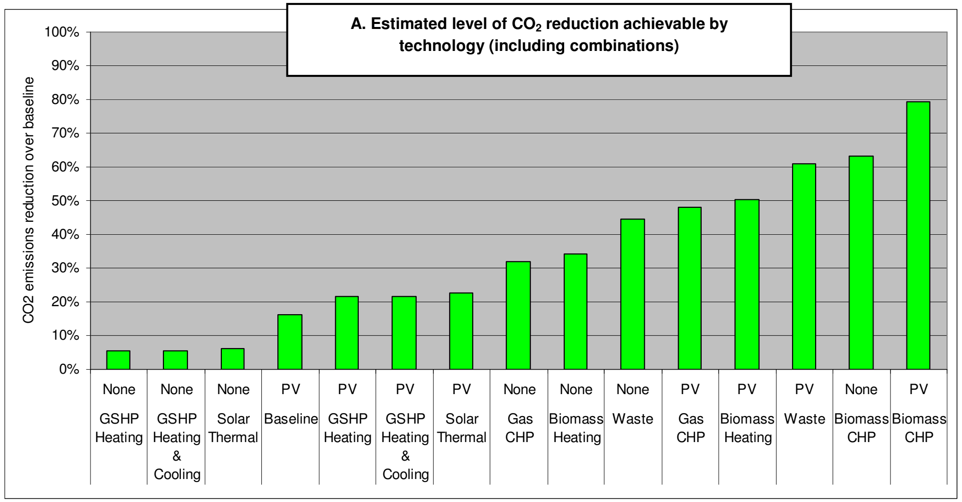
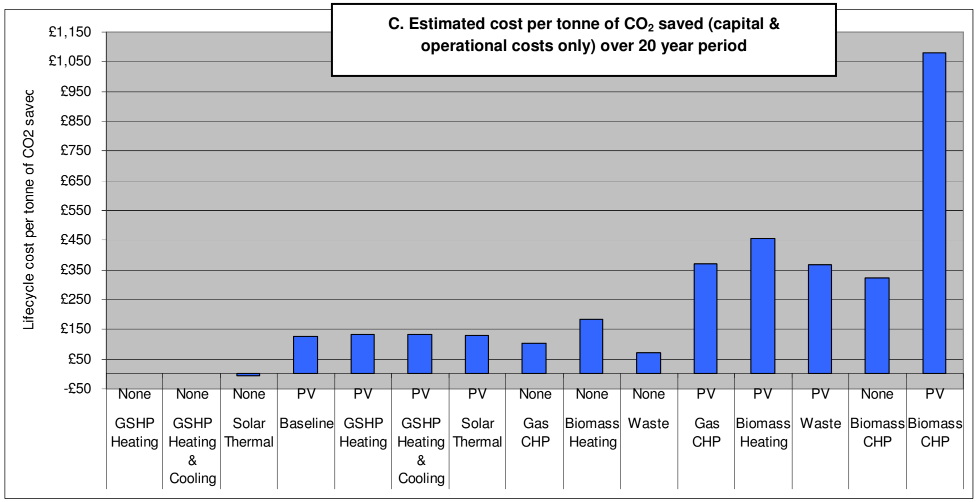
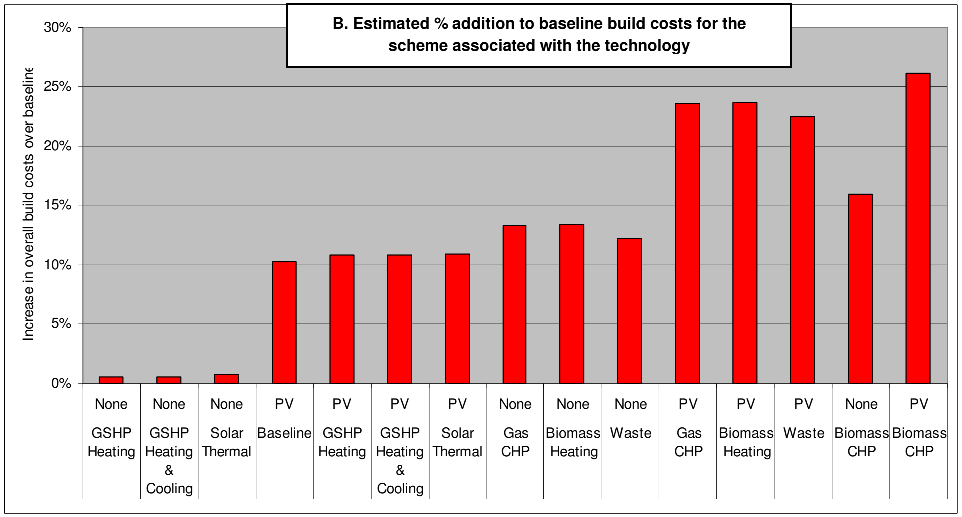
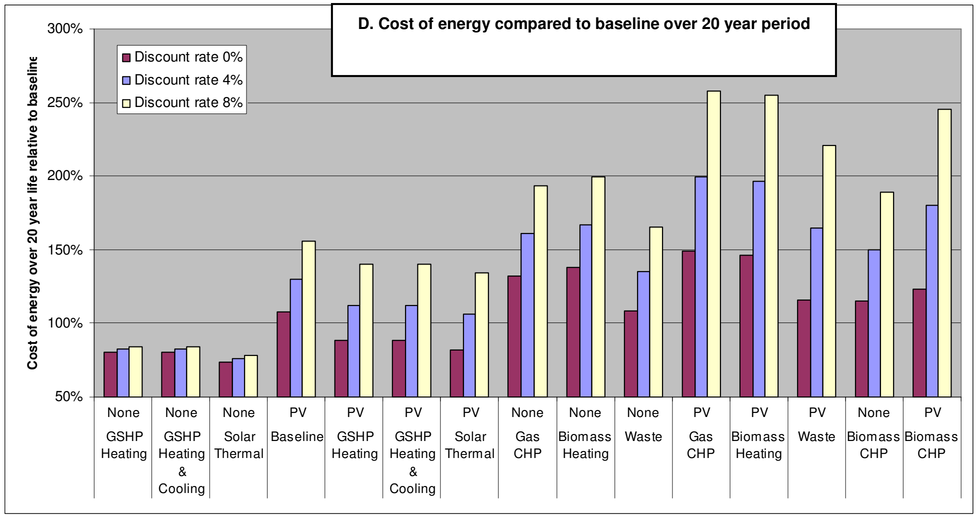
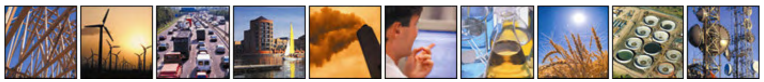
Typology 4 – Brownfield Residential











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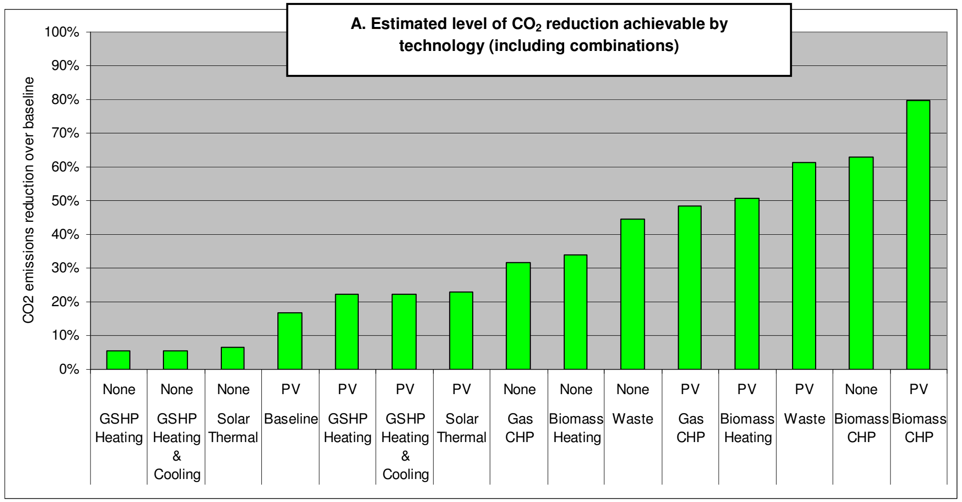
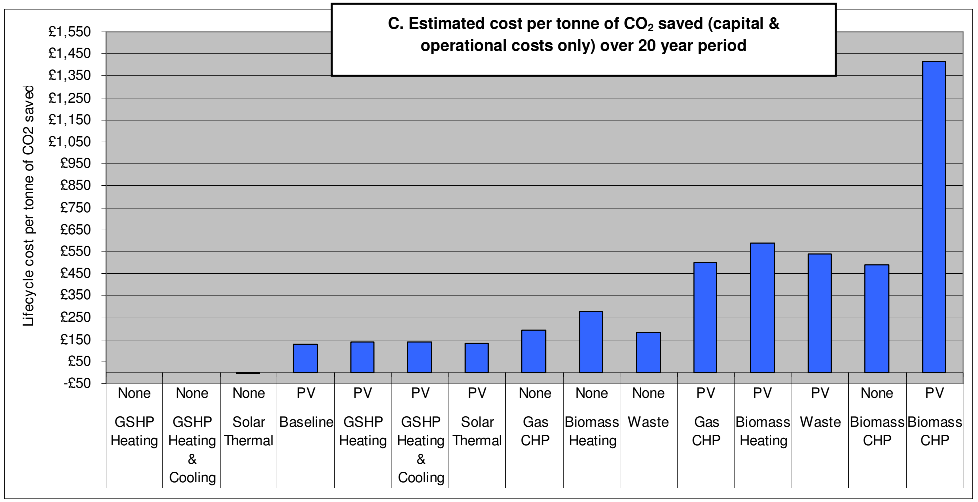
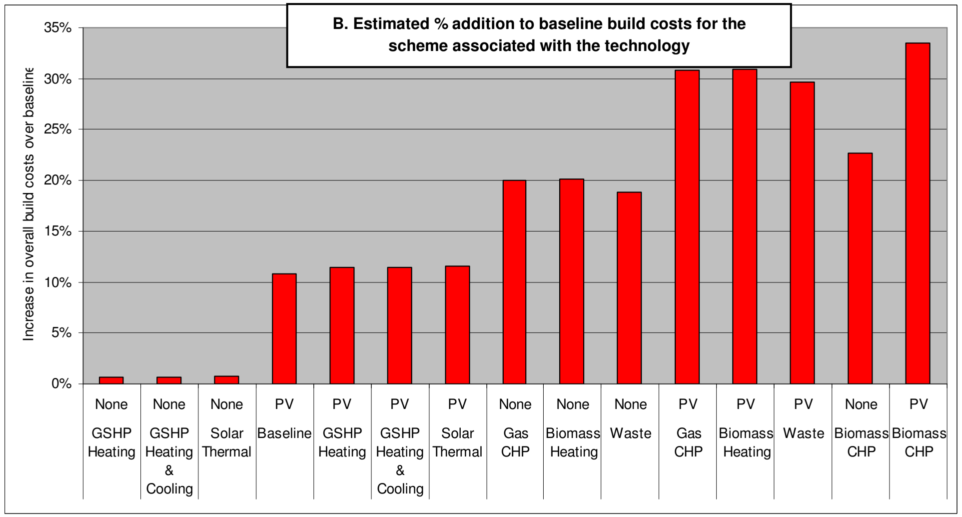
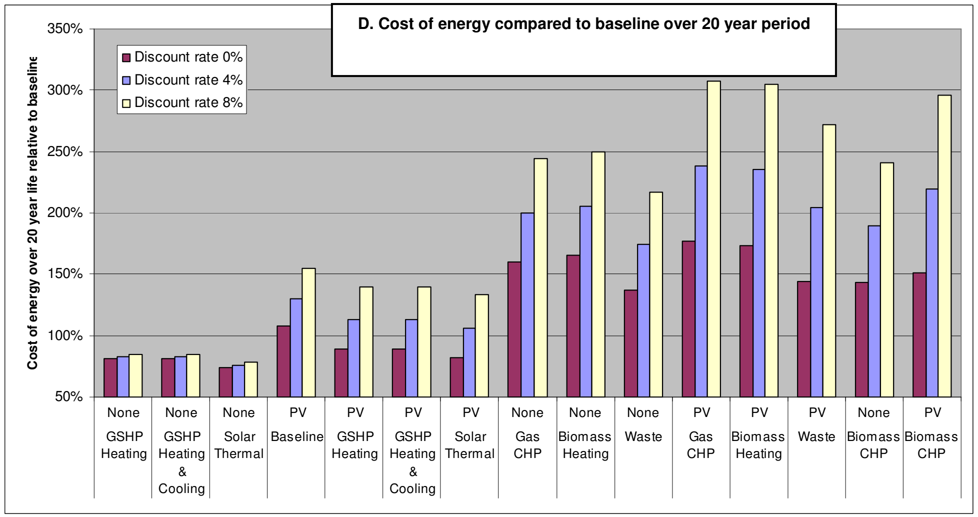
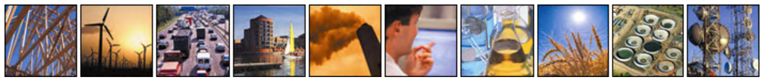
Typology 5 – Small Residential Infill Schemes











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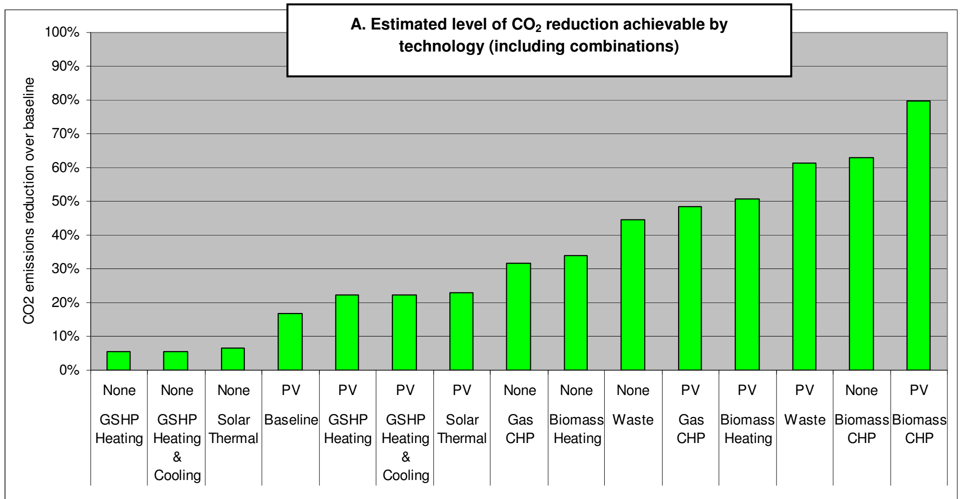
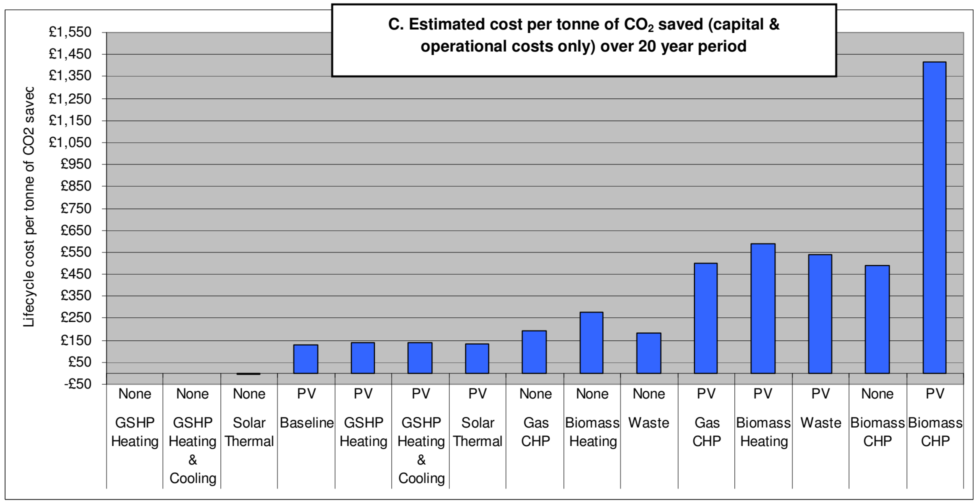
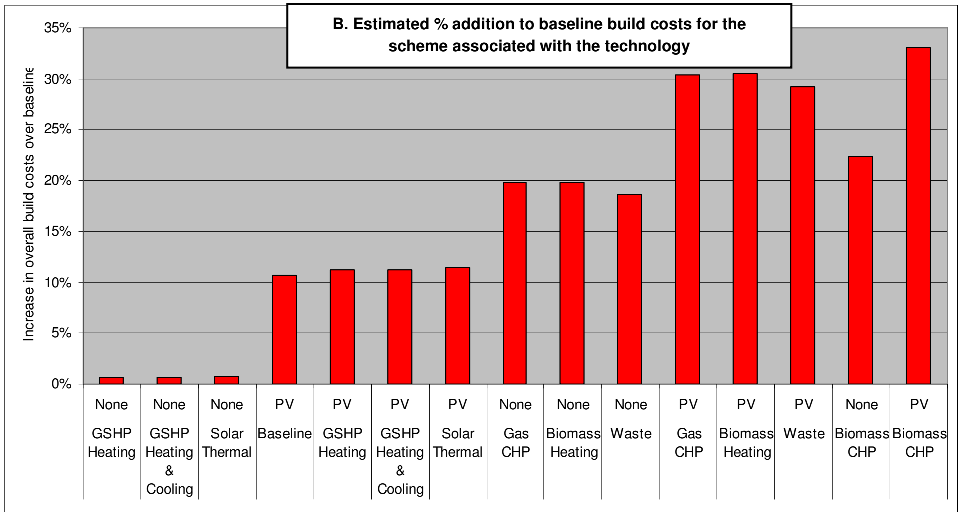
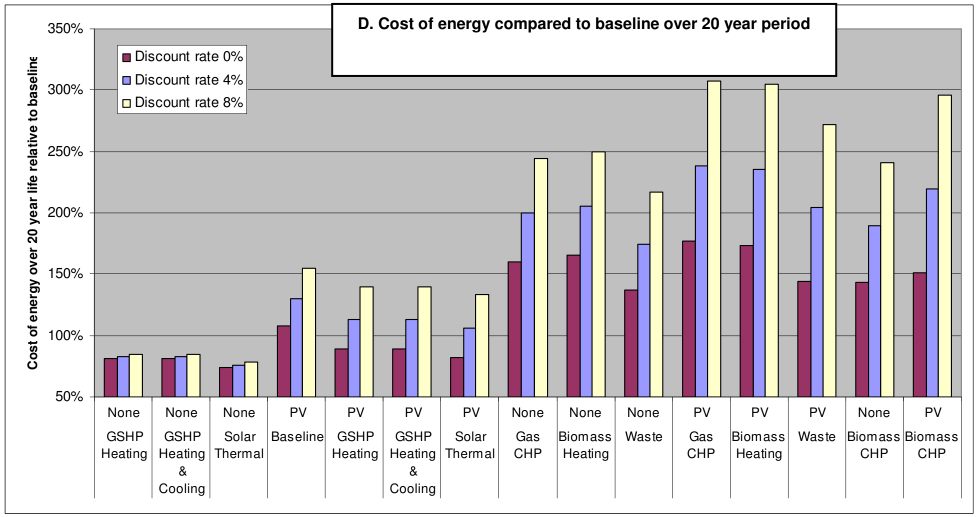
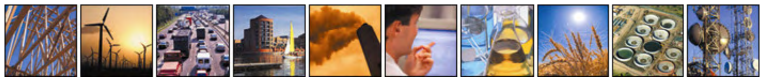
Typology 6 – Large Residential Infill Scheme











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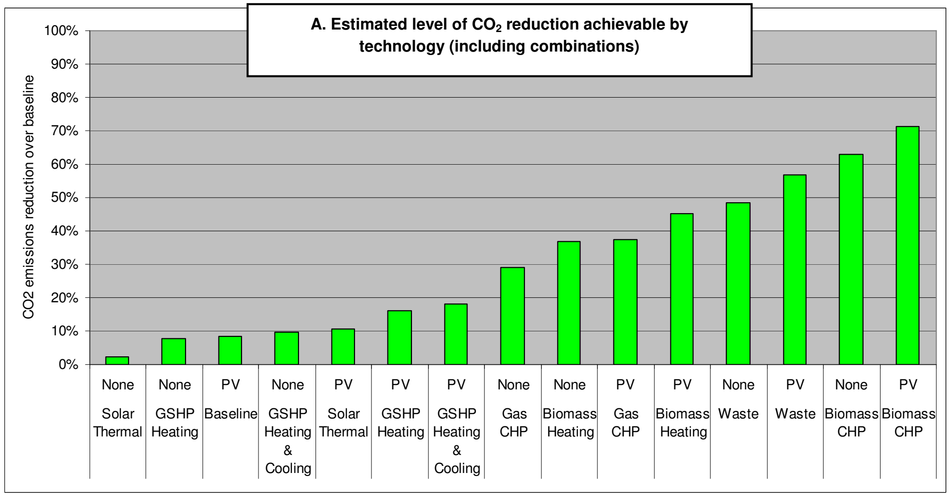
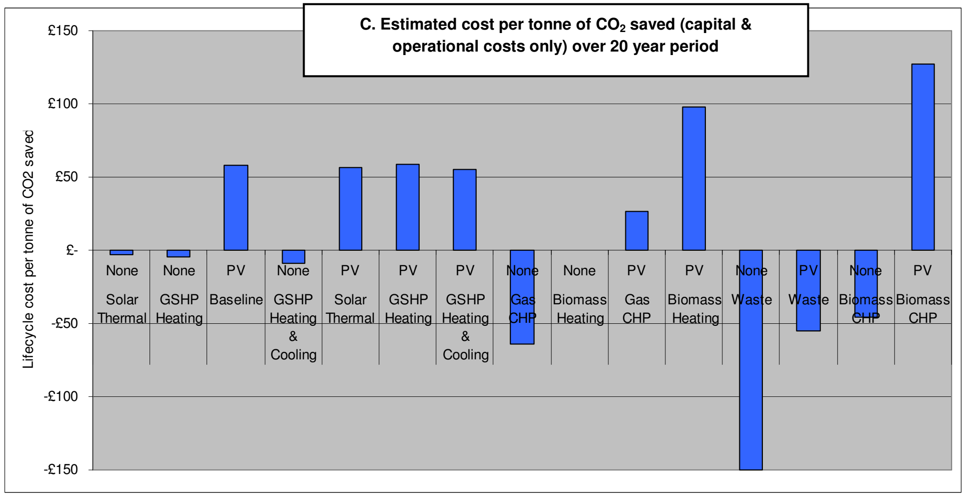
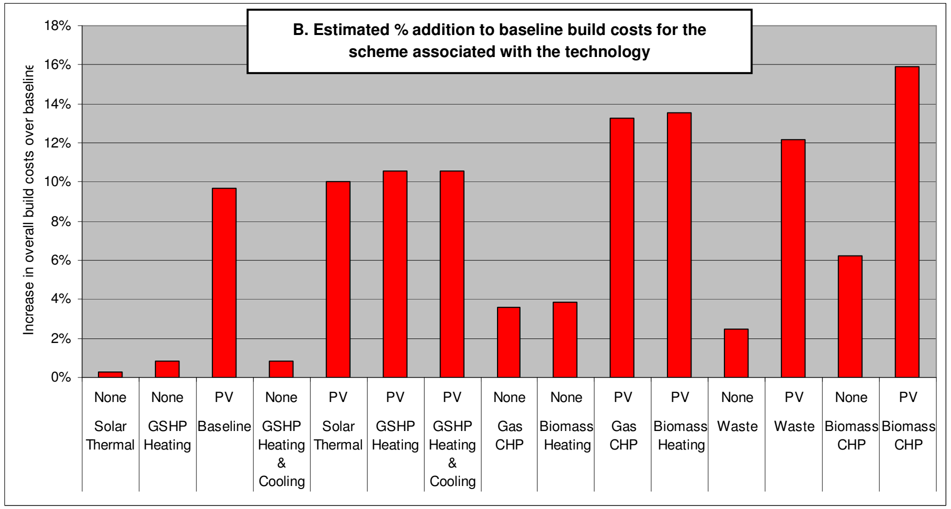
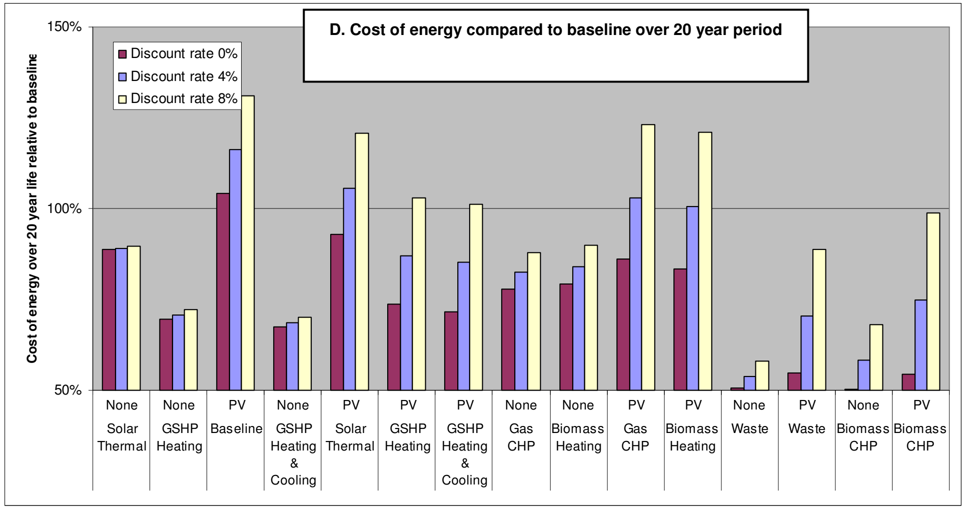
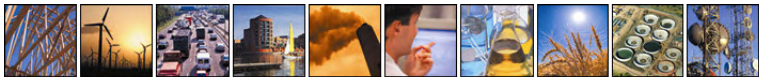
Typology 7 – Employment Park











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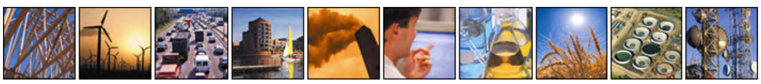


Appendix D

Appendix E
Renewable and Low Carbon Energy Technology Appraisal Model: Methodology and Assumptions

E1 Model description

Overview

The Entec technology appraisal model allows the CO_2 emissions reductions and economic performance of a range of sustainable energy technologies to be quantitatively assessed. The user is responsible for inputting the development assumptions, and all outputs are generated automatically. There are a large number of assumptions relating to energy demand, technologies and costs that can be varied as appropriate. The model is briefly described in the following sections with the key assumptions detailed in section E3.

Energy demand assessment

Assumptions regarding the development mix (number of residential units, floor area of commercial space) are combined with industry standard energy benchmark data to determine the total demand for heat, electricity and cooling. Estimates of peak loads for the purpose of plant sizing are also made at this stage.

Technologies assessment

The energy supply technologies that can be appraised in the model are summarised in Table E1 along with a brief description of each.

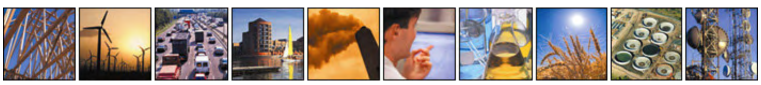


Table E1 Technologies considered in the model

Technology	Description
Gas Boilers (baseline)	Individual gas boilers in each dwelling and commercial building, typical of current practice and the baseline assumption for this study.
National Grid (baseline)	All electricity sourced from the grid.
Solar Thermal Panels	Collector positioned on the roof concentrates energy from the sun onto tubes through which water (or other fluid) which is circulated. Contributes to hot water supply.
Gas CHP	Natural gas is combusted in an internal combustion engine which turns a generator to produce electricity, with residual heat collected and used for space heating and hot water.
Biomass Heating	Biomass combusted in a specialised boiler to provide space heating and hot water.
Biomass CHP	Biomass combusted, with the heat used to turn a generator via a number of possible technologies to produce electricity, with residual heat collected and used for space heating and hot water.
Ground Source Heat Pumps (GSHP) - Heating Only	Coils installed underground through which fluid is circulated, transferred heat from the ground to provide a proportion of space heating.
GSHP - Heating and Cooling	As above, but with the system operated in reverse to provide cooling in summer months.
Solar Photovoltaic (PV) Panels	Photoreceptive panels that convert energy from sunlight into electricity, reducing the net electrical demand of a building.

Outputs

The model can be used to estimate the maximum contribution from on-site renewables that is *technically* achievable at a particular type of site, as well as the maximum contribution likely to actually be viable (by factoring in costs and revenues). Given the number of assumptions, the model is not intended to provide a detailed and accurate assessment of viability, rather it can be used to give an indication of what levels of carbon emissions reduction can be achieved and at what comparative cost, and what technologies are likely to be best suited to this particular type of site.

The model allows the comparison of a large number of parameters, four of the most important of which are listed below and are the primary indicators used in the analysis. **In all cases the impact is considered relative to the baseline scenario**, which assumes all heat is provided by individual gas boilers and electricity is sourced from the national grid:

- **CO_2 emissions reductions:** approximate percentage reduction in CO_2 emissions by installing the renewable energy system.
- **Increase in capital/build costs:** gives an indication of the level of additional costs incurred by the developer (or third party) as a result of the renewable energy system.

- **Cost per tonne of CO_2 saved:** calculated over a 20 year lifetime does not include revenues from support mechanisms for renewable energy.

- **Long-term cost of energy:** the estimated combined cost of heat, electricity and cooling to residents of the development, including support mechanisms for renewables.

The outputs of the model can then be used to estimate whether a particular technology, or combination of technologies, is likely to be viable at a particular site.

Note that although the model is designed to consider the contribution of renewable energy to developments in a realistic manner, it does not consider site specific constraints such as available space, shading and adverse ground conditions which will impact on the feasibility. Hence a degree of care must be taken when interpreting the results.

E2 Model assumptions and limitations

There are, necessarily, a large number of assumptions built into the model. These can all be varied, but for the typology assessment we have used a common set of technical and cost assumptions. Up-to-date published data is used as far as possible, though it is not possible to use such data in all cases as they do not always exist. Where this is the case our own estimates have been made based on our experience and engineering judgement.

A full breakdown of the assumptions in the model is presented in section E3.

E3 Breakdown of assumptions

Technology assumptions

Energy technologies can be split into two main types; decentralised and centralised. Decentralised systems are those in which each individual building has its own heating system (and potentially electricity generation system). Centralised systems are those where heat, and possibly electricity, is generated at a central 'energy centre' at the development, with heat distributed to individual buildings via a network of pipes carrying hot water and electricity distributed through a private network (though this may not always be the case as it may be simply exported to the grid).

The estimation of the amount of useful energy a particular system can provide is based on technical knowledge and industry experience.

Decentralised systems

Table E2 sets out the scenarios considered by technology for decentralised systems. In all cases cooling is assumed to be supplied via air-cooled chillers (powered by electricity), apart from the scenario in which GSHP supplies both heating and cooling.

Table E2 Energy provided by technology (decentralised systems)

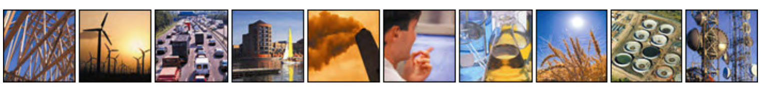
Primary Technology	Contribution	Secondary Technology	Contribution
Individual Gas Boilers (Baseline)	100% of space heating	n/a	n/a
GSHP (Heating Only)	50% of space heating	Gas Boilers	50% of space heating, 100% of hot water
GSHP (Heating and Cooling)	50% of space heating, 100% of cooling	Gas boilers	50% of space heating, 100% of hot water
Solar Thermal	50% of hot water in housing and commercial buildings, 20% in flats - this accounts for total useful annual output and efficiency	Gas boilers	100% of space heating, 50% of hot water (80% in flats)

Centralised systems

Table E3 sets out the scenarios considered by technology for centralised systems.

Table E3 Energy provided by technology (centralised systems)

Primary Technology	Contribution	Secondary Technology	Contribution
Gas CHP	50% of space heating, 100% of hot water	Gas Boilers	50% of space heating
Biomass Heating	90% of space heating, 90% of hot water	Gas Boilers	10% of space heating, 10% of hot water
Biomass CHP	50% of space heating, 100% of hot water	Biomass Boilers	40% of space heating (gas boilers make up the remaining 10%)
Waste	100% of space heating, 100% of hot water	n/a	n/a



Additional renewables

Solar PV

The roof area of all buildings in the assessed development is estimated based on the floor area and assumed number of stories (see benchmark tables). It has been assumed that 25% of the roof area of each building is suitable for PV panels, based on the proportion of the roof that is south facing and allowing for obstructions such as flues, skylights etc.

The energy output for a PV system is assumed to be 0.14kWp/m^2 and 700kWh/kWp/year which equates to 1m^2 PV array generating 98kWh/year. These figures are based on information provided by manufacturer Segen and supported by typical generic figures from the Energy Savings Trust.

Other infrastructure

Gas and district heating pipework

Pipe length required per dwelling/unit is assumed to be 5m for flats and 30m for commercial units across all site types. The pipe length required for houses is estimated to be 20m. This is based on Entec's own estimate and represents a relatively high density development (>50 dwellings per hectare), and hence assumes the development has been carefully designed to minimise pipe length.

System efficiency

The assumed efficiencies of each system are set out in Table E4. Estimates are typical of well designed and maintained systems, so represent a best case based on current technology. Where systems are poorly designed or inherently unsuited to a particular development's demand profile, efficiencies may be significantly lower.

Table E4 Efficiency by technology

Technology	Thermal Efficiency	Electrical output per unit of bought fuel input
Boiler - Gas	90%	N/A
Boiler - Biomass	90%	N/A
CHP - Gas	50%	35%
CHP - Biomass	50%	20%
GSHP - Heating	N/A	420%
ASHP - Heating	N/A	300%
Waste	100%*	N/A
Solar Thermal	- **	N/A
Absorption Chiller	90%	0%
Air Cooled Chiller	N/A	350%
GSHP - Cooling	N/A	600%
Grid Electricity	N/A	100%

* Third party is assumed to be the owner/operator of the plant, with heat delivered to development so no efficiency loss on site.

** Solar thermal assumed to provide 20% of hot water in flats, 50% of hot water in all other buildings.

Financial assumptions

Any financial assumptions used in the model are provided in this section.

Capital cost assumptions

Table E5 Capital cost assumptions for the systems used

Technology	CAPEX (£/kWth)	CAPEX (£/kWe)	Source
Gas Boilers Commercial	45	n/a	SPONS Mechanical and Electrical Services Price Book, 2008
Air Cooled Chiller	125	n/a	SPONS Mechanical and Electrical Services Price Book, 2008
Absorption Chiller	120	n/a	SPONS Mechanical and Electrical Services Price Book, 2008.

Technology	CAPEX (£/kWth)	CAPEX (£/kWe)	Source
Biomass Boiler	368	n/a	Potential and Costs of District Heating Networks, Poyry - April 2009.
CHP Gas	460	657	Entec estimate (large >1MWe).
CHP Biomass	1,400	3,500	Potential and Costs of District Heating Networks, Poyry - April 2009 (>1000kW).
Ground Source Heat Pump	500	n/a	Entec estimate.
Wind power - Large (2.5MW)	n/a	1,100	Based on experience within industry supported by estimates from Renewables UK.
Solar PV	n/a	5,000	Costs quoted from Segen supported by broad estimates made by EST.
Solar Thermal	1,429	n/a	Potential and Costs of District Heating Networks, Poyry - April 2009.
Waste	0	0	Entec assume the cost to the development will be 0 as the owner/operator is assumed to be a third party.

Fuel prices

Table E6 Cost of fuel required per unit of energy generated

Fuel/Energy Prices	Cost (p/kWh)	Source
Gas	3.4	International Energy Agency
Oil	5.2	International Energy Agency
Biomass (wood chip)	2.3	Biomass Energy Centre

Fuel prices are based on figures obtained in November 2009.

Energy sale prices

Table E7 Income from energy sales per unit generated

Source	Income (p/kWh)	Source
Avoided cost of on site elec. generation and use	12	Market price as at Jan 2010
Income from imported elec.	12	Market price as at Jan 2010
Income from elec. exported	14.4	Entec assumption of 20% uplift over imported cost
Income from heat/cooling	4.1	Entec assumption

Support mechanisms

Renewables Obligation Certificates

The main market incentive for renewable energy in the UK is the Renewables Obligation (RO). This is an obligation on licensed suppliers of electricity to source an increasing proportion of the electricity they supply from renewable energy sources. To validate these renewable energy sources, generators receive Renewable Obligation Certificates (ROCs); the number of ROCs received is banded according to the technology used in generation. Though primarily applicable to larger scale electricity generation, it is possible to claim this benefit at any scale (one ROC is equivalent at present to approximately 4p/kWh).

Feed-in Tariffs

This scheme is an additional support mechanism for renewable electricity designed particularly to encourage take-up of small-scale systems. A fixed rate is paid per kWh of electricity generated (regardless of where or how it is used), with the rate paid depending on the technology and fuel type and the scale of the system.

Renewable Heat Incentive

Under the Energy Act 2008 the RHI will be introduced to provide financial assistance to generators of renewable heat, and producers of renewable biogas. This will take the form of a Feed-in Tariff where a fixed rate is paid per kWh of useful heat generated, with the rate paid depending on the technology and fuel type and the scale of the system as per the Feed-in Tariff (FiT). A consultation including proposed tariffs was published in February 2010, and the scheme is planned to be introduced in April 2011.

Table E8 Level of support by technology

Technology	Level of support	Note
Solar PV	2 ROCs/MWh OR 30p/kWh	Based on information available April 2010.
Wind	1 ROC/MWh 4p/kWh	Based on information available April 2010.
Biomass CHP	2 ROCs/MWh	Will not be eligible for FiTs until 2013 at the earliest. Based on information available April 2010.

CO_2 emissions assumptions

The following table shows the assumed emissions values per fuel type based on a report published by Defra in September 2009.

Table E9 Carbon emissions factor by fuel

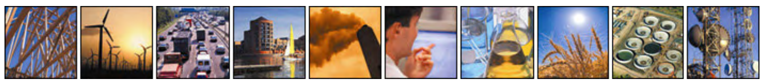
Fuel	CO_2 Emission Factor (kg of CO2 per kWh)	Source
Gas	0.184	Defra September 2009 - represents best 2010 estimate
Grid Electricity	0.554	Defra September 2009 - represents best 2010 estimate
Oil	0.265	Defra September 2009 - represents best 2010 estimate
Biomass	0.028	SAP 2009 (no Defra equivalent figure)
Waste	0	Assumes heat would otherwise be rejected to atmosphere

Development assumptions

Benchmark assumptions for all buildings are detailed in Table E10 and E11.

Table E10 Building specific assumptions - Part 1

Type	Electricity Demand kWh/m^2	Fossil Fuel Demand kWh/m^2	Heat Demand kWh/m^2	Space Heating kWh/m^2	Domestic Hot Water kWh/m^2	Process Hot Water kWh/m^2	Comfort cooling kWh/m^2	Computer room/close control cooling kWh/m^2	Lighting kWh/m^2	Other Electricity kWh/m^2
Offices - Type 1: naturally ventilated, cellular	51	143	129	116	13	0	0	0	22	29
Offices - Type 2: naturally ventilated, open plan	81	143	129	116	13	0	7	0	36	43
Offices - Type 3: air conditioned, standard	203	160	144	130	14	0	98	57	49	111
Offices - Type 4: air conditioned, prestige	312	171	154	138	15	0	122	312	51	137
Industrial mixed use - Type 1: cellular naturally ventilated office	51	143	129	116	13	0	0	0	22	29
Industrial mixed use - Type 2: naturally ventilated, open plan	81	143	129	116	13	0	7	0	36	43
Industrial mixed use - Type 3: air conditioned, standard	189	160	144	130	14	0	98	0	49	112
Industrial mixed use - Type 4: air conditioned, prestige	219	179	161	145	16	0	123	0	51	133
Industrial mixed use - Type 5: distribution and storage	43	185	167	150	17	0	4	0	25	17
Industrial mixed use - Type 6: light manufacturing	70	300	270	243	27	0	7	0	50	18
Industrial mixed use - Type 7: factory office	100	225	203	182	20	0	21	0	60	34
Industrial mixed use - Type 8: general manufacturing	85	325	293	263	29	0	21	0	45	34
Refrigerated warehouses	142	80	72	65	7	0	10	338	28	14



Type	Electricity Demand kWh/m^2	Fossil Fuel Demand kWh/m^2	Heat Demand kWh/m^2	Space Heating kWh/m^2	Domestic Hot Water kWh/m^2	Process Hot Water kWh/m^2	Comfort cooling kWh/m^2	Computer room/close control cooling kWh/m^2	Lighting kWh/m^2	Other Electricity kWh/m^2
Retail - supermarkets	626	159	143	136	7	0	219	657	250	125
Retail - clothes stores	192	72	65	62	3	0	202	0	77	58
Retail - small food shops	350	70	63	50	13	0	123	123	88	193
Retail - distribution warehouses	45	113	102	92	10	0	16	0	18	22
Retail - fast food restaurants	890	670	603	482	121	0	312	312	267	445
Retail - restaurants with bar	730	1,250	1,125	900	225	0	256	128	219	402
Hotel	200	400	360	279	81	0	98	0	65	107
Cinema	160	620	558	502	56	0	168	0	32	64
Education - residential, self-catering, flats	54	240	216	173	43	0	0	0	14	41
Local authority - residential care homes	71	371	333	267	67	0	0	0	18	53
Local authority - day centres	51	362	236	212	24	0	10	0	13	35
Long term residential accommodation	65	420	378	265	113	0	0	0	16	49
General accommodation	60	300	270	189	81	0	0	0	15	45
Call centre	312	171	154	138	15	0	122	312	51	137
Houses (long term residential accommodation)	40	96	87	61	26	0	0	0	8	32
Flats (general accommodation)	41	106	95	67	29	0	0	0	8	33

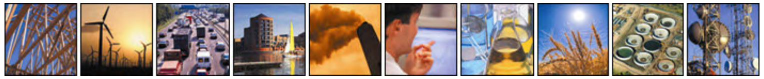
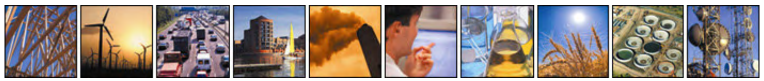


Table E11 Building specific assumptions - Part 2

Type	Peak space heating/hw load - kW/m^2	Peak cooling load kW/m^2	Baseline CAPEX £/m^2	Assumed Number of Stories	Proportion of roof suitable for PV	Diversity Factor	Pipe Length per unit (m)	Typical unit size (m^2)
Offices - Type 1: naturally ventilated, cellular	0.07	0.00	1,568	2	25%	0.50	30	500
Offices - Type 2: naturally ventilated, open plan	0.07	0.12	1,568	2	25%	0.50	30	500
Offices - Type 3: air conditioned, standard	0.06	0.16	1,568	2	25%	0.50	30	500
Offices - Type 4: air conditioned, prestige	0.06	0.15	1,568	2	25%	0.50	30	500
Industrial mixed use - Type 1: cellular naturally ventilated office	0.08	0.00	1,568	2	25%	0.50	30	500
Industrial mixed use - Type 2: naturally ventilated, open plan	0.08	0.13	1,568	2	25%	0.50	30	500
Industrial mixed use - Type 3: air conditioned, standard	0.08	0.18	1,568	2	25%	0.50	30	500
Industrial mixed use - Type 4: air conditioned, prestige	0.08	0.18	1,568	2	25%	0.50	30	500
Industrial mixed use - Type 5: distribution and storage	0.08	0.01	733	2	25%	0.50	30	1,000
Industrial mixed use - Type 6: light manufacturing	0.08	0.01	680	2	25%	0.50	30	500
Industrial mixed use - Type 7: factory office	0.08	0.01	680	2	25%	0.50	30	500
Industrial mixed use - Type 8: general manufacturing	0.08	0.01	680	2	25%	0.50	30	500
Refrigerated warehouses	0.04	0.30	733	1	25%	0.50	30	500
Retail - supermarkets	0.11	0.14	1,049	1	25%	0.50	30	500
Retail - clothes stores	0.11	0.14	1,049	2	25%	0.50	30	250
Retail - small food shops	0.11	0.10	1,049	2	25%	0.50	30	100



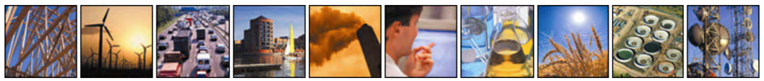
Type	Peak space heating/hw load - kW/m^2	Peak cooling load kW/m^2	Baseline CAPEX £/m^2	Assumed Number of Stories	Proportion of roof suitable for PV	Diversity Factor	Pipe Length per unit (m)	Typical unit size (m^2)
Retail - distribution warehouses	0.11	0.14	733	1	25%	0.50	30	1,000
Retail - fast food restaurants	0.11	0.22	1,049	2	25%	0.50	30	100
Retail - restaurants with bar	0.11	0.22	1,049	1	25%	0.50	30	100
Hotel	0.90	0.23	1,342	4	25%	0.50	30	100
Cinema	0.90	0.14	1,049	2	25%	0.50	30	2,000
Education - residential, self-catering, flats	0.06	0.00	n/a	2	25%	0.50	not used	not used
Local authority - residential care homes	0.06	0.00	n/a	3	25%	0.50	not used	not used
Local authority - day centres	0.09	0.40	n/a	2	25%	0.50	not used	not used
Long term residential accommodation	0.06	0.00	n/a	2	25%	0.50	not used	not used
General accommodation	0.06	0.00	n/a	2	25%	0.50	not used	not used
Call centre	0.06	0.15	1,568	1	25%	0.50	not used	not used
Houses (long term residential accommodation)	0.06	0.00	759	2	25%	0.50	20	calculated
Flats (general accommodation)	0.06	0.00	1,342	5	25%	0.50	5	calculated

Residential assumptions derived from CLG's 2008 report - Research to Assess the Costs and Benefits of the Government's Proposals to Reduce the Carbon Footprint of New Housing.

Non-residential assumptions derived from Energy Efficiency in Buildings, CIBSE Guide F, Chartered Institute of Building Services Engineers 2004.

Heat demand is calculated from fossil fuel demand assuming that fossil fuel systems have an efficiency of 90%.

Cooling demand is calculated assuming that electric cooling systems have an efficiency of 350%.



Build costs

The costs of the energy system are calculated using a combination of the appropriate system size and the figures in the financial assumptions section. In order to estimate the impact on the overall cost of the development, the total cost has been estimated using the floor area of the buildings and the figures in the table below. These figures represent typical costs for building construction and do not include costs associated with site preparation, roads, Section 106 agreements etc.

Table E12 Baseline build costs

Building Type	CAPEX (£/m^2)
Flats	1,342
Houses	759
Retail	1,049
Office	1,568
Industrial	680
Storage/Distribution	733

Residential figures from Research to Assess the Costs and Benefits of the Government's Proposals to Reduce the Carbon Footprint of New Housing, and Entec estimates, CLG 2008.

Commercial figures from Indicative Building Costs 3rd Quarter 2006, EC Harris.

Entec
An AMEC company

Appendix F
Low Carbon Infrastructure Case Studies

Source: http://www.homesandcommunities.co.uk/low-carbon-infrastructure.htm

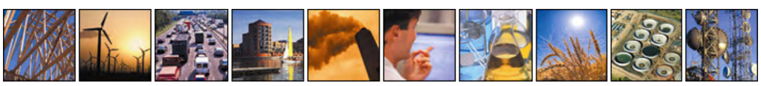
Southampton, Woolston Riverside Community Heating Network - £2.5m

The HCA LCIF Woolston Riverside Project will deliver a site-wide community heating system. This scheme will supply heat to 1,620 homes, a superstore and a hotel. It will also help to deliver the comprehensive regeneration of Southampton's Woolston Riverside. The site is located on the eastern bank of the River Itchen, north of its confluence with the River Test in Southampton Water, 2 km to the southeast of Southampton City Centre. The site is owned by the South East England Development Agency (SEEDA) working in partnership with Southampton City Council. The scheme represents the comprehensive redevelopment of the former Vospa Thorneycroft shipyard, which will provide a mixed use development comprising:

- 1,620 dwellings (including 405 affordable homes)
- Retail (Class A1 – 5,525 square metre, including a food store)
- Restaurants and cafes (Class A3 – 1,543 square metres)
- Offices (Class B1 – 4,527 square metres)
- Yacht manufacture (Class B2 – 21,237 square metres)
- Business, industrial, storage and distribution uses (Class B1/B2/B8 – 2,617 square metres)
- 100 bedroom hotel (Class C1 – 4,633 square metres)
- 28 live/work units (2,408 square metres)
- Community uses (Class D1 – 2,230 square metres)
- 2 energy centres (1,080 square metres)

The proposals for the scheme also include a number of eco features, such as sedum roof areas, rainwater harvesting, and a graduated shingled 'beach' area designed to propagate wildlife and plants, as well as to link people with the waterfront. The scheme includes plans for a site-wide community heating scheme that will supply heat to all dwellings on the site and a range of commercial uses including the food-store, hotel, and Marine Employment Quarter. Two energy centres located to the northeast and southwest will provide heat to the development using a Combined Heat and Power-led Heat Production Strategy.

The energy centres will be connected by high efficiency gas boilers. In later phases, a biomass or biofuel boiler may be utilised to further reduce the carbon emissions across the development site.



Exeter, Cranbrook Urban Extension Community Heating Network

Cranbrook New Community is the largest zero carbon housing scheme in the UK and the first large-scale new development site being built with District Heating and biomass Combined Heat and Power (CHP). The development project's first phase will have 2,900 houses, with 7,500 in total with a 40% affordable element led by the private sector. All dwellings will be built to Code for Sustainable Homes level 3 and BREEAM 'Very Good' for non-residential development. When fully operational the energy centre will be capable of generating 5.5 MWe of renewable electricity and 17MWth of renewable heat using wood and on-site energy crops providing both Cranbrook and nearby Skypark employment site, with the possibility of providing the new school. The Pyrolysis technology being employed at the energy centre heats the biomass in the absence of O2 to produce a H2-rich syngas which is then burnt in engines. Heat from the pyrolysis process and the engine cooling jackets provides the hot water for District Heating and the engines drive generators to produce electricity. Until there is sufficient heat demand to efficiently use heat from the biomass CHP unit, heat for the District Heating system will be provided by smaller centralised gas boilers/CHP engines. These units will be retained to provide back up for times when the biomass CHP unit is undergoing maintenance. Cranbrook is part of a suite of strategic developments. This suite has been deliberately conceived to provide strategic housing growth next to high level employment opportunities. In the period to 2026, ambitious but achievable employment growth is envisaged in the Growth Point with one job created per house built. Translated, this means that around 18,000 jobs will be provided in very close proximity to Cranbrook, with all of them served by a high quality public transport corridor. Cranbrook itself will provide for 1,800 jobs in its town centre in addition to 5ha of employment land, all secured via the Section 106 agreement for the first 2,900 homes and deliver approximate reduction of 15,000 tCO2e per annum.

North Coventry, WEHM Biomass Combined Heat and Power Community Heating Network - £1.6m

LCIF funding for this project is to design and install a District Heating System for 154 houses. This is the first phase of the wider development of 3,328 houses in the Woodend, Henley Green, Manor Farm & Deedmore area (collectively known as WEHM) in which the HCA is providing a comprehensive intervention through the Property & Regeneration, National Affordable Housing and Growth Programmes. The project is an enabler to the City's vision of regenerating and growing sustainable communities through exemplar developments. The funding for the project will achieve and align the objectives as set out in our Sustainable Communities Strategy and Climate Change Strategy, which include:

- Creating low carbon exemplar development for new and existing housing
- Building experience and learning from a range of technologies
- Alleviating fuel poverty
- Reducing upfront capital costs
- Ongoing reinvestment for community benefits
- Developing cohesive partnerships

The WEHM Estates were built in the 1950s and 1960s as council owned stock during Coventry's post war reconstruction. The estates were once considered award-winning, cutting edge designs, but have now fallen into low demand and disrepair with a reputation for high levels of crime and unemployment. The area falls within the top 10% most deprived areas in England according to the Indices of Multiple Deprivation 2007. The proposed scheme will be key in reducing fuel poverty and increasing energy security in the WEHM New Deals for Communities (NDC) area, with anticipated carbon savings affording the potential opportunity to push Code Levels for the new homes to level 4. Carbon savings of around 1.2t CO_2/yr/house (gas comparison, GSHP) are anticipated, and this equates to 185t CO_2/yr for the site. Crucially, this smaller scheme will pave the way for a larger CHP unit for the remaining build on site. It will also contribute to the deliverability of other future schemes in the city by providing a test bed case and building experience to be transferred to future schemes.

Milton Keynes, Anaerobic Digester Gas Injection to Regional Gas Network and Connection to Combined Heat and Power Plant - £1.5m

LCIF funding will enable the Milton Keynes community to enjoy the benefits of an affordable, low carbon lifestyle consistent with the EU's Concerto programme. The scheme comprises:

A new plant for the production of biomethane (at Milton Keynes Council's planned Anaerobic Digestion (AD) plant 5km from the city centre) and its injection into the regional gas network. This will be a first in the UK.

Connection of these renewable fuels to an existing Good Quality Combined Heat and Power (CHP)/private-wire system in Central Milton Keynes. This serves existing, high density, mixed used developments with the possibility of further extension.

The combined technologies will displace approximately 70% of their CO_2 emissions in the area, with a total potential for CO_2 emissions reductions of 3,490 tonnes of CO_2 saved per annum. This will require innovative arrangements to guarantee supply and distribute the renewable gas. CO_2. The scheme will significantly decarbonise the current CHP system. This investment will give the scheme the capacity to expand to serve an additional 600 residential units. Milton Keynes Council is committed to development of an AD plant for energy production from organic refuse to be operational from December 2010. To this end, large scale collection of domestic organic waste in MK began in April 2009, but with treatment at an existing conventional AD plant some distance from the borough. This will ensure a robust waste collection and supply chain by the time the local treatment plant is operational.

Newcastle Riverside Dene - £1.7m HCA investment in Biomass district heating

The iconic estate, formerly known as Cruddas Park, which was featured in the BBC's The Likely Lads and Our Friends in the North, is currently enjoying its biggest revamp since the tower blocks were built in the 1960s. And with Newcastle City Council and its partners, the HCA's investment will help to bring a greener, warmer future for residents.

The Newcastle Riverside Dene Scheme comprises the regeneration and retrofit of 5-10 council owned tower blocks and shopping centre. The scheme received £1.7m from LCIF funding to develop a biomass District Heating network to deliver hot water and heating to the residents of the newly refurbished tower blocks. By replacing the expensive electric storage heaters and providing heat via the District Heating network, the scheme supports households which experience high levels of fuel poverty.

The biomass District Heating system works by burning wooden pellets, thus reducing the area's carbon footprint substantially. This project aims to deliver significant carbon reductions of a figure between 40%-80% through replacing expensive electric storage heaters with district heating. Furthermore, the blocks have had improved thermal efficiency measures put in place, such as improved insulation and double glazing throughout to make them warmer and more efficient.

Nottingham, the Hub and Southside Community Heating Network - £1.5m

HCA grant funding will contribute to the delivery of District Heating System extension to serve proposed new residential and commercial developments in the Southside & Hub regeneration area of Nottingham, supporting housing growth.

The project will accelerate the deployment of renewable low carbon energy to new areas of the City and is an exemplar of using renewable energy in major development schemes.

The District Heating System (DHS) should reduce CO_2 emissions by approximately 6,786 tonnes per annum and will tackle fuel poverty. The introduction of the Merton Rule, requiring developers to source 10% of their schemes energy from renewable sources, incentivises developers to connect to the DHS in Nottingham City.

The project area is situated in a prime location for development; it is adjacent to the City Centre and the new transport interchange.

This is an opportunity to take the DHM into an area that is currently not supplied by the DHS. The master plan for the Hub will create a world-class public transport interchange, which is expected to act as a catalyst for further development activity in the surrounding area. The Hub proposals are supported by the station stakeholders including the City Council and East Midlands Development Agency (EMDA), and public sector funding is committed to complete this project.

Around 970 residential properties are proposed to be constructed in the immediate Hub/Southside area surrounding the proposed extension to the DHS. The developments also include commercial, retail and office space as well as the rail station improvements which will also benefit from the DHS availability.

The installation of the DHS will be a catalyst for the developments in the area. The use of the DH energy has been proven to help relieve fuel poverty with Nottingham City Council's social tariff structure.

Birmingham, Cambridge & Crescent Community Heating Network and Decent Homes - £1.5m

This project will replace the dated heating systems contained within the 16 storey 120-unit Birmingham City Council-owned Cambridge and Crescent tower blocks located in the City Centre, and link them to the existing Combined Heat and Power (CHP) District Heating System located in the International Convention Centre on Broad Street.

This LCIF project is an early exemplar 'Retrofit' project to address fuel poverty and heating issues in existing Local Authority residential tower blocks and will be delivered by Utilicom under the Birmingham District Energy Company (BDEC) partnership procured by the Birmingham Construction Partnership.

One of the key project outcomes will be the reduction of total carbon emissions of Cambridge and Crescent Towers by 357 tonnes of CO2e per annum and add to the impact of earlier Council investment (£2.5m) by bringing the Council's stock up to Decent Homes Standard. This addition to the Broad Street CHP will help create a diverse heat load, thus benefiting existing connected buildings.

Current residents of the Cambridge and Crescent Towers will benefit from lower heating costs and carbon savings. The energy tariffs will offer an energy cost saving of approximately 5% against the Public Sector Comparator benchmark, in comparison to existing installed energy sources within the Towers.

This will be maintained throughout the lifetime of the energy supply agreement. The expected saving to residents by connecting to BDEC, in comparison to the current electric heating system, is circa 59%.

This scheme also has the potential to link up with future City Centre housing development, including Baskerville Wharf, a mixed use development incorporating office, leisure and residential quarters.

Projected economic and household growth will have increasing pressures on the demand for residential accommodation in the city centre. Therefore, this project has the potential to reduce carbon emissions for future housing schemes, in line with the sustainability agenda.

Greenwich, Greenwich Peninsula Community Heating Network - £3m

HCA is providing £3m from the LCIF Programme to help provide the spine heat network.

The Greenwich Peninsula, with its proposed over 10,000 new homes, as part of a larger mixed use scheme including commercial, retail, educational and leisure uses, has the ideal profile to "capture" carbon reduction on a very large scale and for the creation of real employment opportunities during construction, operation, and maintenance phases of the works.

The drivers are as follows:

- To facilitate the provision of low carbon energy to as many homes and other properties as possible.

- To generate immediate employment in the delivery of low carbon infrastructure.

- To enable connection of Greenwich Peninsula customers to the London Thames Gateway Heat Network when available.

- The full combination of works needed includes:

  - Two significant Combined Heat and Power (CHP) pipe work “spines” capturing all significant development areas on the Peninsula.

  - London Thames Gateway Heat Network:

  The London Thames Gateway Heat Network is a hot water transmission network that will connect diverse sources of affordable low/zero carbon heat to existing and new developments helping to create sustainable communities.

  The first source of heat will be the surplus heat from Barking Power Station, normally rejected in the production of electricity.

  However, a number of new advanced conversions from waste technologies are planned and they will be able to connect. Heat from the power station will be captured and the hot water distributed via pipes to properties where the heat will be used for domestic hot water and central heating, replacing conventional boilers.

  Ultimately, up to 120,000 homes and properties could have their heat requirements met be the 23km network, saving almost 100,000 tonnes of CO_2 output each year. The first customers could be supplied by late 2010 or early 2011.

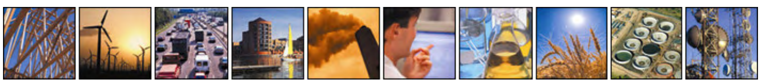
Hanham Hall, Bristol

Hanham Hall, currently owned by the HCA, is the UK’s first Carbon Challenge site. The key aspirations of the Carbon Challenge Programme are to:

- Raise environmental standards – developments will achieve Level 6 of the Code for Sustainable Homes – zero carbon

- Deliver high-quality design combined with exceptional environmental performance – homes that keep warm in the winter and cool in the summer

- Drive down construction and supply chain costs through economies of scales – while delivering zero carbon ,the programme should also seek to maintain the cost efficiency achievements of the Design for Manufacture initiative;



- Incorporate lifestyle features that cut emissions within the community through good designs that encourage behavioural changes in the use of electrical appliances such as televisions and computers, and include changes in transport, waste collection and food delivery; and

- Ensure that developments include affordable and low cost homes, especially for families.

Barratt Developments with HTA architects are designing the scheme, and Kingspan as the main supplier for the 195 new homes which have been designed to meet Code for Sustainable Homes level 6, a third of which will be affordable, and provide community facilities, green spaces and cycle routes as well as the original Hanham Hall, a grade II* listed building transformed as the centrepiece.

Every aspect of development, from the design of the new homes, to good transport links, to recycling facilities and the creation of allotments, have been considered for their environmental implications. The new homes will be prefabricated from Structural Insulated Panels (SIP) with other energy efficient materials, designed to high insulation standards and orientated towards the sun to maximize passive solar heating. The hot water will be stored in a cylinder that can be used for washing as well as the air-based heating system. All the new homes will be fitted with moveable solar screens to manage the temperature in the living spaces. Appropriate materials from the present structures on-site will be recycled in the new development to reduce its carbon footprint.

Hanham Hall will have a communal CHP (Combined Heat and Power) system, powered by a woodchip biomass boiler, which will generate zero carbon electricity and hot water for all homes, the refurbished listed building, the nearby NHS facility and doctors' surgery. The scheme gained £800k funding from the LCIF to extend the heat network to the local secondary school to enable it to be provided with zero carbon heat. Green houses will be built onto the grade II* listed wall running through the central landscape and play trail. All greenhouses will be heated via the CHP system as well.

More than 40% of the UK typical carbon footprint is created through the routines of travel and food consumption. Thus, the real Carbon Challenge is to offer people new lifestyles. A key component of the scheme is to encourage residents to grow their own produce for consumption and live more self sufficiently. Numerous kinds of fruit trees and bushes will be planted to give residents, particularly children, the opportunity to enjoy the simplicity of growing food locally. This will help to educate them about sustainable food production, and eating seasonally. The landscape has been designed to accommodate and increase local wildlife. Rainwater will be harvested for use in homes and gardens. Allotments have also been provided for residents to rent and grow their own produce.

Green houses will be built onto the grade II* listed wall, running through the central landscape and play trail. All greenhouses will be heated via the CHP. Features in the transformed grade II* listed building will include a café, farm shop and crèche together with office space.

Attached to Hanham Hall will be a Sustainable Living Centre, which will house a permanent exhibition of material describing the project, together with the history of the hall itself and offer a space for exhibitions and a base for a car club.

A development trust will be responsible for day-to-day management of the entire neighbourhood, including building maintenance, car sharing and gardening clubs.

Construction is currently underway, and the first homes are due for completion by the end of 2010.

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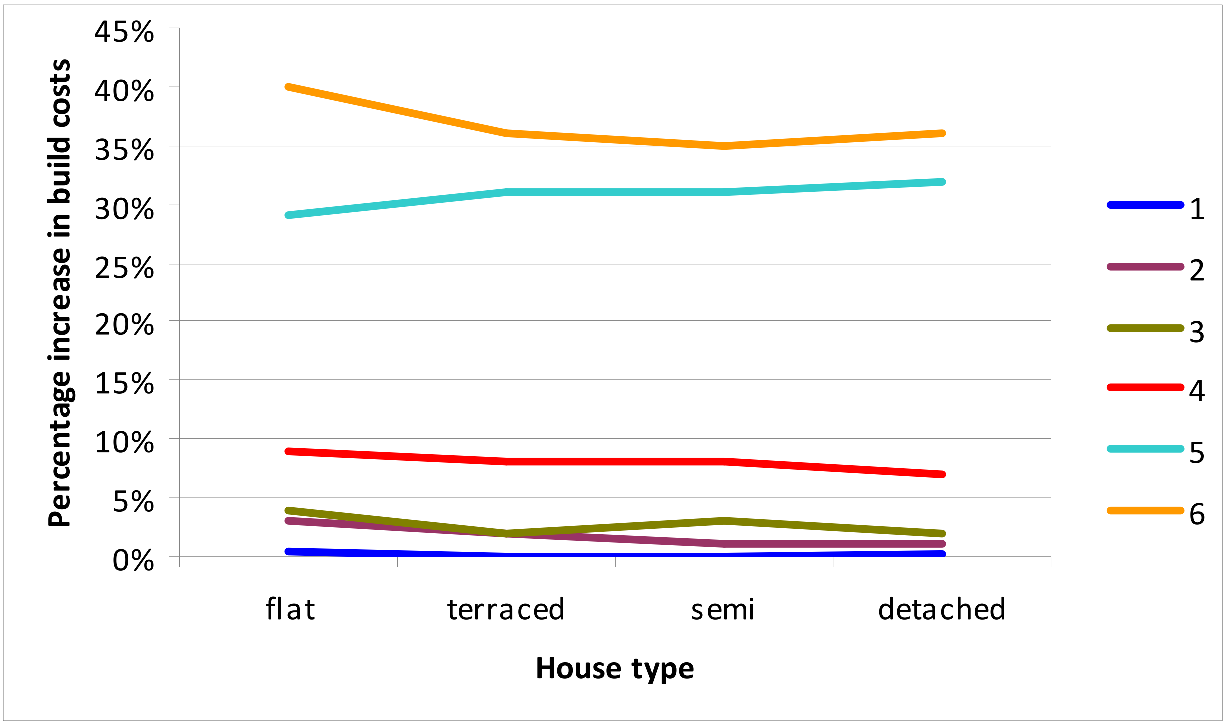
Appendix G
CSH/BREEAM Cost Review

CSH

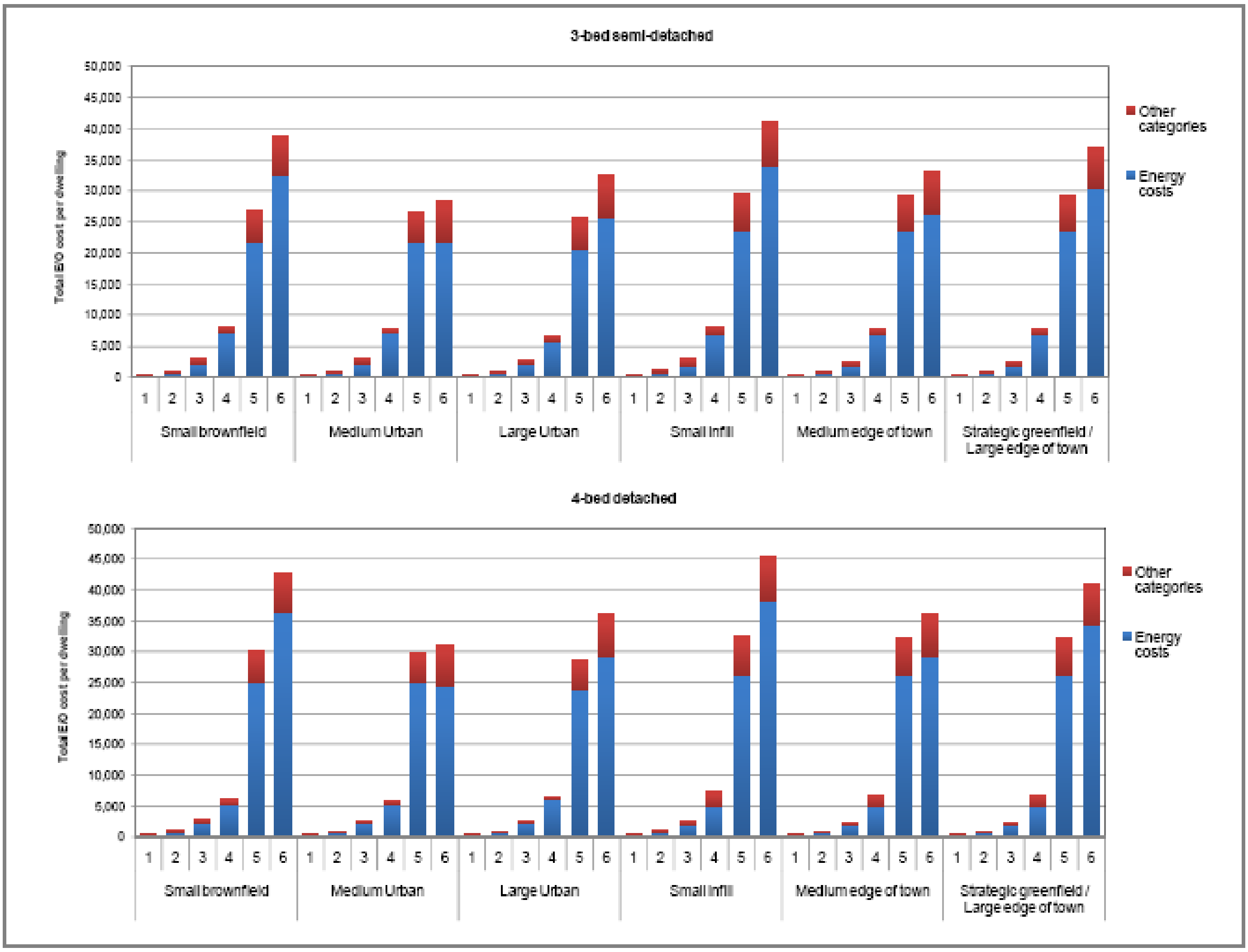
In March 2010 the Department for Communities and Local Government published Code for Sustainable Homes: A Cost Review. The Cost Review demonstrates that the additional build costs (over 2006 Part L) as a percentage to achieve Code Levels 5 and 6 is significant; taking the example of a ‘medium edge of town scenario’ the overall build costs for achieving Levels 5 or 6 could be as much as a further 30-40%. As Figure 4.3 demonstrates, it is achieving the energy credits that accounts for the most significant costs.

Impact of Code Levels on overall Residential Build Costs of a Scheme



Source: Based on figures from Table 68, E/O cost (in 2009) as £/m^2 of floor area and as a percentage of baseline build costs (cost of building dwelling to Part L 2006): Medium Edge of Town Scenario, Code for Sustainable Homes, A Cost Review.

Cost Review of the CSH: Energy Costs Versus Other Categories (3 Bed Semi and Detached Dwellings)



Source: Figure 6: Variation in total Code cost at each Code level with development scenario for each dwelling type, Code for Sustainable Homes, A Cost Review.

It is therefore the percentage increase in build costs to achieve Code Level 5 and Code Level 6 that has caused the property industry the biggest concern with respect to the impacts on site viability. The main reason for the significant additional costs here is due to the requirement for *on-site* renewable electricity, so the government is currently consulting on a revised definition of 'zero carbon' development to ultimately form part of a revised CSH.

Table 4.2 sets out the government's planned timetable for amendments to Building Regulations for achieving zero carbon homes by 2016 together with the implications for requiring renewable and low carbon energy.

Implications of Planned Changes to Part L of 2006 Building Regulation on Requirements for Renewable and Low Carbon Energy

Code Level	Current energy standard (percentage reduction in CO_2 emissions over 2006 Part L)	When equivalent change to Building Regulations is due	Options to achieve standards
3	25%	2010 (October)	Achievable via energy efficiency measures alone (i.e. simply via Part L of 2010 Building Regulations when they come into force). Micro-generation can be used to supplement this and achieve further savings - e.g. solar thermal, solar PV and ground source heat pumps.
4	44%	2013	On-site renewable or low carbon heat likely to be required as a minimum in most cases (in some cases it may be possible to achieve this standard via exceptionally high levels of insulation). Solar thermal, biomass boilers or ground source heat pumps could be used here *or* a communal heating network (gas CHP or biomass).
5	100% 'regulated' emissions	-	Requires on-site heat *and* renewable electricity (e.g. wind, solar or via biomass CHP).
6	Circa 140% regulated and unregulated emissions to achieve 'zero carbon' performance	2016	Requires on-site renewable or low carbon heat, renewable electricity (e.g. wind, solar or via biomass CHP) and allowable solutions to offset net emissions.

Given that from October 2010 Building Regulation will require a 25% reduction in emissions, equivalent to CSH Level 3, achieving Code Level 3 *overall* should be achievable in most cases. Once the energy credits of Code 3 have been achieved the additional costs for reaching Code 3 overall are not too significant, as demonstrated in Figure 4.2 (achieving the energy related aspects of a level of the CSH can account for around 70% of the overall additional cost[32]).

With respect to energy, developers at planning and design stage now need to be considering the 2013 standard for a 44% reduction in emissions equivalent to CSH Level 4, particularly when considering the lead-in times to development commencing. Larger sites that are to be phased over a number of years also need to factor in the requirement for zero carbon homes from 2016.

CSH Levels 5 and 6 are likely to be challenging to achieve on most sites at this stage because of the significant additional costs associated with these standards, however there may be opportunities to do so on particular sites or areas where:

[32] For example DCLG's Cost Analysis of the Code for Sustainable Homes demonstrates that for a small brownfield development it could cost between £2,400 and £3,000 overall to achieve Code Level 3 depending on dwelling type - 70% of the additional cost accounting for achievement of energy-related credits.

- there is clear potential for decentralised and renewable or low carbon energy, for example town centre locations where there is a communal heating network in place or planned;
- there is a greater degree of public sector involvement (e.g. HCA working to a more ambitious timetable); and
- it is known that the developer is committed to higher standards (some developers are already working to higher levels as part of their own design standards).

Ultimately the opportunity to seek higher standards will depend not just on the viability of achieving a particular Code Level but the range of policy and other requirements relating to a scheme, including levels of affordable housing, Section 106 contributions and infrastructure provision for example.

BREEAM

The Council can require minimum levels of BREEAM for new non-residential development across Northumberland (i.e. office, retail and industrial units). BREEAM ratings range from 'pass', 'good', 'very good', 'excellent' to 'outstanding'. It is important to note however that BREEAM ratings are not as dependant on renewable and low carbon energy when compared with the CSH. Higher levels of BREEAM can be achieved without necessarily incorporating on-site renewable or low carbon energy. A further difference when compared with the CSH is that BREEAM ratings consider the *location* of a development. Notwithstanding these differences it is still possible to appraise what minimum standard of BREEAM could be reasonably expected across Northumberland.

As a starting point we have reviewed the approach taken by other local planning authorities with adopted Core Strategy policies that have been tested, examined and approved by the Planning Inspectorate. It is clear that most authorities are seeking *at least* BREEAM 'very good' with some also including a timetable for higher levels of performance[33]. A 'very good' rating broadly aligns with the targets for public sector buildings set out in Table 4.2, including English Partnership's 2007 Quality Standards and DCSF's target for schools and colleges (though we note that the DoH is already seeking BREEAM excellent). With respect to BREEAM 'Outstanding' it is important to note that BRE states that: "*in the absence of it being volunteered by the developer, BRE would recommend that LPAs do not require an Outstanding Level at any point in the future, as this will remain an immensely challenging level of sustainability (as is intended)*".[34]

We now consider the additional costs of achieving BREEAM standards. Whilst there is no recent published information relating to the costs for achieving BREEAM 2008, Putting a Price on Sustainability, published by the

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[33] Dover Core Strategy, Mole Valley Core Strategy, Poole Core Strategy and Sheffield Core Strategy for example.

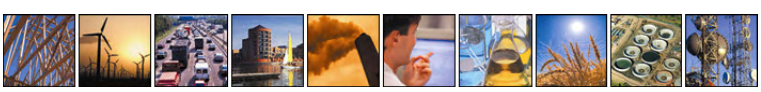
[34] Page 8, Guidance for Local Planning Authorities Incorporating BREEAM and the Code for Sustainable Homes within planning policy.

BRE Trust and Cyril Sweet in 2005, concludes that the additional costs for achieving BREEAM ratings should not be significant, particularly when considering sustainability at the outset of the design and planning process. In particular the report notes that a BREEAM 'very good' rating can be achieved for a *naturally ventilated office* for an additional cost of up to 2% and an 'excellent' rating for between 2.5% and 3.4%. For an *air conditioned office* the costs increase to 5.7% for a 'very good' rating and up to 7% for an 'excellent' rating. Although from 2005, this cost data indicates that the additional build cost for achieving this rating for offices is circa 5%, so unlikely to present a *significant* barrier in viability terms (pending consideration of detailed design, location and a full range of requirements affecting the viability of a specific site, e.g. affordable housing, S106 and etc.). In advance of more up to date cost information it is this baseline that most authorities are referring to in their evidence base underpinning BREEAM policy requirements.

Based on a review of the standards adopted by other local planning authorities and estimated costs for achieving a minimum BREEAM rating for non-residential development we suggest that a minimum of BREEAM 'very good' is likely to be achievable in most cases.

Opportunities to seek higher BREEAM standards for particular areas or specific sites include:

- when working on public sector-led sites (e.g. HCA funded), who may ultimately adopt their own higher standards;
- sites where the developer has their own sustainability commitments (some developers have corporate commitments to higher levels of sustainable performance, part of increasing their profile and value of a scheme); and
- where sites or areas perform exceptionally well in terms of the location-based criteria of BREEAM and where there is clear potential to link to or established a renewable or low carbon energy supply.



Appendix G