Mid Devon District Council

Local Development Framework Housing Preferred Options

Renewable Energy Capacity, Carbon Impacts and Low Emission Strategies

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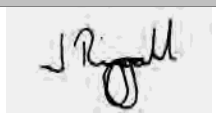
Prepared by:	Jonathan Riggall Kris Atkins Nicki Trought	Senior Scientist Graduate Engineer Senior Scientist		30 March 2009
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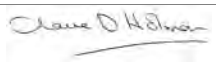
Approved by:	Claire Holman	Director		30 March 2009
For and on behalf of Peter Brett Associates LLP				

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1 Introduction

1.1 Background

1.1.1 Mid Devon District Council (MDDC) has proposed, through their adopted Local Development Framework (LDF) Core Strategy[1], to meet the housing provision requirement of 6,290 dwellings between the years 2006 and 2026, with 10% flexibility. This allocation will be met by green and brownfield residential developments with associated commercial and mixed use proposals.

1.1.2 The LDF proposes the development of 21 preferred options for development within MDDC (see Figure 1 of Appendix A). In addition to these 21 preferred options a further eight reserved sites (or extensions to the preferred options) are being considered. The preferred options and reserved sites are in or close to Tiverton, Cullompton, Crediton and Bampton. T

1.1.3 MDDC has completed a Strategic Environmental Assessment (SEA) and Sustainability Appraisal (SA) of their proposed Local Development Framework (LDF). The completed assessments meet the requirements of both the Planning and Compulsory Purchase Act 2004 and the Environmental Assessment of Plans and Programmes Regulations 2004.

1.1.4 MDDC has commissioned Peter Brett Associates LLP (PBA) to provide an assessment of carbon impacts and opportunities for the preferred housing options to support the SEA and SA process; the potential for renewable energy and low carbon technologies to be incorporated into the preferred options; and possible measures to be included in a Low Emissions Strategy (LES). The report has been developed in line with central Government's aims of carbon emissions reduction from new developments.

1.1.5 The first two sections of the report focus on carbon emissions, as carbon dioxide (CO_2) is the key anthropogenic greenhouse gas linked to climate change. The LES measures to reduce emissions of nitrogen dioxide (NO_2) and particulate matter (PM_{10}) ,as these are the pollutants of concern locally in terms of air quality, as well as CO_2.

1.2 Report Structure

1.2.1 The report is structured as follows:

Section 2: Policy Context

Section 3: Renewable Energy Capacity

Section 4: Carbon Impacts

Section 5: Low Emissions Strategy

Section 6: Summary and Conclusions.

[1] http://www.middevon.gov.uk/media/pdf/b/8/Core_Strategy_Adopted.pdf

2 Policy Context

2.1 National and Regional Policy

Climate Change

2.1.1 In the UK the **Climate Change Act 2008**[2] (CCA) received Royal Assent in November 2008. It notably sets the following legally binding emissions reduction targets:

- 80% reduction in emissions of greenhouse gases (GHG)[3] by the year 2050 from 1990 levels
- 26% reduction of CO_2 emissions by 2020 from 1990 levels

2.1.2 Two budgets are proposed for after 2013 depending on whether a global deal on emission reductions is achieved. The Intended Budget, which should apply once the global deal has been reached, would require a reduction in 2020 of 42% in GHG emissions below 1990 levels. The Interim Budget, which the UK would be committed to in the absence of a global deal, would require a reduction of 34% in 2020 from 1990 levels. This is more stringent than the current target for 2020 in the CCA (which only applies to CO_2 emissions).

2.1.3 The **Energy Act** also received Royal Assent in November 2008[1], further laying the foundations to meet and exceed a variety of European Union obligations, setting stringent legally binding emissions reduction targets and creating a framework for future regulatory reform.

2.1.4 The Energy and Climate Change Acts outline the Government's commitments to national and international GHG reduction targets, carbon budgeting and emissions trading, in addition to outlining the responsibilities of Government to demonstrate leadership in carbon management internationally and assist the transition toward a low carbon economy in the UK.

2.1.5 **Planning Policy Statement 22: Renewable Energy (PPS22)** sets out the Government's fundamental energy policy objectives alongside guidance on the various types of renewable energy sources and how planning authorities should include requirements for renewable energy in their plans. PPS22 also sets out further targets for emissions reduction and electricity production from renewable energy sources.

2.1.6 The **Planning Policy Statement: Planning and Climate Change - Supplement to PPS1 (**the PPS1 Supplement) sets out the responsibilities of regional planning bodies and planning authorities to provide for emissions reduction and renewable energy provision to inform the planning process through their regional spatial strategies and local development documents. PPS1 clearly establishes the need for planning authorities to develop a

[2] Received Royal Assent on 26th November 2008
[3] Currently carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons. Sulphur hexafluoride

firm evidence base to inform spatial planning requirements and local targets for renewable and low carbon energy and/or carbon emissions reduction.

2.1.7 In July 2007, following consultation, the Government's *Building A Greener Future: Policy Statement* announced that all new homes will be zero carbon from 2016. Additionally, in the 2008 Budget the government announced their aspiration that from 2019 all new non-domestic buildings would similarly be zero carbon, with earlier dates for schools (2016) and other public buildings (2018).

2.1.8 Recently, it has become apparent that the definition of zero carbon in the Code for Sustainable Homes requires further clarification. Currently all "regulated emissions" – those associated with fixed lighting, space heating, ventilation and hot water, plus "unregulated emissions" – those attributed to cooking and running appliances, within the home should be net zero over the year. Further, all renewable and low carbon energy technologies must be on-site and directly connected to each dwelling for the displaced carbon to be attributed to each dwelling.

2.1.9 The Department for Communities and Local Government has recently consulted on this issue. The aim is to provide greater flexibility in the way zero carbon homes are achieved and it proposes a hierarchy for achieving zero carbon homes where:

1. Energy efficiency is the first priority and all new homes must achieve high levels of energy efficiency.
2. A minimum level of CO_2 emission reductions (compared to current building regulations) is achieved through a combination of energy efficiency, on-site energy supply and directly connected low and zero carbon heat, the latter may be located off-site. This element is referred to as "carbon compliance".
3. Where the above measures do not result in achieving a zero carbon home, the "residual emissions" are addressed through a range of "allowable solutions" which can be undertaken locally, or further afield and may include;
    - Export of heat from the site;
    - Direct investments in off-site renewable electricity;
    - S106 contributions to fund local low carbon infrastructure;
    - Retrofitting of existing buildings within the locality with energy efficient technologies.

Air Quality

2.1.10 The **Environment Act 1995** introduced a system of Local Air Quality Management (LAQM). This requires Local Authorities to regularly and systematically review and assess air quality

within their boundaries against a series of objectives, and appraise development and transport plans against these assessments. Where the objectives are not likely to be achieved the Local Authority must designate an Air Quality Management Area (AQMA), and may need to draw up an Air Quality Action Plan setting out the measures it intends to introduce in pursuit of the objectives within its AQMA.

2.1.11 The **Air Quality Strategy (2007)** establishes the policy for ambient air quality for the UK. Its primary objective is to ensure that everyone can enjoy a level of ambient air quality in public places which poses no significant risk to health or quality of life. The Strategy sets out the National Air Quality Objectives (NAQOs). Those included within LAQM are prescribed in the **Air Quality (England) Regulations 2000** and the **Air Quality (Amendment) (England) Regulations 2002**.

2.1.12 The air quality objectives apply to outdoor locations where people are regularly present, and where they might reasonably be expected to be exposed over the relevant averaging times (which vary from 15 minutes to a year). The air quality objectives do not apply to occupational, indoor or in-vehicle exposure.

2.1.13 **Planning Policy Statement 23: Planning and Pollution Control (PPS23)** sets out the Government's current policies on air quality and planning. It identifies the consideration of air quality and potential air quality impacts arising from development as capable of being a material planning consideration.

2.1.13.1 PPS23 states that in considering proposals for development, Local Planning Authorities should take account of the potential risks of and from pollution and land contamination and how these can be managed or reduced. It advises that the planning system should focus on whether the development itself is an acceptable use of the land and the impacts of those uses rather than the control of processes or emissions themselves.

Regional Policy

2.1.14 The **Draft Regional Spatial Strategy for the South West (2006- 2026)** identifies energy consumption as a significant contributor to the region's eco-footprint and recognises the importance of generating energy within the region and from renewable sources, to address emissions targets and stimulate the regional economy.

2.1.15 The RSS presents targets for renewable energy production and empowers local authorities to include policies in their LDD's to achieve these targets. The RSS advocates the benefits of off-shore and on-shore wind energy, energy from waste and biomass technology as energy solutions, while recommending that all new developments consider incorporating energy production on-site and energy efficiency measures.

2.1.16 The RSS also aims to *"secure fundamental improvements to public transport, traffic management and use of road space to tackle congestion and poor air quality in many urban areas."*

2.1.17 The RSS includes Policy RE9 on Air Quality which states that: "The impacts of the development proposals on air quality must take into account and local authorities should

ensure, though LDDs, that new development will not exacerbate air quality problems in existing and potential AQMAs."

2.1.18 With respect to climate change, the RSS notes that *"climate change, principally due to the emission of greenhouse gases from human activity, is already affecting life in the South West."*

2.1.19 Policy SD2 (Climate Change) states that the *"region's contribution to climate change will be reduced by reducing the greenhouse gas emissions at least in line with current national targets…"*. This reduction will be achieved through measures outlined in Policy SD1 (The Ecological Footprint), for example, *"minimising the need to travel by better alignment of jobs, homes and services, reducing the reliance on the private car by improving public transport and effective planning of future development, and a strong demand management regime applied in the region's main centres in particular"*.

2.1.20 Section 9 of **Regional Planning Guidance 10**: **"SW: Energy Efficiency and Renewable Energy" (RPG 10)** sets out the policy relating to energy efficiency and renewable energy.

2.1.21 The relevant policy on renewable energy, RE 6, encourages Local Authorities to support national emissions and renewable energy targets. Local Authorities are also encouraged to promote the use of renewable energy including community-based projects such as CHP.

2.1.22 Paragraph 9.35 of the explanatory notes to this policy states the importance of renewable energy schemes being compatible with other environmental objectives for the region and that environmental impact must be addressed by developers. It further states that rural development opportunities could be enhanced through the use of biomass fuels to generate electricity.

2.1.23 In 2008, the Beacons Low Emissions Strategy Group published the consultation draft good practice guidance '*Low Emissions Strategies: Using the planning system to reduce transport emissions*'. This guidance aims to aid local authorities in the successful implementation of low emission strategies and is intended to encourage innovative measures as well as more established measures.

2.1.24 The guidance provides an outline of measures that could be included within an LES.

2.2 Local Policy

2.2.1 The **Devon Structure Plan 2001-2016** was adopted in 2004 and provides policy context directly relating to renewable energy development through policy CO12.

2.2.2 The policy makes clear recommendations that local planning authorities should plan positively in order to contribute to renewable energy targets. The policy makes reference to "areas of search"; priority locations that the Plan has highlighted for consideration in wind power development. The area of search within Mid Devon does not include any of the proposed development sites under consideration.

2.2.3 The **Mid Devon District Local Plan-First Alteration 2006** is in the process of being superseded under the **Planning and Compulsory Purchase Act 2004** by the Local Development Framework for Mid Devon, however the Local Plan policies have been saved; the Local Plan currently forming part of a suite of LDF documents.

2.2.4 While there are no specific saved policies relating to air quality, Policy S5 states that:

"Developments will be permitted provided they meet the following criteria in addition to any other Development Plan policies which apply;

> *… iii) the operation of the site, including any additional road traffic arising, will not be detrimental to the amenity, health or safety of nearby occupants or the wider environment through noise, smell, glare, light pollution, heat, vibration, fumes or other forms of pollution or nuisance…"*

2.2.5 Policies ENV2 and ENV3 relate to renewable energy in the district. Policy ENV2 deals exclusively with wind energy, and ENV3 with all other forms of renewable energy. Both policies outline the commitment to support renewable energy in the district, where local and environmental impacts permit.

2.2.6 The **Mid Devon Core Strategy 2026** was adopted in 2007 and provides an over-arching planning strategy for the district. Climate Change policy COR5 seeks to minimise the impact of developments on Climate Change and contribute to national and regional emissions targets outlined in national policy.

2.2.7 Policy COR5 of MDDC's Core Strategy (2007) states that *"…it is intended that all new development will be carbon neutral in development and use as soon as a detailed approach can be developed through the preparation of a Supplementary Planning Document (SPD) on this subject. This is likely to be through appropriate choice of materials, energy efficiency measures, transport management, renewable energy generation and carbon fixing. Until such time as the SPD is adopted all development should take positive measures to reduce carbon emissions to a realistic minimum."*

2.2.8 A Supplementary Planning Document on Air Quality and Development was adopted in May 2008. This document expands on the policies within the Mid Devon Local Plan and emerging Local Development Framework. It provides guidance on when an air quality assessment may be required for a proposed development and discusses a number of specific measures relating to the AQMAs.

3 Renewable Energy Capacity Assessment of the Preferred Development Options

3.1 Introduction

3.1.1 The assessment provides an analysis of each proposed (preferred and reserve) development site against a set of physical constraint criteria for each renewable energy option using spatial data in a Geographical Information System (GIS) model.

3.1.2 The purpose of this study is to provide an objective appraisal of the renewable energy options available for each site. This is followed by a subjective discussion of each option.

3.1.3 This assessment covers the most common renewable energy technologies considered cost-effective and reliable in the current market-place. These technologies are:

- **Biomass Combined Heat and Power (CHP):** The combustion of biomass (a renewable fuel source) to produce electricity and heat. CHP technologies can be scaled according to the required heat demand. Costs associated with CHP technologies (per building) are influenced by economies of scale but typically cost £1 to 2 million/MW
- **Large-scale Wind Generator:** 45m hub height wind turbine harnessing wind energy to produce electricity for a development. Single turbines can cost £0.8 to £1 million/MW. Typically turbines with a 45m hub height will be rated 1-2MW.
- **Micro-scale Wind Generator:** Smaller, building mounted turbines providing electricity at lower volumes to individual properties. Micro wind generation costs in the region of £5,000 to £30,000 depending on the size of the turbine.
- **Hydroelectricity:** Generating electricity from a turbine powered by moving water. Costs associated with hydro power depend on the size of the plant. The applications of hydropower are limited, therefore costs of development are slightly higher than other readily available technologies and not readily known in the UK at a MW level.
- **Ground-and Water-Source Heat Pumps:** Using refrigerant chemicals pumped through capillaries installed in soil, bedrock or running water to harness and concentrate low-level but constant heat, to supply space heating or cooling in properties. Heat pumps cost in the region of £4,000 per residential property with larger applications increasing likely installation fees. The cost is likely to be £0.8 to £1.5million/MW.
- **Solar Photo-Voltaic:** Panels of photo-voltaic material that convert solar energy to electricity. Photo voltaic cells are expensive and cost around £20million/MW
- **Solar Thermal Hot-Water:** Water is pumped through fine capillaries inside insulated panels that absorb solar energy, to produce hot water. Solar thermal technologies are comparatively low cost with household applications starting at £4000 upwards which equates to £0.8 to £1.4million/MW
- **Anaerobic Digestion:** Process undertaken at modified sewage treatment plants using anaerobic bacteria to digest sewage and produce methane. This gas can be burnt to provide combined heat and power, to supply adjacent developments. Anaerobic digestion plants are not well established in the UK. The development costs are therefore not well known but are likely to be related to size of the application. Typical plants are likely to cost in the region of £1 to £1.2million/MW.

- **Energy from Waste:** Large scale combustion of municipal or commercial waste streams as a fuel to provide electricity or CHP to large developments. Large scale plants have high development costs associated with them. A 100,000 tonne per annum plant is likely to cost in excess of £5 million. The heat energy delivered from such plant costs around £0.5 to £0.6million/MW.

3.1.4 In addition, consideration has been given to the viability of **Gas CHP.** This is a non-renewable but low carbon technology using combustion of mains natural gas to provide heat and electricity. Although this technology is reliant on combustion of fossil fuel and is therefore not renewable, it is likely to be suitable for use in many of the proposed locations and is an efficient and low carbon energy technology. Fuel cell technologies have not been considered within this report as their application in urban developments is not considered economically viable.

3.1.5 These technologies have been considered individually for each Preferred and Reserved Options development site listed in the Mid Devon Local Development Framework, against a set of physical constraints outlined in Section 3.2 below.

3.1.6 A previous study commissioned by MDCC addressed constraints to wind power, hydro power and biomass across the district as a whole. The study concluded that hydro power viability could only be assessed based on the presence of water channels as any further analysis would require advanced catchment modelling and abstraction data for the district which would require considerable time and expense.

3.1.7 The study also concluded that while large scale (2MW+) wind power was a likely answer to meeting the region's carbon reduction commitments, locating the turbines would be heavily constrained by noise affecting residential areas and environmentally designated areas.

3.1.8 The use of biomass was concluded to be a viable option in Mid Devon due to the availability of the resource, however questions were raised regarding the ecological and landscape impact associated with mono-cultivation for biofuel.

3.2 GIS Methodology

Building the Database

3.2.1 The GIS platform used in this assessment was ArcGIS v.9.1.

3.2.2 Spatial data was obtained from a variety of sources providing information on all the expected physical constraints to each renewable energy technology. The spatial data was displayed graphically, over-laying an Ordnance Survey base and site boundaries of the preferred and reserved proposed development locations given in MDDC's LDF documents.

3.2.3 The spatial data obtained and its source is given in Table 3.1 below.

Table 3.1- Spatial Data Obtained

Data Set	Data Included	Source
Ordnance Survey Base Mapping	1: 10,000 scale 1: 50,000 scale	MDDC MDDC
Proposed Development Locations	Preferred Options Reserve Options Options Not Included	MDDC MDDC MDDC
Mid Devon District Boundary	Mid Devon District Boundary	MDDC
Topographic Data	5m Elevation Contours	MDDC
Biomass Fuel Suppliers	Biomass Fuel Suppliers	www.swwf.info /hardwareandinstallers
Wind Data	Operational Wind Farms Wind Farms Under Construction NOABL Wind Speed Data: 10m height NOABL Wind Speed Data: 25m height NOABL Wind Speed Data: 45m height	www.bwea.com/ www.bwea.com/ www.berr.gov.uk/ www.berr.gov.uk/ www.berr.gov.uk/
Road, Rail and Footpath Network	A-Roads and Motorways + 150m buffer Railway Lines + 150m Buffer Public Footpaths + 200m Buffer	PBA PBA MDDC
Electric and Gas Infrastructure	Electricity Towers Electricity Lines + 150m Buffer Electricity Sub-Station Mains Gas Network	MDDC MDDC MDDC PBA
Waste Infrastructure	Existing and Historic Landfill Sites Sewage Treatment Works	MDDC MDDC
MDDC AQMAs	Crediton Air Quality Management Area Cullompton Air Quality Management Area	www.middevon.gov.uk www.middevon.gov.uk
Land Use Classification	Land Use Classification	MDDC
Designated Sites	Ancient Woodland Inventory Local Nature Reserves Sites of Special Scientific Interest Scheduled Monuments Dartmoor National Park Areas of Outstanding Natural Beauty	www.magic.gov.uk www.magic.gov.uk MDDC MDDC MDDC MDDC
Hydrology	Flood Zones 2 and 3 River Centre Lines	MDDC MDDC

Constraints

3.2.4 Physical constraints to construction, operation and up-keep of the renewable technologies were set out on the basis that a location must satisfy all the constraints to a renewable technology option to be viable. These are given in Table 3.2 below and explained fully in paragraphs 3.2.9 onwards.

3.2.5 This assessment does not consider potential or perceived constraints to renewable energy technologies that are not physically definable or that are flexible or interpretative, for example proximity to designated areas and aviation, noise nuisance and personal opinion.

3.2.6 This approach is objective and based on rigid criteria to yield a “pass/ fail” system of assessment for each technology option. In reality of course, viability is far less polar; more a graded scale that is flexible on many criteria, for example suitability of underlying geology to

support ground source heat pumps. Uncertainties will be addressed at a more detailed site-specific assessment stage.

3.2.7 A more subjective discussion is provided to support the spatial analysis in Section 3.3. The summary information in Table 3.3 also highlights several sites where viability of a renewable technology is uncertain due to small scale changes across the site or in spatial data that cannot be resolved without more detailed on-site assessment.

3.2.8 There is some potential interest in the use of biological waste products from abattoir and large scale farming operations in anaerobic digestion energy production similar to that undertaken during sewage treatment. However, due to the nature of the process and the logistics of conducting it on residential sites where space and public perception may be limiting, it has not been considered in this assessment.

Table 3.2- Physical Constraints to Energy Technologies Considered

Energy Technology	Constraints Considered in this study
Biomass CHP	Supplier ≤ 30km from site No impact on Air Quality Management Areas Size and location of site suitable regarding space for CHP unit and access for deliveries
Largescale Wind	Location ≥ 500m from Residential Areas Location ≥ 200m from Public Footpaths Location ≥ 150m from Major Roads/ Motorways Location ≥ 150m from Railway Location ≥ 150m from Powerlines Size of site suitable Wind speed ≥ 6m/s at 45m height
Microwind	Wind Speed of ≥4m/s at 10m height Open Aspect
Hydro	River On-Site
Heat Pumps (ground source) *(water source)*	Suitable underlying geology River On-Site
Solar P.V.	Site aspect suitable
Solar Thermal Hot Water	Site aspect suitable
Gas CHP	Mains Gas connection
Anaerobic Digestion of Sewage	Next to sewage works
Energy from Waste	Supplier ≤ 30km from site No impact on Air Quality Management Areas Size and location of site suitable regarding space for EfW unit and access for deliveries

3.2.9 The constraints below have been set according to industry standard health and safety guidelines, technical requirements for operation of the technology, logistics and local environmental considerations, and are explained below.

3.2.10 The use of biomass or waste for combustion to produce electricity and heat has an air quality impact. For this reason, these technologies are constrained by local Air Quality Management Areas (AQMA's) that highlight areas of poor air quality to encourage improvement.

3.2.11 These technologies also require delivery of fuel to the site which should be from a "local" source (generally defined as within 30km) in the interests of minimising road transport and promoting local self sufficiency. There is also a requirement for space to accommodate the fuel deliveries and the CHP or EfW unit on the site. Currently the scale of modern EfW units will not be suitable to the majority of proposed sites.

3.2.12 More obvious constraints to energy technologies often prove to be critical in the viability assessment, removing the need to assess other limiting factors (space, efficiency etc), for example the over riding constraint to solar energy (PV and thermal hot water) is a site aspect that receives sunlight, for hydro power a water course must be present, for gas CHP a mains gas connection must exist and for heat pump technologies suitable geology or a moving water body must be present to harness the low level heat.

3.2.13 Similarly, energy as a product of anaerobic sewage digestion must be obtained from a sewage treatment works where this process takes place and supplied to a development immediately adjacent. This is generally only cost-effective and efficient to install in conjunction with large developments.

3.2.14 Large scale wind power is constrained by many physical factors due to the large size of the turbines and the associated health and safety and construction considerations. In this assessment, non-physical environmental constraints such as radar, visual impact and public opinion have not been considered.

3.2.15 In response to noise impact guidance given in PPS22 (2003), large (45m) wind turbines must be situated greater than 500m from residential areas. With respect to risk from potential blade throw or topple, 45m turbines must also be 200m from public footpaths and 150m from major roads, railway lines and overhead power lines.

3.2.16 Adhering to these minimum distances and ensuring a site could support the magnitude of construction necessary, limits the use of large scale wind energy to larger sites.

3.2.17 For the purpose of this assessment it is taken that wind speeds of 6m/s or greater at a 45m height are necessary for efficient operation of a large wind turbine. Smaller, micro-scale wind energy is often building-mounted, meaning that space for installation is not an issue and health and safety considerations are less prominent. Micro wind generation requires wind speeds of 4m/s or greater at 10m height and a site aspect in a south-westerly direction, free from surrounding structures which disrupt wind patterns.

Analysis

3.2.18 The analysis undertaken consisted of visual assessment and spatial interrogation of the data contained in the GIS model on an individual site basis.

3.2.19 The GIS software allows creation of boundaries, routes and areas traced from an OS background and creation of "buffer zones" at set distances surrounding a point, line or shape. The software also allows interrogation of large data sets against a rule, to yield, for example all preferred development sites containing a water channel, or only those development sites containing wind data of 6m/s or more.

3.2.20 The application of these functions makes visual identification of viable sites against set criteria relatively quick and unambiguous. Table 3.3 below summarises the assessment approach made using the GIS, stating whether each renewable energy technology would have overall likely suitability (✓), unlikely suitability (✗) or potential suitability pending more in-depth assessment (○). Where heat pump technology has been assessed, the suitability of both water source and ground source types is shown, separated by a '/'.

3.2.21 This follows the "pass/ fail" analysis conducted for each proposed site against the set constraints given in Table 3.2. The raw data is shown in Appendix B.

3.2.22 The suitability of each technology at the proposed and "not selected" development sites for Tiverton, Cullompton, Crediton, Bampton and the Rural Settlements is summarised graphically in Figures 3.1- 3.5. The sites are labelled concurrent with the lettering as per the LDF Preferred Options document and Table 3.3.

3.2.23 This assessment is a screening approach to renewable energy and therefore should not be considered definitive. The capacity for each site to develop renewable energy will require bespoke assessment based on a wider set of parameters.

3.2.24 In some cases where the scale or accuracy of data is not sufficient, or where conditions across the development site are changeable, a definitive judgement is not possible. These cases are noted and viability is defined as potentially possible pending more in-depth assessment.

Table 3.3- Summary of Renewable Energies Viability for Each Development Location Using GIS

✓ - Likely Suitability
× - Unlikely Suitability
○ - Potential Suitability

Tiverton	Renewable Energy >									
Site V	Biomass CHP	Large Scale Wind	Micro Wind	Hydro.	Heat Pumps (WS /GS)	Solar P.V.	Solar Thermal	Gas CHP	Anaerobic Digestion	EfW
A- E.U.E	✓	○	✓	×	×/ ✓	✓	✓	✓	×	✓
B- Farleigh Meadows	✓	×	✓	×	×/ ✓	✓	✓	✓	×	×
C- Belmont Hospital	×	×	×	×	×/ ✓	✓	✓	✓	×	×
D- Castle School	×	×	×	×	×/ ✓	✓	✓	✓	×	×
E- Palmerstone Park	×	×	✓	×	×/ ○	✓	✓	✓	×	×
F- William Street Hospital	×	×	×	×	×/ ✓	✓	✓	✓	×	×
G- Blundells Garage	×	×	×	×	×/ ✓	✓	✓	✓	×	×
H- Roundhill	×	×	✓	×	×/ ○	✓	✓	✓	×	×
I -Hay Park	×	×	×	×	×/ ✓	✓	✓	✓	×	×
J- The Avenue	✓	×	×	×	×/ ✓	✓	✓	✓	×	×
K- Phoenix Lane	×	×	×	×	×/ ✓	✓	✓	✓	×	×
L- Bampton Street	×	×	×	×	×/ ✓	✓	✓	✓	×	×
R1- Palmerstone Park/ Howden Court	✓	×	✓	×	×/ ○	✓	✓	✓	×	×
R2- Tidcombe Hall	×	×	✓	×	×/ ✓	✓	✓	✓	×	×
R3- Exeter Hill	×	×	✓	×	×/ ✓	✓	✓	✓	×	×
NS1-Blundells Road	×	×	×	×	×/ ✓	✓	✓	✓	×	×
NS3-Lower Farleigh	✓	×	✓	×	×/ ✓	✓	✓	✓	×	×
NS5-Horsden Lane	×	×	×	×	×/ ✓	✓	✓	✓	×	×
NS6-Wynnards Mead	×	×	✓	×	×/ ✓	✓	✓	✓	×	×
NS7-Lower Warnicombe	×	×	✓	×	×/ ✓	✓	✓	✓	×	×

Cullompton	Renewable Energy >									
Site V	Biomass CHP	Large Scale Wind	Micro Wind	Hydro.	Heat Pumps (WS /GS)	Solar P.V.	Solar Thermal	Gas CHP	Anaerobic Digestion	EfW
A- North West Cullompton (+/- 3 Ha)	✓	○	○	×	×/ ✓	✓	✓	✓	×	×
B- Knowle Lane (+/-6 Ha)	○	×	○	✓	✓/ ✓	✓	✓	✓	×	×
C- Court Farm	×	×	×	×	×/ ○	✓	✓	✓	×	×
D- Padbrook	×	×	✓	×	×/ ○	✓	✓	✓	✓	×
E- Lower Bull Ring	×	×	×	×	×/ ○	✓	✓	✓	×	×
F- Kings Mill Road	○	×	✓	×	×/ ○	✓	✓	✓	×	×
NS1-Colebrooke	✓	×	✓	×	×/ ✓	✓	✓	✓	×	×
NS2-East Culm Farm	✓	×	✓	×	×/ ○	✓	✓	✓	×	×
NS3-Exeter Road	×	×	✓	×	×/ ○	✓	✓	✓	✓	×
NS4-Herons Bank	×	×	✓	×	×/ ✓	✓	✓	✓	×	×
NS5-Longbridge	×	×	×	✓	✓/ ○	✓	✓	✓	×	×
NS6-Square Close	×	×	×	✓	✓/ ○	✓	✓	✓	×	×
NS7-Venn Farm Phase 2	✓	×	✓	×	×/ ○	✓	✓	✓	×	×
NS8-Week Farm	✓	×	○	×	×/ ○	✓	✓	✓	×	×

Crediton	Renewable Energy >									
Site V	*Biomass CHP*	*Large Scale Wind*	*Micro Wind*	*Hydro.*	*Heat Pumps (WS /GS)*	*Solar P.V.*	*Solar Thermal*	*Gas CHP*	*Anaerobic Digestion*	*EfW*
A- Wellparks	✓	✗	✓	✗	✗/ ○	✓	✓	✓	✗	✗
B- Pedlerspool	✓	✗	✓	✗	✗/ ○	✓	✓	✓	✗	✗
C- Red Cross Hill	○	✗	✓	✗	✗/ ○	✓	✓	✓	✗	✗
D- The Woods Group	✗	✗	✗	✗	✗/ ✓	✓	✓	✓	✗	✗
E- Moores, High Street	✗	✗	✗	✗	✗/ ✓	✓	✓	✓	✗	✗
R1- Cromwells	✗	✗	✗	✗	✗/ ✓	✓	✓	✓	✗	✗
R2- Higher Road	✗	✗	✓	✗	✗/ ○	✓	✓	✓	✗	✗
R3- Westwood Road	✗	✗	✓	✗	✗/ ✓	✓	✓	✓	✗	✗
George Hill	✗	✗	✗	✗	✗/ ○	✓	✓	✓	✗	✗
Alexander Close	✗	✗	✗	✗	✗/ ○	✓	✓	✓	✗	✗
1-Chapel Down	✓	✗	✓	✗	✗/ ○	✓	✓	✓	✗	✗
2-Chiddenbrook	✓	✗	✓	✗	✗/ ✓	✓	✓	✓	✗	✗
3-Queen Elizabeth Lower School	✗	✗	✓	✗	✗/ ✓	✓	✓	✓	✗	✗
4-Barn Park	✗	✗	✓	✗	✗/ ✓	✓	✓	✓	✗	✗
7-Milk Link, East Town	✗	✗	✗	✗	✗/ ✓	✓	✓	✓	✗	✗
9-Fair Haven	✗	✗	✗	✗	✗/ ✓	✓	✓	✓	✗	✗
13-Okefield	✗	✗	✗	✗	✗/ ○	✓	✓	✓	✗	✗
15-Forches and Mount Jocelyn	✗	✗	✗	✗	✗/ ○	✓	✓	✓	✗	✗
16-Queen Elizabeth Upper School	✗	✗	✗	✗	✗/ ✓	✓	✓	✓	✗	✗
17-Queen Elizabeth Upper School Alexander Rd.	✗	✗	✗	✗	✗/ ○	✓	✓	✓	✗	✗
19-Rugby Club	✗	✗	✗	✗	✗/ ○	✓	✓	✓	✗	✗
NS1-St. Saviours Way	✗	✗	✗	✗	✗/ ✓	✓	✓	✓	✗	✗
NS4-Forches Cross Playing Field	✗	✗	✗	✗	✗/ ○	✓	✓	✓	✗	✗
NS5-Barnfield	✗	✗	✓	✗	✗/ ✓	✓	✓	✓	✗	✗
Bampton	Renewable Energy >									
Site V	*Biomass CHP*	*Large Scale Wind*	*Micro Wind*	*Hydro.*	*Heat Pumps (WS /GS)*	*Solar P.V.*	*Solar Thermal*	*Gas CHP*	*Anaerobic Digestion*	*EfW*
A- School Close	✗	✗	✓	✗	✗/ ✓	✓	✓	✓	✓	✗
B- Bourchier Close	✓	✗	✓	✗	✗/ ○	✓	✓	✓	✗	✗
C- Ashleigh Park	✗	✗	✓	✗	✗/ ✓	✓	✓	✓	✗	✗
D- Newton Square	✗	✗	✓	✗	✗/ ✓	✓	✓	✓	✗	✗
NS1-Birchdown Farm North	✓	✗	✓	✗	✗/ ○	✓	✓	✓	✗	✗
NS2-East of Scout Hut	✗	✗	✓	✗	✗/ ✓	✓	✓	✓	✗	✗
NS3-Luttrells Quarry	✗	✗	✓	✗	✗/ ✓	✓	✓	✓	✗	✗
NS4-Scout Hut	✗	✗	✓	✗	✗/ ✓	✓	✓	✓	✗	✗
NS5-South Molton Road	✓	✗	✓	✗	✗/ ✓	✓	✓	✓	✗	✗
NS6-Tanyard Field	✗	✗	✓	✗	✗/ ○	✓	✓	✓	✗	✗

Rural Settlements (site)	Renewable Energy >									
Site V	Biomass CHP	Large Scale Wind	Micro Wind	Hydro.	Heat Pumps (WS /GS)	Solar P.V.	Solar Thermal	Gas CHP	Anaerobic Digestion	EfW
Bow Site 1- South of Iter Cross	✗	✗	✗	✗	✗/ ✓	✓	✓	✓	✗	✗
Bow Site 3- West of Godfrey Gardens	✗	✗	✓	✗	✗/ ✓	✓	✓	✓	✗	✗
Bow Site 4- South West of Junction Road	✗	✗	✓	✗	✗/ ✓	✓	✓	✓	✗	✗
Copplestone New Site 1- East of Fenworthy Gdns	✗	✗	✗	✗	✗/ ✓	✓	✓	✓	✗	✗
Copplestone New Site 2- Land off Bassetts Close	✗	✗	✗	✗	✗/ ✓	✓	✓	✓	✗	✗
Culmstock Site 1- Hunters Hill	✗	✗	✓	✗	✗/ ○	✓	✓	✓	✗	✗
Culmstock Site 2- Linhay Close	✗	✗	✓	✗	✗/ ✓	✓	✓	✓	✗	✗
Hemyock New Site 1- Churchills Farm	✗	✗	✓	✗	✗/ ○	✓	✓	✓	✗	✗
Kentisbeare Site 1- South of Village Hall	✗	✗	✓	✗	✗/ ✓	✓	✓	✓	✗	✗
Morchard Bishop Site 1- Greenaway	✗	✗	✓	✗	✗/ ○	✓	✓	✓	✓	✗
Sandford Site 1- South of Village Hall	✗	✗	○	✗	✗/ ○	✓	✓	✓	✗	✗
Willand Site 1- Willand Moor	✗	✗	✗	✗	✗/ ✓	✓	✓	✓	✗	✗
Willand Site 3- Lloyd Maunders	✓	✗	✓	✗	✗/ ✓	✓	✓	✓	✗	✗
Willand New Site 3- Land adjacent to B3181	✗	✗	✓	✗	✗/ ○	✓	✓	✓	✗	✗
Willand New Site 5- Silver Street	✗	✗	✓	✗	✗/ ○	✓	✓	✓	✗	✗

3.3 Discussion

Tiverton

3.3.1 The Tiverton area is well covered by local biomass fuel suppliers and contains no AQMA's, so biomass CHP technology would be feasible on any site where space and access restrictions allow. The requirement for an air quality assessment of proposed biomass combustion plant should be considered. .

3.3.2 Likewise, a local supply of waste to support energy from waste technology is possible from any council depot in the district. The Eastern Urban Expansion (E.U.E.), Farleigh Meadows, Avenue, Palmerstone Park/ Howden Court (reserve) and Lower Farleigh (NS) sites are all considered to have space and access provision sufficient for biomass CHP use, although only a site such as the E.U.E would be of a sufficient size to consider EfW.

3.3.3 None of the proposed or "not selected" sites for Tiverton are adjacent to sewage treatment works', ruling out energy supply from AD for all sites. The E.U.E is the only site of sufficient size to support large scale wind energy; an area outside of the critical proximity to road, rail, powerlines, footpaths and residential areas in the central-southern part of the site which, dependant on the alignment of buildings within the E.U.E, could be viable. Wind speeds are also predicted to be sufficient in this area.

3.3.4 The other potential development sites in Tiverton, while having acceptable wind speeds and favourable location in some cases, are not large enough to support large scale wind, being too constrained by nearby residential areas.

3.3.5 The use of micro-scale wind energy is viable at the E.U.E., Farleigh Meadows, Palmerstone Park, Roundhill, Palmerstone Park/ Howden Court (reserve), Tidcombe Hall (reserve) and Exeter Hill (reserve) sites. The other potential sites either do not receive high enough wind speeds or are within an urban context likely to generate a turbulent wind regime, unsuitable for micro wind generation. The "not selected" sites NS3, 6 and 7 are all suitable for micro-scale wind energy generation.

3.3.6 All of the proposed and "not selected" sites were identified as having the potential for mains gas connection meaning that all sites could support gas CHP technology. Similarly, all sites are likely to receive sufficient solar energy to support solar PV and solar thermal technologies.

3.3.7 Ground source heat pumps rely on suitable underlying geology or soil. The geology of the Tiverton area consists of sandstone, breccia, various mudstones and conglomerate, overlain in places by alluvial material and gravels. Sandstones, breccias and conglomerates are all potentially suitable to support ground source heat pumps due to their permeable structure or presence of fracturing. Alluvium and gravel are also suitable due to their permeability. Mudstones generally are much less porous and are therefore less suitable.

3.3.8 All sites have suitable geology to support ground source heat pumps however the Palmerstone Park, Roundhill and Palmerstone Park/ Howden Court (reserve) sites are only suitable in areas where sandstone and not mudstone is present.

3.3.9 None of the candidate or alternative development sites for Tiverton contain water channels, ruling out hydro energy for all sites.

Cullompton

3.3.10 The candidate and alternative development sites for Cullompton are all of too small to support energy from waste and, except the northwest Cullompton site, large scale wind energy. The northwest Cullompton site is heavily constrained by residential and footpath proximity however a location on the far west boundary of the site may be suitable, depending on the alignment of buildings within the development. The west of the northwest Cullompton site is also the most likely area of the site to provide sufficient wind speeds.

3.3.11 Micro scale wind generation is considered suitable at the Padbrook and Kingsmill Road (higher growth option) sites and the alternative sites due their aspect to oncoming winds from the southwest. The northwest Cullompton and Knowle Lane sites could offer suitable aspects for wind in places, for both the lower and higher growth options while the Court Farm and Lower Bull Ring sites are within the urban fabric reducing wind viability. All sites are likely to have sufficient wind speeds for micro scale wind power.

3.3.12 Cullompton is also well served by biomass fuel suppliers although the developed area of the town as a whole is covered by an AQMA. This means the Court Farm, Padbrook, Lower Bull Ring and Kings Mill Road (higher growth option) sites are all likely to be unsuitable, although the Kings Mill Road site is not in proximity to the worst affected roads[4] so may be an option. The brownfield sites at Padbrook and Lower Bull Ring are also constrained by space for the units within the development, while the larger of the alternative sites are suitable.

3.3.13 The Knowle Lane and northwest Cullompton sites are both large enough to support biomass CHP technology and, except the eastern part of the Knowle Lane site, are unlikely to be constrained by air quality. It should be noted that the AQMA covers the current urban extent of the town, so when built, the developments at northwest Cullompton and Knowle Lane may lie within a revised AQMA.

3.3.14 Deliveries of biomass fuel to the northwest Cullompton and Knowle Lane sites are best supplied from the west of the town to avoid increasing HGV traffic in the AQMA , particularly the roads with poor air quality in the town centre. Deliveries from the north and south of the town will be unlikely to impact on the AQMA, provided the proposed western relief road is built, whereas any deliveries from the M5 or A373 routes would likely have to pass through the town.

3.3.15 All sites are likely to be suitable for the use of ground source heat pump technology. The northwest Cullompton and Knowle Lane sites are most likely, being underlain by Sandstone,

[4] Higher Street, Fore Street and Station Road (Mid Devon Local Development Framework Preferred Options Documents (Nov. 2008))

the other sites having unfavourable bedrock material (Marl) but favourable surface material in the form of Alluvium. The Knowle Lane site has potential for the use of water source heat pump technology due to the presence of a water body on the site.

3.3.16 All of the proposed sites were identified as having the potential for mains gas connection meaning that all sites could support gas CHP technology. Similarly, all sites are likely to receive sufficient solar energy to support solar PV and solar thermal technologies. The Knowle Lane site is the only site to contain a water body making the site potentially suitable for hydro power. Likewise, the Padbrook site is the only site potentially suitable for provision of energy from anaerobic sewage digestion due to its proximity to a sewage treatment works.

Crediton

3.3.17 Crediton contains one designated AQMA area which covers the built-up areas of the town. This potentially rules out the use of biomass CHP at all sites except the Wellparks and Pedlerspool sites which are outside of the AQMA. The extent of the AQMA, however may be extended to include these sites when built. The Red Cross Hill site may also be viable as, despite being within the AQMA, it is distanced from the roads with poor air quality[5].

3.3.18 Deliveries of biomass fuel to the Pedlerspool and Red Cross Hill sites will be best supplied by deliveries from the north; deliveries from the west and south of the town will likely have to use the AQMA effected roads in the town centre. Deliveries of biomass to the Wellparks site will be best supplied from the south and east of the region, approaching the town on the A377 without passing through the AQMA area.

3.3.19 The lack of proximity to sewage treatment works rules out the potential to utilise energy from anaerobic sewage digestion at all the proposed sites. There are also no water courses running through any of the sites proposed for Crediton, making the use of hydro power and water source heat pump technologies not possible.

3.3.20 There is potential however at all sites for the use of ground source heat pump technology; the Woods Group, Moores High Street, Cromwells (reserve) and Westwood Road (reserve) sites all being under-lain by Sandstone. The other sites are all likely to be suitable where there is Sandstone present or where underlying Breccia bedrock is fractured.

3.3.21 All of the proposed sites were identified as having the potential for mains gas connection meaning that all sites could support gas CHP technology. Similarly, all sites are likely to receive sufficient solar energy to support solar PV and solar thermal technologies.

3.3.22 All sites proposed for Crediton are constrained by space and access restrictions to host energy from waste technology, and too constrained by proximity to residential areas and by sufficient wind speeds to host large scale wind power. The opportunity to utilise micro generation wind power however is present at many of the sites. The Wellparks, Pedlerspool, Red Cross Hill, Higher Road (reserve) and Westwood Road (reserve) sites are all likely to

[5] High Street and Exeter Road (Mid Devon Local Development Framework Preferred Options Documents (Nov. 2008))

receive sufficient wind speeds and are all positioned at a suitable south-westerly aspect. The other sites are all located in areas considered too built up.

Bampton

3.3.23 All sites within Bampton are considered too restricted by space, access and residential proximity to support large scale wind or energy from waste technologies. The School Close site is the only site in Bampton that has the possibility to receive power from an adjacent sewage treatment works. The site however may be considered too small to warrant the installation of such technology, although consideration could be given to utilising the energy at both the proposed development site and the school which it surrounds.

3.3.24 All of the proposed sites were identified as having the potential for mains gas connection meaning that all sites could support gas CHP technology. Similarly, all sites are likely to receive sufficient solar energy to support solar PV and solar thermal technologies. There are no sites that contain a water course suitable for providing hydro power or supporting water source heat pump technology.

3.3.25 All sites have geology suitable for use in ground source heat pump technology, being underlain by limestone and sandstone. The Bourchier Close site however may only be suitable in places where sandstone is present instead of less suitable shale.

3.3.26 All sites are located favourably to receive south-westerly winds of sufficient speed to allow for small scale wind power. All sites are adequately served by biomass fuel suppliers, however only the Bourchier Close site has sufficient access and space allowance to support biomass CHP usage.

Rural Settlements

3.3.27 Of the rural settlement locations at Bow, Copplestone, Culmstock, Hemyock, Kentisbeare, Morchard Bishop, Sandford and Willand, none of the proposed developments are of a size that would allow large scale wind energy or energy from waste technologies. Only the Lloyd Maunders site at Willand is large enough for potential use of biomass CHP technology.

3.3.28 None of the sites contain a water body suitable for hydro-power or water source heat-pump technologies, although all sites have geological conditions offering the potential for ground source heat pump technology. Those sites underlain by sandstone offer the best potential whereas others may only succeed where fracturing of the breccia bedrock or a suitable surface material is present.

3.3.29 All of the proposed sites were identified as having the potential for mains gas connection meaning that all sites could support gas CHP technology. Similarly, all sites are likely to receive sufficient solar energy to support solar PV and solar thermal technologies. The Morchard Bishop site 1 is adjacent to a sewage treatment works raising the potential for energy supply following AD at the plant.

3.3.30 Micro-scale wind power is potentially suitable at all rural settlement sites with modelled wind speeds at 10m exceeding the required levels at all locations. The aspect of these sites with

regards to micro-scale wind energy is the only constraint, with only the Bow site 1, Willand site 1 and Copplestone sites being likely too constrained.

4 Carbon Impact Comparison of the Alternative and Candidate Housing Options

4.1 Introduction

4.1.1 Principles for the assessment of GHG emissions have been set out by the British Standards Institute in PAS 2050:2008[6] . Further guidance is provided by the Greenhouse Gas Protocol[7].

4.1.2 PAS 2050:2008 sets out a common methodology of assessing the carbon footprint of a service or a product. The Greenhouse Gas Protocol provides the methodology for accounting for the quantity of GHG emissions from an activity.

4.1.3 Both direct GHG emissions and indirect emission (as defined by ISO 14064) need to be considered when undertaking any form of carbon impact analysis. These are defined as:

- **Direct emissions** are associated with behaviour and have a direct connection with an individual, process or product.
- **Indirect emissions** occur off-site from the individual, process or product and are influenced by behaviour. Typically 2/3rds of a total carbon account will be associated with indirect emissions.

4.1.4 This project does not seek to generate a carbon footprint as defined by the PAS 2050, nor does it represent a carbon accounting process as defined in the Protocol. Instead the analysis presented here draws on both these documents to undertake an analysis of the likely CO_2 emissions generated from human behaviour during the operation of the development sites presented in MDDC's LDF. The carbon analysis will therefore use the term carbon impact.

4.1.5 To undertake the carbon impact assessment the analysis of CO_2 emissions conforms to the principles set out in the PAS 2050:

- **Relevance:** select GHG sources, carbon storage, data and methods appropriate to the assessment of the GHG emissions arising.
- **Completeness:** include all specified GHG emissions and storage that provide a material contribution to the assessment of GHG emissions arising from products.
- **Consistency:** enable meaningful comparisons in GHG
- **Accuracy:** reduce bias and uncertainties as far as is practical
- **Transparency:** where the results of life cycle GHG emissions assessment carried out in accordance with PAS are communicated to a third party, the organisation communicating these results shall disclose GHG emissions related information sufficient to allow such third parties to make associated decisions with confidence.

[6] British Standards Institute Specification for the assessment of the life cycle greenhouse gas emissions of goods and services PAS 2050:2008.
[7] Protocol Initiative Team: The GHG Protocol for Project Accounting GHG 2003

4.2 Methodology

Introduction

4.2.1 Quantifying carbon is important for identifying the climate impacts of a wide range of different products, services and organisations. Techniques such as carbon footprinting or carbon risk assessment have been developed as a performance indicator over the whole life cycle, taking account of both direct and indirect emissions. Defining the boundaries of an assessment is often difficult and depends on the availability of adequate data as well as how the data will be used. It is important to understand the scope or boundaries of a carbon impact analysis.

Boundaries

4.2.2 This study is based on the carbon impacts of the candidate and alternative housing options in the LDF. Therefore the carbon impacts analysis covers only those activities related to these sites.

4.2.3 Emissions occur during both the construction and operation of developments. In the absence of a detailed understanding of the construction techniques this study is restricted to the operation of the proposed developments.

4.2.4 Direct emissions from energy use at the household level can be divided into home (water and space heating), appliances and transport. There are additional, indirect, emissions during the production, distribution and transport of a range of goods, fuels and services used by households. However the LDF has, in general, no influence in these areas, and therefore these emissions are excluded from the analysis. The exception is low carbon power and heat production associated directly with new development.

4.2.5 Energy represents a considerable source of CO_2 emissions from the residential sector[5]. MDDC therefore have addressed this problem by including within their adopted core strategy (COR 5) the requirement for all new developments within their area to be "carbon neutral"[8]. The capacity for developments to move towards carbon neutrality will depend on energy efficiency and the capacity for decentralised renewable energy generation. It is recommended, therefore, that any strategies developed to move towards carbon neutrality consider both elements.

4.2.6 It is not possible to influence household use of appliances, and this may in any case be included within the Government's definition of zero carbon, and therefore this has also been excluded the analysis.

4.2.7 This analysis focuses on the CO_2 emissions from transport associated with the new developments.

[8] http://www.middevon.gov.uk/media/pdf/b/8/Core_Strategy_Adopted.pdf

Differentiating sites

4.2.8 It is possible to generate assumptions and provide a predicted energy demand for each individual property (see Section 4.5). The carbon dioxide emissions from this energy demand can be calculated with standard emission factors for grid electricity and house heating fuels. A renewable energy carbon reduction can then be factored into this total emission per property. As the capacity for on site generation is (with the exception the Tiverton Eastern Urban Extension) limited by space availability, the carbon reduction impact from large scale renewable energy is therefore reduced. The renewable energy solutions therefore are generally the same for all developments and the carbon reduction capacity from renewable energy for each site will therefore be generally be the same.

4.2.9 It is recommended that the eventual carbon emission reduction strategy or targets set for developments should take account of the potential of both energy efficiency and renewable energy.

4.2.10 By estimating the energy use per household, an annual emission per property, and per potential development can be calculated. The results of such a generic calculation would provide little useful information. The larger the development the larger the carbon impact. It is therefore of limited benefit to decision making.

4.2.11 Similarly using generic consumption estimates per household for consumer products, food, water and waste could be used to estimate carbon impacts of non energy consumables and waste. Like energy, the results would not provide useful information for decision making, because they would depend only on the size of the development.

4.2.12 The main location factor is travel behaviour. Each site's proximity to a variety of services and employment opportunities, and current Mid Devon residents' travel patterns have been used to assess the carbon impact of each site.

4.2.13 The following activities have been considered:

- Travel to work
- Travel to school
- Travel for shopping.

4.2.14 These journeys are considered to be the main ones affecting a new development's transport emissions that the majority of the Mid Devon population will undertake in any one week and that can be influenced by a low emission strategy.

4.2.15 Inevitably, there are other travel activities, for example, for recreation, including overseas holidays. Data on such activities in Mid Devon does not exist. Whilst generic assumptions could be made per dwelling the results of any analysis would again become dependant on development size only.

4.2.16 There are also indirect transport emissions associated with residential developments including waste collection, street cleaning and other Local Authority services. This

assessment focuses on direct emissions that can be influenced by low emission strategies, rather than indirect emissions as a result of third party activities.

4.3 Data Source and Calculations

4.3.1 The information obtained for each journey is based on data from the *2001 Census*, the *MDDC Local Development Framework – Retail Study* December 2004 and Geographical Information System data provided by MDDC. The Mid Devon Local Development Framework Preferred Options Documents provide the number of dwellings suggested for each preferred and reserved option. The candidate sites (i.e. not included in the preferred options), have also been assessed.

4.3.2 Defra's emission factors[9] for the modes of transport detailed in the census and retail study data were used to calculate the total CO_2 emissions from the journeys per annum. The final carbon impact therefore is expressed in tonnes/year.

4.3.3 Emissions for each of the modes of transport are based on typical vehicles. In reality, emissions depend on size of vehicle, engine technology, fuel, driving style, maintenance and occupancy levels[10]. These factors cannot be considered in a strategic level analysis. The following CO_2 emission factors were used:

Table 4.1 Carbon Dioxide Emissions Equivalent from DEFRA

Mode of Transport	CO_2 Emission Factor kg/km	Justification
Car	0.22	Typical family petrol car
Bus	0.00[1]	No additional emission per passenger[11]
Walk	0.00	No emissions
Taxi	0.19	Typical diesel saloon
Bicycle	0.00	No emissions
Good Delivered	0.27	Small van making single trip
Train	0.06	Per passenger on standard rail network

[1] All emission factors from Defra except for buses, where MDDC requested that 0.00 kg/km was used, based on the assumption that additional passengers on existing bus services do not increase emissions.

[9] http://www.defra.gov.uk/environment/business/envrp/pdf/conversion-factors.pdf
[10] Passenger Transport Emissions Factors, Methodology Paper, Defra 2007

Travel to Work

4.3.4 The distance travelled to work from the ward data "*Distance Travelled to Work (UV35*)" of the 2001 Census was used. This is broken down to eight different distances in kilometres (>2, 5, 10, 20, 30, 40, 50, <60).

4.3.5 For each development data from "*Travel to Work (KS15*)" census data at the ward level was used. This presents the percentage of people who travel to work by train, bus, motorcycle, car, car passenger, taxi, bicycle or foot. It also includes the percentage of the population who work at home.

4.3.6 The calculations are described in Appendix C.

Travel to School

4.3.7 The number of school children living in the proposed developments was estimated from the census data. The distance travelled to and from primary and secondary schools was calculated using GIS data of the schools location and the preferred direct road route from the centre of the proposed development to the front of the defined school.

4.3.8 Devon County Council's *Schools Transport Policy* (September 2008) defines that school buses will be provided to all primary school aged children who are over 3km away and provided to secondary school aged children who are over 5km away from school. It was assumed that children living closer than these distances would walk or cycle (to be consistent with the *Devon Transport Plan*). The calculations are described in Appendix C.

Travel to Retail

4.3.9 The *Mid Devon Retail Study* provides a breakdown of shopping destinations and the modes of transport used to go shopping for eight regions. Each region represents separate urban areas and includes Tiverton, Cullompton, Crediton, and Bampton. Data provided in Table 4 of the Retail Study was used to represent the percentage of the census population movements to a retail outlet separated into the main and top-up shopping trips. In addition, two Tesco stores have been developed at Tiverton and Cullompton, with work started on another in Crediton. Without relevant data the impact of these has not been accounted for, but they are likely to lead to changes in retail travel patterns.

4.3.10 The retail report was completed in 2004 and since then the Safeway store has become a Morrison Store and the Kwik Save store has become a Marks and Spenser Food Outlet. With no updated data the percentage of people travelling to these stores was assumed to be the same.

4.3.11 The retail study also gathered data on the modes of transport used to go shopping (Question 2 of Survey). The percentage using each mode was then used to represent different ways of getting to each individual shopping destination and back.

4.3.12 It was assumed that each household would undertake one main and one top-up shopping event a week, on average, over a year.

4.3.13 The calculations are described in Appendix C

Combined Data

4.3.14 The estimated CO_2 emissions from the three activities were combined to provide a total carbon impact for the development.

4.3.15 Obviously, the larger the proposed development the greater the CO_2 emissions will be. To understand the impact of the location of the development the emissions per dwelling was also calculated.

Limitations to Methodology

4.3.16 The analysis is at a strategic level and therefore actual data for each site is limited to the site boundary and the number of dwellings proposed, as discussed above. To provide a full carbon footprint detailed information on the design of the properties, energy generation, carbon offsetting strategies, car use etc. of the occupants and their behaviour would be needed. Such details are not available.

4.3.17 Vehicles emit a number of pollutants that have impacts on climate change. We have only considered CO_2 as the single largest GHG from fossil fuel combustion. When referring to carbon it is therefore in the context of CO_2.

4.3.18 It is recognised that the methodology and boundaries were set around human activity relating to urban design and occupation. CO_2 emissions also occur as part of the natural carbon cycle from ground and soil biological activity. The change of land use of agricultural land to residential development will affect the natural carbon (and other GHG) emissions. This has not been factored into the calculations.

4.3.19 It is assumed that the majority of modes of transport for a population travelling less than 2km will either be by foot or cycle, and the use of public transport (bus) is likely to be higher for these shorter journeys. Longer distances are likely to be made by car or rail and unlikely to be made by walking. In order to keep the modes of transport assumptions across the analysis equal, the variation of modes of transport for different distances has not been considered.

4.3.20 Reliance on the 2001 Census assumes that the data is representative of the future. It is likely that demographics and activity related to the ward populations will change. Therefore population figures for eligible children, dwellings and employment populations may be different.

4.3.21 It is assumed that all eligible children would go to the nearest primary or secondary school. Private or grammar schools were not considered within this analysis as figures for day pupils commuting were not available within the Devon Schools Transport Plan.

4.3.22 An assumption was made based in the Devon School Transport Plan that all children within 3km of a primary school and 5km of a secondary school would walk or cycle. It is acknowledge that it is common behaviour for children to be driven short distances to school

by parents. This behaviour has not been factored into the analysis due to the difficulty of creating individual behaviour assumptions. In addition, school runs can either be done as individual households, car run shares, or a part journey drop off. These factors therefore complicate the assumptions being made for the analysis.

4.3.23 Since the 2004 Mid Devon Retail Survey was completed a number of retail stores have changed merchant. In Tiverton the Safeway has recently been taken over by WM Morrison and the Kwik Save store is now a Marks and Spenser Food Outlet. The sizes of these stores have not dramatically changed. It is unknown whether the customer loyalty for the store location was retained by the new store owners, although it would seem likely that there would be some change in shopping patterns. The customer loyalty held during the snap shot of the retail survey in 2004 may also have been influenced by the new stores or refurbishments in each area. The calculations therefore have assumed that the shop loyalty and mode of transport to shop has not changed.

4.3.24 When assessing the housing allocations the influence of new employment or retail facilities was not considered. The MDDC does provide allowances for additional employment and retail close to the preferred housing options. This may reduce the carbon impacts of each development considerably. The assessment of each preferred option therefore considers a business as usual approach to the locations of such sectors.

4.3.25 The emission factors for transport are based on current vehicle technology, and are likely to over-estimate future CO_2 emissions, as anticipated mandatory EU requirements to limit CO_2 emissions from car are introduced.

4.4 Results of the Analysis

Data Analysis

4.4.1 A summary of the total carbon emission impacts for each proposed development is provided in Table 4.2 and represented graphically in Figure 4.1 and 4.2 (in Appendix A).

4.4.2 The average CO_2 emission is 148 tonnes/annum per development and 0.98 tonnes/annum per dwelling.

4.4.3 The results of the analysis show, as anticipated in the methodology section, that in general the larger the development the larger the likely carbon impacts will be. The Tiverton E.U.E (2000 dwellings) has the largest impact of all the developments, whereas Tiverton – the Avenue (5 dwellings) has the smallest impact.

4.4.4 As shown in Figure 4.2 (Appendix A) CO_2 emissions per dwelling in the Bampton and Cullompton developments are considerably higher than the Crediton and Tiverton developments. Bampton has the highest, and Tiverton the lowest impacts on average per dwelling. The rural settlements all represent close to average CO_2 emissions.

4.4.5 The highest impact per dwelling in Tiverton comes from the eastern extension. This high value is due to the considerable number of projected journeys by cars for shopping at out of centre shopping units. In addition, it is affected by the lack of a secondary school within 5km

of the site. It is recognised that future developments may also include the building of new primary and secondary schools which will reduce the carbon emission impacts from school trips.

4.4.6 A break down of the individual travel scenarios shows that the greatest carbon impacts come from commuting, with the exception of the rural settlements where the populations emit more CO_2 through travelling to retail outlets. Table 4.3 in Appendix A shows the average annual carbon impacts for each development.

4.4.7 The data from the commuting analysis shows that the developments in Cullompton and Bampton will lead to the employed population having to travel further to work. The majority of people within these developments would be attracted to Tiverton and Exeter for work. They would also tend to travel by car.

4.4.8 Both Tiverton and Crediton have lower carbon impacts from commuting associated with the shorter distances to commute to business centres. In addition, the population in Tiverton use public transport more than the other urban centres. This is further discussed in Section 5.

4.4.9 Retail options across the district are varied and have been considered based on the MDDC Retail Report. The results of the analysis are summarised in Table 4.4, Appendix A.

4.4.10 The travel to retail outlet analysis shows that typically the larger the development the larger the carbon impacts will be from people shopping. The developments in Bampton are likely to have the greatest impact per dwelling. Developments in Cullompton are also high compared to those in Tiverton and Crediton. Recently Tesco stores have been built in both Tiverton and Cullompton which will reduce the impacts of travel to retail. The rural settlements have the highest impacts in retail travel.

4.4.11 All areas showed a high dependency on cars for shopping. In the Rural Settlements, Bampton and Cullompton the communities travel further for both weekly and top-up shopping. The details of shopping behaviour in the eight regions of Mid Devon are explained in the Mid Devon Retail Report.

4.4.12 School journeys have a lower CO_2 impact than retail and commuting and are shown in Table 4.5.

Table 4.5 CO_2 Emissions of School Journeys from Candidate Developments

Town Region	Preferred Option	Total CO_2 Emission from School Travel tonnes/annum
Bampton	School Close	4.7
	Newton Square	0.4
	Ashleigh Park	0.4
	Bourchier Close	2.9
Tiverton	Eastern Urban Extension	84.7
Rural Settlements	Morchard Bishop	11.8
	Kentisbeare	6.8
	Bow	11.3

4.4.13 The carbon impacts of school trips is low when compared to commuting or retail. The majority of schools are within the Devon County Council's 3km or 5km boundaries for primary and secondary schools respectively. Only the proposed developments in Bampton and Rural Settlements were over the required secondary school distance for provision of transport, therefore creating carbon impacts. The Eastern Urban Extension also presents a high impact due to the short fall of a secondary school within its catchments. New school developments are likely to change these impacts.

4.4.14 All of the alternative sites for Bampton are outside a secondary school boundary of 5km.

Comparison with National Averages

4.4.15 Defra[12] provide national average CO_2 emissions for households and individuals as shown in Table 4.6 below.

Table 4.6 2007 National Average Personal CO_2 emissions used in the Act on CO_2 Calculator

National Average Direct Emissions	Household	Individual
Home	4,530	1,932
Appliance	1,619	691
Travel	3,811	1,626
Total	9,960	4,249

4.4.16 The above figures take into consideration wider assumptions of travel including aviation. The national averages in Table 3.5 are almost twice those calculated in this study (Table 3.1). The boundaries set in the Defra study were broad and general and therefore the results are not directly comparable.

4.4.17 Based on the above figures 6,920 dwellings would generate nearly 70,000 tonnes of CO_2 per year. Of this, based on current national average emissions, approximately 31,000 tonnes of CO_2 comes from homes use of electrical and heat energy. If the developments are zero carbon there will be no emissions from these sources.

4.4.18 The Carbon Trust[13] provides further data on typical UK CO_2 emissions from travel. These studies show that typically a household will generate 0.81 tonnes of CO_2 from commuting. This figure is similar to the Mid Devon commuter carbon impact shown in Table 4.3.

4.4.19 The preferred option developments in Tiverton and Cullompton are estimated to have lower carbon impacts from commuting than the national average.

[12] http://www.defra.gov.uk/environment/climatechange/uk/individual/pdf/actonco2-calc-methodology.pdf
[13] http://www.carbontrust.co.uk/publications/publicationdetail.htm?productid=CTC603

4.5 Discussion

4.5.1 The previous section has presented the likely impacts of each of the developments in relation to the assessed travel emissions. The carbon impacts of each development area is discussed below as a per dwelling scenario as well as the likely overall carbon impacts.

Tiverton

4.5.2 The options in Tiverton offer the lowest carbon impacts. The majority of the developments are relatively small, with less than 80 dwellings, which reduces the impacts due to the scale of the developments. However, the Tiverton E.U.E. and Farleigh Meadows are large developments and have above average impacts. The Farleigh Meadows per dwelling carbon emission is below average and in line with the rest of the Tiverton sites.

4.5.3 The E.U.E. is by far the largest development proposed in Mid Devon and therefore has the highest impact of all the options. The emission per dwelling is also higher than the average. This is due to the amount of car traffic associated with both the commuting and retail activity. It is likely that the development will have enhanced public transport, retail and commercial developments which are likely to reduce the overall impacts of the site considerably. The analysis shows without this infrastructure the E.U.E. will cause the greatest carbon impacts of all the preferred options.

Crediton

4.5.4 The carbon impact of the options in Crediton are generally below average due to the smaller size of the proposed developments. Both Wellparks and Pedlerspool of the candidate sites have the highest total carbon impacts for Crediton. The overall impacts though are reduced due to the town's location closer to Exeter reducing commuter distance impacts. Crediton is well serviced for shopping, with the majority of the current population using services in and around the town.

Cullompton

4.5.5 The impact analysis shows a high level of total carbon emission for the Cullompton options. Apart from the Padbrook site, all the developments were generally large in comparison to the rest of the preferred options. The impacts were greatest from the use of car travel for commuting and shopping to Exeter. A significant amount of people are likely to need to travel by car to shop due to a comparative short fall of local services.

Bampton

4.5.6 The two main preferred options in Bampton (School Close and Bouchier Close) have below average impacts whereas the per dwelling impacts are the highest in Mid Devon. The impacts are highest due to the likely reliance of the Bampton residents on cars and the distances needed to be travelled. All the sites have CO_2 emissions above the typical UK average for commuting.

Rural Settlements

4.5.7 The rural settlements have impacts that are average compared to the other towns. The greatest impacts come from movement to retail outlets from the settlements showing a reliance on car. The lower impacts from commuting are due to the proximity of the settlements to an urban centre and a higher working at home rate.

The Mid Devon Region

4.5.8 On a regional level the Tiverton and Crediton preferred options are likely to have the lowest impact. The provision of additional employment and retail opportunities will further reduce these impacts as the preferred options are developed. The rural settlements present average impacts in comparison.

4.5.9 Both Bampton and Cullompton have relatively high carbon impacts per dwelling. The North West Cullompton development has an option to develop 45,000m^2 of light office space. This will potentially help reduce the commuting impacts if the occupiers of the new dwellings decide to work locally. The analysis shows that the preferred options for both Bampton and Cullompton would require additional measures to reduce holistic carbon impacts from the development other than a good Code for Sustainable Homes (CfSH) requirement. Whilst both Bampton and Cullompton may have relatively good services it is clear that how the new population interacts with these services may need to be addressed.

4.5.10 It should be noted that the transport emissions identified in this study are not all additional emissions, new journeys from the preferred option locations will displace journeys that would have occurred elsewhere.

Carbon Management of the LDF

4.5.11 New developments are likely to attract additional populations from outside MDDC borders. The additional population will therefore add to Mid Devon's current "carbon footprint".

4.5.12 There are a range of options for MDDC to manage the increase in emissions associated with the LDF. These will have to be developed in partnership with key stakeholders to ensure that a low carbon infrastructure is developed. They include the promotion of locally sourced biofuels, low carbon transport provision, local renewable energy generation and reducing urban electricity usage. The preferred option developments are themselves subject to local policy requiring all new development to be carbon neutral. To be carbon neutral the LDF will have to allow for off site solutions to allow carbon reduction to occur.

4.5.13 Travel within Mid Devon contributes to a high percentage of CO_2 emissions. In addition, low carbon emission strategies will aid the LDF to progress with a reduced impact from transport related emissions. This is discussed further in Section 5.

4.5.14 A high percentage of the Mid Devon population work at home, reducing the need to commute. The current CfSH allows additional credits for home office facilities with the general aim of reducing a population's need to travel to work. Whilst this reduces transport emissions it increases energy uses in the home. In an office the control of the use of energy

is financially driven, whereas in the home it is influenced more by social behaviour. In addition, there is some evidence that working from homes influences behaviour by increasing travel during non-working hours, which in turn may influence a wider set of carbon emissions.

4.5.15 Whilst energy emissions of the new developments have not been calculated within this report it is obvious that this is an important factor in future carbon impacts of Mid Devon. In order for these developments to become zero carbon (by the eventual Government Definition) or meet COR 5 of the MDDC core strategy and therefore be carbon neutral a sensible offsetting or allowable solution[14] mechanisms will be required.

4.5.16 Such mechanisms can take the form of investing in energy saving schemes or developing renewable energy generating facilities within the hierarchy of on-site, in Mid Devon, the South West, nationally or internationally.

4.5.17 The Government are currently working on generating preferred offsetting mechanisms. This is a way of reducing the quantity of GHG emissions over a product's lifecycle by removing an equivalent quantity of GHG from the atmosphere. Schemes to offset include planting trees or donating money for the development of renewable energy (although receiving no financial benefit back).

4.5.18 Allowable solutions have been discussed previously in this report. The benefits of allowable solutions means MDDC will be able to retain control of displacing CO_2 emissions within their authority. Allowable solutions therefore could be factored into the LDF for developers of the preferred options to buy into whether directly or through Section 106 agreements or set out a Community Infrastructure Levy that helps the LDF meet its climate change targets.

4.5.19 Based on a typical UK household energy demand, approximately 31,000 tonnes CO_2 would be generated from the development of 6,920 dwellings (see section 3.2). The current CfSH standards requires a 44% reduction over 2006 Building Regulations in carbon emissions to achieve Level 4 status, which is seen as a standard achievable level for all developments. If a 44% reduction of typical levels can be reduced through energy efficiency and micro generation on site then only 17,360 tonnes needs to be reduced through other solutions.

4.5.20 As an example of how this could be achieved a typical 2MW wind turbine reduces CO_2 emissions by 2,260 tonnes per annum[15]. Therefore only 8 turbines would be needed to displace the CO_2 emissions from the preferred option development. It is considered that this is an entirely achievable figure. Costs from previously developed turbines (such as the Dagenham Plant Turbines) suggest that total construction costs are £735/kw therefore installing 16MW would cost in the region of £12 million.

4.5.21 Developing an energy infrastructure to match the carbon impacts of the LDF can also benefit the current and future residents of Mid Devon. Co-operatives and community renewable energy schemes have been proven to be significant methods of engaging a population into a low carbon economy. By either MDDC or the community owning the renewable energy

[14] As in the Government's Zero Homes consultation – give full ref.
[15] http://www.bwea.com/edu/calcs.html

generation, profits can be secured backed into the community. With greater participation in energy generation from a community, the acceptability of new forms of technology is likely to be greater.

5 Low Emission Strategy (LES)

5.1 Introduction

5.1.1 This section provides a brief description of a range of possible measures for reducing emissions across MDDC which could be included in a LES.

5.1.2 The LES would provide a series of measures to reduce carbon and other emissions within MDDC, and developers would be expected to make a contribution towards the LES fund based on predetermined criteria, set out in a SPD.

5.1.3 On the larger preferred option sites, in particular, the Tiverton E.U.E, it is anticipated that MDDC will require developers to incorporate a number of LES measures within their proposals, instead of contributing to the LES fund.. For the smaller sites, it is anticipated that MDDC will request Section 106 contributions (or Community Infrastructure Levies) to fund LES measures across MDDC. The financial contribution could be related to the number of proposed dwellings or the number of proposed parking spaces within the development using a similar approach to that included within MDDC's Air Quality SPD.

5.1.4 Where measures are particularly suitable for new housing development in one of the four preferred option areas, this has been mentioned within the relevant section below. However, as most measures are equally applicable to all new housing development in MDDC irrespective of its location, each of the 21 preferred option sites has not been considered in turn.

5.1.5 For all developments it is assumed that proposals will incorporate the principles of good design, for example, the provision of sufficient cycleways and footpaths to reduce motorised travel. In addition, MDDC's existing planning documents include policies resulting in reduced emissions, for example, policies C4 and C5 of the 2006 Local Plan aim to ensure a minimum of 60sq m of equipped public open space per dwelling. This, in turn, will reduce the need for recreational travel.

5.1.6 Further details relating to the implementation of an LES is provided in Section 5.6. It should be noted that MDDC need to seek legal advice regarding the permitted use of developer contributions, in particular, to ensure that any LES meets the requirements of ODPM Circular 05/05. This includes a requirement, amongst others, for a planning obligation to be directly related to the proposed development and for it to be reasonable.

5.1.7 Given the rural nature of Mid Devon it is likely that residents will continue to be more dependent on the car than in more built up areas, where the provision of frequent public transport services is more viable, and distances between facilities is often less. However, the use of a LES is an opportunity to influence travel behaviour and vehicle choice.

5.1.8 In addition, due to the demographics within MDDC, it is considered that residents will respond best to education and gentle persuasion rather than being forced to change their lifestyles. For example, providing information on attractive alternatives to personal car use is

considered to be a preferred approach rather than restricting car ownership through car-park free developments.

5.1.9 Due to the timescales of constructing new developments, it is important that the LES takes into account future technological improvements and potential social changes.

5.1.10 A summary of the indicative costs and impacts of the measures on air quality and climate change is provided in Table 5.1. It should be noted that this table is indicative only and a detailed cost-benefit analysis has not been undertaken. The air quality and climate change benefits are based on expert judgement not quantitative analysis.

5.1.11 Consideration has been given to Defra's **Practice Guidance notes** (February 2009) and **Local Air Quality Management Technical Guidance** (**LAQM.TG(09)**).

5.2 General

5.2.1 Below are general policies that could be included within the LDF to encourage low emission development within MDDC.

5.2.2 The LDF should require a LES to be submitted with the planning application for all major residential developments. Similarly, effective green travel plans could be required for housing developments exceeding a certain size, with appropriate targets and measures for monitoring their achievements.

5.2.3 Inter-authority partnerships can be a successful means of ensuring that transport measures are successfully integrated across local authority boundaries. In addition, economies of scale may mean that certain measures are only viable when applied to a number of authorities. Many of the issues affecting MDDC are likely to be similar in neighbouring authorities. Therefore it may be beneficial for MDDC to develop an LES in partnership with neighbouring authorities, or at least consider expanding the LES to other authorities in future years.

5.3 Transport

Behavioural change

5.3.1 It is important to allow people to make their own informed travel decisions, as coercion may not achieve the desired effects. For example, restricting parking provision within new developments may have complex knock-on effects as people find alternative places to park.

5.3.2 The provision of alternatives to the private car may fail in the absence of a clear behavioural change strategy. Such a strategy would include measures to market the benefits of public transport, cycling and walking and could also incorporate measures to encourage the purchase and use of lower impact cars.

5.3.3 Targeted, personalised information needs to be provided to new residents in the form of information packs for new homes and/or community websites. A good example of a community website is that hosted by local people in Chiswick (http://www.chiswickw4.com/). The Chiswick community website has over 10,000 members and is funded by advertising,

mainly of local, independent businesses[16]. There are a number of other examples of community websites in London, including Putney, Acton, Hammersmith and Ealing. A community website would also be beneficial to existing MDDC residents.

5.3.4 Use should be made of available travel surveys to ensure that information is targeted towards the most appropriate audience. Alternatively, if insufficient travel data is available, financial contributions from new developments could be used to fund travel surveys for selected areas which are expected to exhibit similar travel patterns to the preferred option sites. This additional travel data could be used to target information packs for new homes.

5.3.5 Another example of successful promotion includes Brighton buses where large photos of ordinary people have been used on the sides of buses along with simple slogans (http://history.buses.co.uk/history/fleethist/iotbus.htm).

5.3.6 The promotion of behavioural change should apply to all new homes in all four of the preferred option areas. Information packs and community websites can also be used for existing residents close to the preferred option areas.

5.3.7 The Department for Transport's report '**Smarter Choices – Changing the way we travel**' (2005) discusses the potential impacts of soft transport measures based on earlier studies, case studies and the experience of relevant stakeholders. This report identified a wide variety of travel awareness campaigns, from targeted intensive approaches through to more general campaigns. There is evidence that both approaches result in reduction in car usage.

5.3.8 The report noted the importance of national awareness campaigns and MDDC should aim to tie any travel behaviour initiatives into relevant national campaigns, such as Bike Week (http://www.bikeweek.org.uk/) and In Town, Without My Car! (http://www.dft.gov.uk/pgr/sustainable/awareness/itwmc/intownwithoutmycarchecklist).

Car-park free developments

5.3.9 For car-park free development to be successful there needs to be a viable transport alternative for residents otherwise they will find simply find other places to park and the aim of emission free developments will not be achieved. Due to MDDC's rural setting amenities are spread over reasonably large geographical areas which may not be connected by regular public transport links. Therefore, it is not considered feasible to expect residents to practice car-free living.

5.3.10 As such, it is not appropriate to actively encourage car-park free developments within MDDC. However, there may be opportunities for promoting car-park free developments in the future. If so, these should be carefully sited to provide residents with transport alternatives and they should be promoted appropriately to ensure that any concerns from existing residents of knock on effects are addressed. It may be beneficial to promote these as 'emission free' developments.

[16] http://www.chiswickw4.com accessed on 2nd February 2009

Walking and cycling

5.3.11 It is assumed that sufficient walking and cycling routes would be provided to link new developments to facilities in accordance with best practice urban design.

5.3.12 There would need to be appropriate lighting on routes to ensure they could be used throughout the year. Innovative designs should be encouraged to minimise the impact of lighting on the surrounding area, for example, downlighting or movement sensors to turn lights on when a section of cycleway or footpath is in use.

5.3.13 Consideration should be given to the cost of ongoing maintenance of walking and cycling routes being included in the financial contributions from all new developments, assuming that a more appropriate public funding source is not available.

5.3.14 Walking and cycling routes can be incorporated into all of the preferred option sites. Financial contributions could also be used to fund offsite schemes and maintenance of existing routes, where appropriate.

5.3.15 The promotion of walking is in accordance with Action Plan Measure 10 of the Crediton Action Plan which states that “the Council will actively support local events targeted towards reducing private car transport to Crediton Schools in conjunction with the national Walking to School campaign”.

Public Transport

Bus services

5.3.16 Devon County Council (DCC) works with bus companies across the County including Stagecoach and First. There is a relatively high frequency, approximately twice hourly, bus service serving both Cullompton and Tiverton from Exeter[17]. Bus services to Tiverton Parkway station are fairly poor, less than one an hour. Due to the location of Tiverton Parkway and the availability of parking, the majority of people choose to drive to the station. There is a suggestion to allow pedestrian access to the A361 and to create a new bus stop to enable greater bus patronage to the station.

5.3.17 In addition, DCC has aspirations to develop a two-way looped bus service through Tiverton, Cullompton and Exeter. It is hoped that this service would incorporate the new employment area to the east of Exeter.

5.3.18 There is currently an hourly service running from Bampton to Taunton. However, the bus service linking Bampton (and the surrounding area) south to Tiverton is currently only 2-hourly. DCC are considering enhancing this service, particularly during peak hours and potentially extending this further northwards towards Minehead, Dulverton etc. This could reduce car trips for commuting to Tiverton and also trips to East Devon College in Tiverton.

5.3.19 It is important that any improvements to bus services are publicised appropriately.

[17] http://www.travelinesw.com , accessed 2nd March 2009

Information should be included within packs for new homes and information should be made available to existing residents. DfT's Smarter Choices (2005) report suggests that with appropriate public transport information and marketing bus patronage can double.

5.3.20 Suggestions for measures to be included in LES:

- Financial contribution for enhancing bus service and associated marketing of bus services across MDDC
- Free use of buses for new residents for, say, 3 months. This would need to be made available to new residents as soon as they move into the development.

5.3.21 The above could be incorporated into all of the preferred option sites.

Park and Ride

5.3.22 For Park and Ride facilities to be successful there needs to be a common destination, for example, a large employment or commercial area. It is not considered that any of the towns within MDDC are of sufficient size to ensure that a Park and Ride facility is economically viable and to encourage sufficient bus patronage for there to be a net reduction in emissions.

5.3.23 Park and Ride facilities are not considered appropriate within MDDC at this time.

Train services

5.3.24 MDDC is served by two main lines; one running east from Exeter through Tiverton Parkway towards Bristol and London and the other running from Exeter through Crediton to Barnstaple.

5.3.25 Crediton station is located within walking and cycling distance of Crediton and is served by approximately hourly services to Barnstaple and Exeter. It is felt that the main enhancement to Crediton station would be to improve the appearance of the station. It is not considered that these enhancements would be sufficiently beneficial in terms of reducing emissions to be funded through the LES process.

5.3.26 Tiverton Parkway station is located approximately 8km east of Tiverton close to the M5. As mentioned above the current bus service to Tiverton Parkway Station is fairly limited. Other than improving the public transport links to Tiverton Parkway Station, there are no further measures that could be included within the LES.

Low emissions zone

5.3.27 Typically, low emission zones are specified areas within which certain high polluting vehicles are banned. Establishing the infrastructure for a 'standard' low emissions zone, and monitoring and enforcing it would be costly. In addition, such low emission zones can appear negative as they are designed to ban highly polluting vehicles rather than providing incentives for the uptake of cleaner vehicles.

5.3.28 No further consideration has been given to developing a restrictive low emission zone within MDDC.

5.3.29 However, the idea of a low emission zone could be used as an instrument for promoting the low emission strategy by providing an area within which low emission strategy policies can be focused. This approach may also assist in raising public awareness of the low emission strategy. Caution should be taken with this approach to ensure that any negative views from larger low emission zones are not attached to one within MDDC.

Car club

5.3.30 Car clubs provide an alternative to personal car ownership. The club owns and maintains a fleet of cars which have dedicated parking spaces. Members then pay an hourly rate for use of a car. For car clubs to be successful there needs to be sufficient cars available. Priority parking in prominent and convenient town centre locations helps to raise the profile and convenience of car clubs.

5.3.31 Although it would be possible for MDDC to set up their own car club, it is likely to be more cost effective to encourage developers to contribute to an existing car club scheme. The LES may require developers to pay for annual membership for all residents for a limited period, for example, for the first two years and provide a number of car club parking spaces within the residential development. The local authority and/or other organisations would need to provide car club parking spaces within suitable retail or employment areas. A financial contribution could be sought to fund car club spaces across MDDC.

5.3.32 Cars used within the car club may be low emission vehicles thereby further reducing transport emissions.

5.3.33 Again, it is key that any car club scheme is successfully publicised and that car club spaces are in convenient, visible places.

Liftsharing

5.3.34 A car sharing scheme already exists within Devon (www.carsharedevon.com). This provides a database of people and journeys registered across Devon and allows members to search at no cost for others doing the same, or similar, journey thereby allowing people to share lifts.

5.3.35 This car sharing scheme should be promoted in information packs provided to new residents to encourage the use of this service.

5.3.36 This is in accordance with Action Plan Measure 26 from MDDC's Crediton Air Quality Action Plan which states that there should be "*increased promotion targeted in Crediton of the Car Share Devon scheme".*

Low emission vehicles

5.3.37 Soft measures could be funded by new developments to encourage the uptake of low emission vehicles within MDDC; both new and retro-fitted vehicles. For example, free or cheap parking for low emission vehicles registered within MDDC.

5.3.38 Any UK government incentives or grants to encourage the uptake of low emission vehicles across the UK need to be appropriately publicised across MDDC to raise awareness.

5.3.39 When low emission vehicle used alternative fuels, to ensure success, MDDC needs to provide sufficient low emission fuelling points. Intra-authority partnerships would be beneficial to ensure that a usable network of low emission fuelling points is established across DCC.

5.3.40 To further encourage the uptake of low emission vehicles, MDDC could investigate the legality of using financial contributions from developers to fund improvements to the local authority's own fleet. This could help improve the visibility of low emission vehicles within MDDC and may encourage neighbouring authorities to invest in low emission vehicles.

5.3.41 Quality bus partnerships (QBPs) between councils, bus operators and other relevant parties can enhance existing bus services for customers. QBPs could be used across MDDC and DCC with the aim of introducing cleaner, more efficient vehicles as well as encouraging greater bus patronage through improved frequency and service convenience.

5.3.42 It may be possible to encourage the use of low emission buses for schools through developer contributions. Newer, cleaner, school buses would also be safer.

Electric cars

5.3.43 The range of current electric cars is up to around 100 miles, dependent on factors such as car type, driving style and loading. For electric cars to be a viable alternative for residents within MDDC there needs to be a good spread of secure charging points.

5.3.44 Developers could be required to provide electric charging points on the larger preferred option sites, particularly the Tiverton E.U.E. It may be possible for contributions to be sought from the developers of the smaller sites to fund installation of charging points at convenient locations in town centres or at employment areas. MDDC and DCC would also need to provide funding to ensure a sufficient network of charging points.

5.3.45 The inclusion of soft measures for low emission vehicles, as discussed above, would further encourage residents to use electric cars.

5.3.46 Electric cars are likely to be most suitable for areas around Crediton, Cullompton and Tiverton rather than Bampton which may be too remote for the current range of electric cars. MDDC's terrain may reduce the range of electric vehicles. However, as electric vehicle batteries improve the spatial range of these vehicles will increase thereby making more remote areas increasingly accessible.

5.3.47 As for all of these transport measures, appropriate marketing is essential. It is important for people to accept that electric cars are a viable option, rather than vehicles for the avid environmentalist.

Dial-and-Ride

5.3.48 A dial-and–ride service falls between a bus and taxi service. There is an existing dial-and-ride service covering Somerset (SLINKY bus). A dial-and-ride service may be suitable for more remote areas of MDDC where regular bus services are likely to be underused, for example, the small villages around Bampton.

5.3.49 LES financial contributions could be used to setup and manage a dial-and-ride scheme. Again, it is important that such a service is correctly marketed to ensure patronage.

5.4 Housing

5.4.1 The majority of measures within the LES will be related to transport emissions. However, there will also be carbon and other emissions from the operation of the homes.

5.4.2 Below are suggested measures that could be included within the LES to reduce these emissions.

5.4.3 Provide funding for retrofitting existing properties with energy saving and renewable energy technologies. It may be possible to include this as a means of offsetting carbon emissions from a new development. It could even contribute towards meeting a new development's zero carbon requirement. This option is included within the Government's consultation on the definition of zero carbon homes.

5.4.4 This approach may be particularly appropriate in MDDC where there is a supply of older, less carbon efficient properties. There are potentially easy carbon gains available by funding improving insulation, upgrading heating systems or fitting solar panels to these older properties. However, caution is required to ensure that the developer implements available carbon reduction measures within the proposed development before funding these potential offsite carbon gains.

5.4.5 Renewable energy should be encouraged where viable, although energy saving should be the first priority. This is discussed in more detail for the preferred option sites in Section 4 of this report.

5.4.6 Smoke free zones could be set up across MDDC to reduce the impact from wood burning in homes. There are currently no smoke free zones in MDDC. The feasibility of a smoke free zone across Crediton has previously been investigated as part of the Air Quality Action Plan. However, it was concluded that this would not be economically viable as it would be too costly to enforce and the air quality gains would be limited. It is considered more reasonable for residents within Crediton, Cullompton and Tiverton to be encouraged to use cleaner fuels for heating rather than enforcing this through a smoke free zone. It should be noted that this approach may not be feasible within more remote areas of MDDC, such as Bampton, where residents are more reliant on solid fuel for heating.

5.4.7 MDDC should support debate and discussion of climate change within the local area, for example, through the Transition Town initiative. Transition Towns are initiated by individuals keen to reduce their town's oil usage and its impact on climate change. More information is

available on the Transition Town website (http://transitiontowns.org/). Crediton is already officially a Transition Town. It is unclear how this could be effectively incorporated into an LES as the success of Transition Towns is dependent on recruiting enthusiastic individuals. However, it may be possible to use the Transition Town group as a forum to develop ideas for MDDC.

5.4.8 The majority of services operating within a new housing development are likely to be MDDC services, such as, refuse collection. The provision of segregated collection points within a new development may reduce the number of refuse collections required. Efforts should be made to minimise waste and emissions associated with its collection, treatment and/or disposal.

5.4.9 There will also be a small number of vehicle movements associated with parcel deliveries. It may be possible to specify a central drop-off point for all parcels on a new development to prevent the need for repeated vehicle trips if the recipient is not home.

5.5 Construction

5.5.1 Although the impacts of demolition and construction activities are only short-term there are a number of measures that could be included within an LES to reduce the air quality and carbon emissions. A number of possible measures are discussed below.

5.5.2 Developers should be encouraged to sign up to the Considerate Constructors Scheme (http://www.considerateconstructorsscheme.org.uk/). This scheme requires developers to consider ways to reduce the site's carbon footprint and any air pollution.

5.5.3 For developments within an AQMA, developers could be encouraged to take account of the London Council's guidance relating to best practice in demolition and construction. Selected measures could be included within MDDC's LES to ensure that developers adhere to them.

5.5.4 For example, the LES could require the use of low sulphur diesel and particulate abatement technology for construction plant, where practicable. MDDC could also specify a minimum EURO emission standard for construction vehicles and plant. These measures are likely to be particularly relevant for developments within an AQMA.

5.5.5 The LES could encourage best construction practice, by specifying that a method statement be submitted to the LPA for approval as a planning condition, set targets for material re-use on site, and ban the burning of material on-site.

5.5.6 The above measures could be included for all developments within MDDC irrespective of size or location.

5.6 Implementation of LES and funding

5.6.1 On the larger preferred option sites, such as Tiverton's E.U.E., it may be reasonable to expect developers to include some of the LES measures within their development, for example, car club spaces or electric car charging points.

5.6.2 The majority of MDDC's preferred option sites are fairly small, suitable for less than a couple of hundred dwellings. For these sites it is anticipated that MDDC will request Section 106 contributions (or Community Infrastructure Levies) to help fund LES measures across MDDC.

5.6.3 The Beacons Low Emission Strategies Group Best Practice Guidance suggests that a "practicable approach for mitigating the cumulative impacts of transport emissions from development is to require standardised contributions from all developments over a certain threshold".

5.6.4 This guidance suggests that the financial contribution could be calculated dependent on the emission damage costs[18]. This approach could be onerous on the developer to robustly calculate the emission damage costs and it may therefore be preferable to develop a simple equation relating to the number of proposed dwellings and/or parking spaces. This latter approach would compliment that in Policy AQ3 of MDDC's Air Quality and Development SPD. Policy AQ3 states that "*new development…that would lead to an increase in traffic that will have a worsening effect on air quality will be required to provide for mitigation through contribution to implement the Air Quality Action Plan as follows: Market House £2,800-£5,509 per dwelling…*".

5.6.5 The contribution needs to be flexible to ensure that it does not become a means for the developer to pay to pollute. The approach needs to be sufficiently flexible to encourage developers to introduce innovative measures within their development and benefit from reduced financial contributions, It also needs to be flexible to ensure that over time the contributions do not get diluted by inflation.

5.6.6 The advantage of seeking financial contributions means that MDDC can decide how best to spend the funds. The purpose of the fund must be sufficiently broad to allow MDDC flexibility over the use of the contributions, whilst remaining sufficiently specific that the fund is used for LES measures.

5.7 Costs and benefits

5.7.1 Table 5.1 provides an indication of the potential financial costs, climate change gains and air quality gains for each of the possible low emission strategy measures. It should be noted that these are estimates only to give an approximate comparison of the potential costs and benefits of each of the measures. A detailed economic analysis of set-up and running costs has not been undertaken.

5.7.2 Where the table has a '0', these means zero or negligible costs or emissions benefit.

[18] Damage costs from carbon dioxide (Transport Analysis Guidance, Unit 3.3.5), from air quality (Air quality: Damage costs for air pollution (AEA Technology, March 2006))

Measure		Benefits		Cost ***	Comment
		Air Quality*	Climate Change **		
General	Require a LES to be submitted with planning application	0	0	£	No direct air quality/climate change gains
	Encourage inter-authority partnerships	0	0	£	No direct air quality/climate change gains
Transport	Encourage behavioural change through targeted information packs or community website	+	+	££	
	Car-park free developments	+	+	£	Not considered suitable for MDDC
	Encourage walking and cycling	+	+	£	
	Enhance local bus services	+	+	£-££	
	Free bus use for new residents	+	+	£	
	Park and Ride	+	+	££-£££	Not considered suitable for MDDC
	Enhancements to train service	+	+	??	More details needed to estimate cost
	Low emissions zone	++	++	££-£££	Assumed to be a package of measures
	Car club	+	+	£-££	
	Liftsharing	+	+	0	Assuming the use of an existing resource
	Low emission vehicles	+	+	££-£££	
	Electric cars	+	+	££	
	Dial-and-Ride	+	+	£-££	
Housing	Renewable energy	+	++	£££	
	Smoke free zones	+	0	£££	
	Transition Towns	0	0	0	
	Retrofitting existing properties	0	+	££-£££	
	Central parcel drop off point	0	0	££	Assumes requires staffed facility
Construction	Considerate Constructors Scheme	0	0	£	Temporary impact over small area, assumed no measurable impact
	Encourage best practice and take account of the GLA guidance	0	0	££	
	Encourage use of low emission vehicles and plant	0	0	££	

* Air quality: 0 Negligible change in air quality anticipated (<1%),
+ Small improvement in air quality anticipated. Moving in the right direction but not likely to be a measurable improvement (1-2%),
++ Larger, possibly measurable, improvement in air quality anticipated (>2%)

** Climate change: 0 Negligible change in carbon emissions anticipated (<1%),
+ Small reduction in carbon emissions anticipated in air quality anticipated (1-2%),
++ Larger reduction in carbon emissions anticipated (2-5%)

*** Cost (per development): 0 Zero or negligible cost,
£ Small cost, say £100s to £1,000s,
££ Medium cost, say £10,000s,
£££ Large cost, say >£100,000s

Tale 5.1: Cost and benefits of potential low emission strategy measures

6 Summary

6.1 Renewable Energy Capacity

6.1.1 The study conducted on physical constraints to renewable energy has addressed the fundamental requirements for provision of the most common renewable energy technologies at the proposed residential and mixed use development sites contained in the Mid Devon Local Development Framework.

6.1.2 The analysis method, based on a “pass/ fail” system, has yielded results for each site where a renewable technology is considered generally viable or generally not viable for that site. The scale of the information on which these considerations are based is not sufficient to make definitive recommendations, particularly in the case of wind speed data and sub-surface geology. Data provided by GIS analysis of the base mapping however, can reliably inform on the general viability of some technologies with respect to space or proximity considerations.

6.1.3 The general viability assessment for each site should inform the focus of any future in-depth studies at a site specific scale.

6.1.4 It can be concluded that the large construction and operational footprints of large scale wind power and energy from waste plants mean these technologies are only likely to be viable on the largest sites where access for construction and proximity to residential areas and other constraints permit.

6.1.5 Likewise, only the sites outside or on the outskirts of urbanised areas are likely to have space for fuel delivery access and be sufficient distance from an AQMA for biomass CHP use. Urban fringe developments are more suitable for micro scale wind power due to open wind resource availability.

6.1.6 Just one site contains a water channel and will require certain channel conditions and flow conditions to consider hosting hydro power or water source heat pump technologies. This assessment has indicated that there is potential to utilise the water course at this site, however detailed investigation will be needed before unambiguous viability can be decided.

6.1.7 Sites located in urbanised areas and on brownfield land are likely only to suit hosting solar PV, solar thermal and gas CHP technologies due to their restrictions on space for installation of renewable energy plant. These technologies are equally suitable at non urbanised sites where space is not an issue.

6.1.8 Ground source heat pumps are also suitable in both urban and non urban areas as they are contained within vertical boreholes requiring little space, reliant on a more detailed site survey of geological conditions. Non urban sites where space constraints are less prominent may also be suitable for horizontal ground source heat pump usage, dependant on surface material. Emerging aquifer source heat pump technology may also be suitable in these sites.

6.1.9 There are three sites where energy from anaerobic sewage digestion is considered viable and these sites should be considered in the context of their size and possible co-provision of energy with adjacent buildings such as schools and community buildings.

6.2 Carbon Impacts

6.2.1 There are a number of measures available to both MDDC and the developers of the preferred options to reduce the carbon impacts of the LDF housing preferred options. This includes introduction of fiscal local policy, encouraging carbon mitigation measures through the LDF, effective offsetting, leading implementation of technology through planning and the use of off site solutions.

6.2.2 The LDF will increase CO_2 emissions if not managed. Typically these will be in line with UK averages. The analysis in this report suggests that emissions associated with commuting are likely to be a leading contributor to carbon impacts. In addition the large developments such as the Tiverton E.U.E. will produce the largest risks of an increase in GHG emissions.

6.2.3 The developments in Bampton and Cullompton are likely to have higher carbon impacts than those in Crediton and Tiverton due to a short fall of local services and employment requiring a higher dependency on motor vehicles and further travel distances.

6.2.4 The knowledge of these impacts can inform the LDF process and allow MDDC to provide direction to the future development scenarios to become leading low carbon products. It is though necessary to approach this without alienating the current population within Mid Devon. Their inclusion in this process, whether it is through consultation, education or ownership of the infrastructure will play an important role in a low carbon LDF.

6.3 Low Emissions Strategy

6.3.1 Table 6.1 below summarises the possible measures that could be included within a LES and suitability of these measures to the four preferred option areas (overall likely suitability (✓), unlikely suitability (✗) or potential suitability pending more in-depth assessment (○)).

Measure		Preferred Option Area				Comment
		Cullompton	Crediton	Tiverton	Bampton	
General	Require a LES to be submitted with planning application	✓	✓	✓	✓	For developments above a certain size
	Encourage inter-authority partnerships	✓	✓	✓	✓	
Transport	Encourage behavioural change through targeted information packs or community website	✓	✓	✓	✓	
	Car-park free developments	×	×	×	×	Car club required to make it viable
	Encourage walking and cycling	✓	✓	✓	✓	
	Enhance local bus services	✓	✓	✓	✓	Appropriate marketing and publicity essential
	Free bus use for new residents	✓	✓	✓	✓	
	Park and Ride	×	×	×	×	Not considered appropriate
	Enhancements to train service	×	×	×	×	Enhancements to public transport links to Tiverton Parkway Station, and improvements to Crediton Station
	Low emissions zone	×	×	×	×	
	Car club	✓	✓	✓	✓	Appropriate marketing and publicity essential
	Liftsharing	✓	✓	✓	✓	Publicising existing service
	Low emission vehicles	✓	✓	✓	✓	
	Electric cars	✓	✓	✓	×	
	Dial-and-Ride	×	×	×	○	
Housing	Renewable energy	See section 4				
	Minimum Code for Sustainable Homes rating	✓	✓	✓	✓	
	Encourage use of gas central heating	✓	✓	✓	×	
	Smoke free zones	✓	✓	✓	×	Feasibility study for smoke free zone in Crediton being carried out as part of AQAP
	Transition Towns	○	✓ – already registered	○	○	Require enthusiastic individual
	Retrofitting existing properties	✓	✓	✓	✓	
	Central parcel drop off point	✓	✓	✓	✓	
Construction	Considerate Constructors Scheme	✓	✓	✓	✓	
	Encourage best practice and take account of the GLA guidance	✓	✓	✓	✓	
	Encourage use of low emission vehicles and plant	✓	✓	✓	✓	

Table 6.1: Possible measures to be included within LES and suitability of these measures to the four preferred option areas

7 Conclusions and Recommendations

7.1.1 This report has assessed the potential carbon emission impacts of the candidate and alternative sites for the Local Development Framework, the likely capacity for renewable energy to reduce energy related carbon emissions and outlines a low emission strategy for Mid Devon.

7.1.2 The assessment of potential renewable energy capacity at each of the alternative and candidate housing locations has shown there are a limited number of renewable technologies viable across Mid Devon.

7.1.3 It can be concluded that the construction and operational footprints of large scale wind power and energy from waste plants mean these technologies are only likely to be viable on the largest sites.

7.1.4 Likewise, only the sites outside or on the outskirts of urbanised areas are likely to allow space for fuel delivery access and distance from AQMAs required for biomass CHP use. Urban fringe developments are more suitable for micro scale wind power due to open wind resource availability.

7.1.5 Sites located in urbanised areas and on brownfield land are likely only to suit hosting solar PV, solar thermal and gas CHP technologies due to restrictions on space for the installation of renewable energy plant. These technologies are equally suitable at non urbanised sites where space is not an issue.

7.1.6 Ground source heat pumps are also suitable in both urban and non urban areas as they can be contained within vertical boreholes requiring little space, subject to a more detailed site survey of geological conditions. Non urban sites where space constraints are less prominent may also be suitable for horizontal ground source heat pump usage, dependant on surface material. Emerging aquifer source heat pump technology may also be suitable in these sites.

7.1.7 There are three sites that are viable to utilise energy from anaerobic sewage digestion and these sites should be considered in the context of their size and possible co-provision of energy with adjacent buildings such as schools and community buildings.

7.1.8 The LDF will increase CO_2 emissions in Mid Devon if not managed. Typically these will be in line with UK averages. The analysis suggests that emissions associated with commuting are likely to be a leading contributor to carbon impacts. In addition, the large developments such as the Tiverton E.U.E. have the largest GHG emissions risks .

7.1.9 There are a number of measures available to both MDDC and the developers of the preferred options to reduce the carbon impacts of the LDF housing preferred options. This includes introduction of fiscal local policy, allowing carbon mitigation measures to be available through the LDF, effective offsetting, leading implementation of technology through planning and the use of off site solutions.

7.1.10 The developments in Bampton and Cullompton are likely to have higher carbon impacts that those in Crediton and Tiverton due to a short fall of local services and employment requiring a higher dependency on motor vehicles and longer travel distances.

7.1.11 The knowledge of these impacts can inform the LDF process and allow MDDC to provide direction to the future development scenarios to become leading low carbon products. It is though necessary to approach this without alienating the current population within Mid Devon. Their inclusion in this process, whether it is through consultation, education or ownership of the infrastructure, will play an important role in a low carbon LDF.

7.1.12 In order to reduce carbon emissions, as well as other emissions, it is recommended that a low emission strategy is included within the LDF.

7.1.13 The capacity for developments to move towards carbon neutrality will be dependent on both energy efficiency and the capacity for decentralised renewable energy generation. It is recommended, therefore, that any strategies developed to move towards carbon neutrality consider both elements in the setting of any targets.