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Renewable Energy Study for Winchester District Development Framework

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INTRODUCTION

The government has stated its goal of achieving an 80% reduction in CO_2 emissions (from 1990 levels) by 2050, so that the UK can play its role in helping to stabilise climate change at an acceptable level. Local authorities are facing a growing number of climate change related duties, and have the responsibility of stimulating energy efficiency and renewable energy within their areas. PPS 1 requires renewable energy and low carbon requirements within local planning policies to be based on a detailed understanding of the local available resource. This renewable energy assessment for the Winchester District Development Framework:

- Assesses the *technical* potential for renewable energy generation within Winchester District;
- Uses this technical potential to suggest renewable energy *targets* within Winchester District for 2016 and 2026 in line with the LDF target dates;
- Specifies suitable low carbon solutions and requirements for different development types, and relates this to the planned new development within the district; and,
- Provides direction on the policy options that would be required to turn the district's potential renewable energy resource into reality.

RENEWABLE ENERGY RESOURCE – TECHNICAL POTENTIAL

As illustrated in table 3, the technical potential for renewable energy in the district could provide 136% of its electricity demand and 126% of its heat demand, and therefore the district could become zero carbon. Two specific technologies dominate this renewable energy technical potential – large wind turbines and biomass. 45% of the renewable electricity potential is from large wind turbines and biomass CHP energy could supply approximately 95% of both heat and power needs in the district, with over three quarters of this biomass resource coming from energy crops. The technical potential of the other renewable energy technologies amount to a much smaller percentage of approximately 10% of the district's energy consumption and carbon emissions. Hydropower has a very small technical potential due to the fairly limited opportunities for hydropower in the district and the diminutive power generation potential of small scale hydropower installations.

This technical potential is the total theoretical resource that is available if all sensible opportunities for renewable energy development are exploited. Although this technical assessment applies a wide range of constraints on the development of renewable energy, it does not consider the market conditions or costs of developing the resource. However, it gives an overview of the resource that is available, and the basis upon which to set targets for renewable energy within the district.

RENEWABLE ENERGY RESOURCE – TARGET POTENTIAL

Renewable energy targets for the district have been developed for 2016 and 2026. These suggested targets are based on an assessment of what could practically be achieved over the next 10 to 15 years considering current government policy, market conditions, consumer behaviour and the potential speed of change in terms of development of the renewable energy industry within the UK as a whole and with the district and region. Nonetheless, the actual targets that are chosen will constitute a political decision for the council and its partners.

The suggested targets for the different renewable energy technologies amount to 17% of the district's current carbon emissions. In the same way as the technical potential, large wind turbines and biomass dominate this target. Over 50% of the target is from biomass and approximately one third is from wind, and it corresponds with 10% of agricultural land being utilised for energy crops and 20 large wind turbines. If energy crops are entirely removed from the renewable energy target then it would be possible to deliver the target but only if the other biomass resources were almost fully exploited.

This suggested renewable energy target would also generate more than sufficient energy needs for all the new development planned by 2026, and therefore it is theoretically possible to provide zero carbon energy for all the new development in the district.

TECHNICAL APPROACHES TO LOW CARBON DEVELOPMENT

The precise nature of the technical solution for a specific new development will vary depending on the scale, density and mix of the development, as well as the available renewable energy resource at the site locality. However, combined heat & power systems, with a district heating network, are generally required in order to deliver very low to zero carbon developments. Although, the economic viability and effectiveness of CHP is generally dependent on a high density of development with large numbers of units, it can be installed in lower density developments at a higher cost. Individual building-integrated low carbon technologies, such as photovoltaics, solar water heating, ground source heat pumps and improved energy efficiency standards, can contribute effectively to achieving the carbon standards for Code for Sustainable Homes (CSH) Levels 2, 3 and even 4, but face significant technical and cost challenges in achieving the very low carbon requirements of CSH Levels 5 and 6. In general, therefore, it is more practical delivering low to zero carbon standards in the higher density, larger developments and more technically and financially challenging to do so in smaller, lower density development.

APPROPRIATE ENERGY SUPPLY SOLUTIONS FOR NEW DEVELOPMENT IN WINCHESTER DISTRICT

Section 4 categorises different development types and considers the mix of different technologies that are likely to provide the optimum energy system for delivering low and zero carbon developments. These alternative energy systems can be applied to the various proposed new developments within Winchester District, and it may be appropriate for the Winchester District Development Framework to encourage the relevant developers to incorporate these technical approaches within their energy strategies. The optimum technical solution for the higher density development will be communal energy systems with CHP, whereas the higher cost of communal systems in lower density development might favour an alternative solution, based on high energy efficiency standards and large scale wind. However, it is important to note that if communal energy systems are not utilised, then large wind turbines would have a crucial role in achieving the carbon reductions required under CSH Levels 5 & 6.

If the phased build-out rate of new housing within Winchester follows the projection figures outlined in the Winchester District Annual Monitoring Report 2007, then approximately 7,500 housing units will be constructed before 2016 and approximately 5,000 units will be built after 2016. Therefore, approximately half of the development would be captured by the 2016 zero carbon requirement. Winchester City Council needs to assess the likelihood of these build-out rates being achieved, and also the specific developments that are likely to come forward earliest.

POTENTIAL PLANNING POLICY MEASURES FOR THE LDF

Setting low carbon requirements for new development

When considering carbon requirements within the Winchester District Development Framework, the key question is whether the proposed Building Regulation improvements are considered adequate or whether Winchester would like to set stricter standards for its new developments. Essentially this is a political decision for Winchester City Council and depends on the aspirations within the council and the district for sustainable low carbon development.

The renewable energy resource assessment for Winchester District illustrates that site specific targets in advance of national standards could be set for the large sites as it would be technically possible to achieve zero carbon status through biomass CHP and a contractual linkage with large wind turbines within the north of the district. In this way, ‘offsite’ wind turbines within the district would play an important role in enabling zero carbon developments at an acceptable cost.

Although it is technically feasible for all the larger developments to achieve zero carbon status by using communal renewable energy systems on or near the site, the ability of a specific site to achieve zero carbon status at an acceptable financial cost would need to be determined through a site specific assessment. In addition, the Government’s planned Building Regulation improvements are already considered very challenging by developers, who are likely to argue against even tighter targets.

The Government’s estimated costs of achieving the carbon standards in the different CSH levels (see section 5), highlight that costs can vary significantly across development types. The cost of achieving Level 6 can vary from £40,000 to £6,865, depending on the type of development and whether large scale wind can be utilised.

If it is not felt to be appropriate to require zero carbon developments immediately, then in order to ensure that all developments are carbon neutral from now onwards the Council could establish a ‘carbon offset fund’ in a similar way to Milton Keynes Council which requires developers to pay to offset all the residual emissions from their developments. The Council would need to establish a 'carbon offset fund' into which these payments are deposited, and then distributed to energy saving or renewable energy schemes within the district. The issues to consider include the decision concerning the cost per tonne of the offsets and the challenge of ensuring the carbon savings are additional to what would have happened anyway.

Facilitating the development of shared infrastructure and renewable energy

In terms of achieving low to zero carbon standards, the Council should outline that developers should focus on communal energy infrastructure rather than just opting for the smaller, less complex building integrated renewables. This will ensure that developers don't opt for cheaper strategies in the earlier phases which jeopardise the ability of the development to achieve significant carbon savings in the longer term. The council could also establish a ring fenced 'carbon investment fund' to provide upfront capital for communal infrastructure that would be reimbursed through payments from private sector developers as their developments are rolled out.

The available wind resource for the district has been shown to reside primarily in the north of the district, whilst much of the new development will be located in the PUSH area in the south. Nonetheless, this does not mean that the district's wind resource is incompatible with the energy demands of the new development, and the new developments could still establish a contractual relationship with wind turbine installations located away from the site. Winchester City Council and PUSH could pay a role in stimulating and sanctioning such relationships between housing developers and commercial wind developers.

KEY POLICY RECOMMENDATIONS FOR WINCHESTER DISTRICT DEVELOPMENT FRAMEWORK

1. **Require CHP and district heating in all new mixed use developments above a certain density and scale**
2. **Ensure that the master plans for the key growth sites contain comprehensive zero carbon methodologies addressing buildings and low carbon infrastructure**
3. **Encourage housing developers to work with wind turbine developers and landowners so as to establish contractual relationship with offsite wind turbines that are located within the district or county**
4. **Allow offsite generation that is linked to the development either through a physical connection or contractual arrangement to help enable zero carbon development**
5. **Undertaking heat mapping for the whole district to show where CHP and heat networks may be feasible in both planned and existing development**
6. **Encourage ESCO activity in the district, including the development of a Council led energy supply project**
7. **Consider the establishment of a ring fenced Carbon Investment Fund to provide the upfront capital needed for financing large scale low carbon infrastructure such as CHP and district heating networks that can supply phased developments.**

COUNCIL LEADING BY EXAMPLE TO STIMULATE RENEWABLE ENERGY & LOW CARBON DEVELOPMENT

Planning policy alone will not be able to deliver renewable energy targets for the district, and a range of policy measures addressing the commercial renewable energy market and council initiated energy projects will also be required. The Council has a great opportunity to directly progress renewable energy installations and decentralized energy generation by taking forward projects on its own buildings and land. As outlined in section 6.2, the council could establish a local ESCO to help implement these low carbon energy projects. The council has a particular opportunity in terms of using its public buildings as an anchor heat load around which to establish CHP and a district heating network.

ESCOs help to overcome project risks and financing barriers and address the market and policy failures that affect local sustainable energy projects. The Council and its partners should consider establishing an ESCO for the district which works to install sustainable energy systems within both the new development and existing buildings. The council has opportunities in terms of using its public buildings as an anchor heat load around which to establish CHP and a district heating network, establishing renewable energy installations on its buildings, such as PV and solar water heating, and even a power supply agreement with a wind turbine located within the district.

POTENTIAL ECONOMIC BENEFITS OF SUSTAINABLE ENERGY IN THE DISTRICT

The renewable energy and energy efficiency sectors are experiencing rapid growth. The economic benefits of this growth will be reaped best by those areas which proactively encourage the development of renewable and energy efficiency. The suggested renewable energy target for Winchester could create 150 new jobs in the district based on a Government assessment of the job creation benefits of the renewable energy industry.

1 Introduction

1.1 Study overview

Winchester City Council commissioned ESD in July 2008 to assist development of evidence based renewable energy targets and policies within the Winchester District Local Development Framework (LDF). This report presents the methodology and conclusions of this work.

More specifically, the project has:

- Assessed the *technical* potential for renewable energy generation within Winchester District;
- Used this technical potential to suggest renewable energy *targets* within Winchester District for 2016 and 2026 in line with the LDF target dates;
- Specified suitable low carbon solutions and requirements for different development types, and related these to the planned new development within the district; and,
- Provided direction on the policy options that would be required to turn the district's potential renewable energy resource into reality.

1.2 The Winchester context

Winchester District lies within central-southern Hampshire and covers an area of 64,750 hectares with a resident population of some 112 500 people. The District is mainly rural interspersed with some 50 small towns and villages with the city of Winchester as the main centre for commercial activity. The southern part of the Winchester District lies within the South Hampshire sub region which is a key housing growth area in the South East. Winchester is also characterised by the East Hampshire Area of Outstanding Natural Beauty, and there are other areas of high landscape value and also important ecological areas. There is currently a proposal for the South Downs to be upgraded to National Park status which would enlarge the area covered, and cover a significant proportion of Winchester District. The main river running through the area is the Itchen. Currently there are 44,420 dwellings within Winchester District and a non-residential buildings ground floor area of over 2,537,680m^2. By 2026 the South East Plan expects the district to increase its housing stock by 12,740 dwellings; an increase of 29%. With this, additional employment and public buildings will be required.

The South Hampshire sub region or PUSH area (Partnership for Urban South Hampshire) is seeking to coordinate development in the area, and has developed both a Sustainability Framework and an energy strategy[1]. These strategy documents seek to set a common approach and common standards across the PUSH area and to ensure synergies between the large developments that are planned for the area. This study will relate the renewable energy potential of the district to the energy demand and carbon footprint of the district. The Winchester Action on Climate Change group has set a target of reducing carbon emissions by 30% by 2015. Although achieving this target would mainly rely upon energy efficiency improvements, the renewable energy potential of the district will also have a role to play.

1.3 Winchester District's current energy demand and CO_2 emissions

Excluding existing major power generation, the main source of carbon emissions in the Winchester District will be from burning gas to heat buildings, both commercial and domestic. It is considered appropriate to attribute carbon emissions from electricity generation to end users, rather than to explicitly attribute carbon emissions from power generation in the area, to the area, since electricity is distributed on a national basis, and so an average 'grid carbon intensity' can be applied to electricity demand in the area.

BERR publish figures for energy consumption on a local authority level. Metered gas and electricity data is provided as numbers of gigawatt-hours used, with the latest available dataset being from 2006. In 2006, the total

[1] Feasibility of an Energy and Climate Change Strategy for Urban South Hampshire, Arup, September 2008

energy demand from both domestic and non-domestic buildings within Winchester[2] and the associated CO_2 emissions were:

- 642,000MWh of electricity
- 1,296,000MWh of heating[3]
- 613,307 tonnes of CO_2[4]

The table below presents an overview of the district's domestic, as well as commercial & industrial current energy consumption, subdivided into the four fuel types of gas, electricity, oil and coal.

Table 1: Current energy consumption within Winchester District (based on 2006 data)

Winchester district existing energy consumption pattern (adopted from BERR figures)			
Fuel	Domestic	Commercial & Industrial	Total
Gas (2006)	691GWh	268 GWh	959 GWh
Electricity (2006)	241 GWh	401 GWh	642 GWh
Oil (2005; converted from ktoe)	169 GWh	143 GWh	312 GWh
Coal (2005; converted from ktoe)	19 GWh	6 GWh	25 GWh
Total	**1120 GWh**	**818 GWh**	**1938 GWh**

If the South East Plan's requirement for 12,740 new homes and associated mixed use non-residential development were to be built to today's standards (i.e. Building Regulations 2006) the energy requirement and resulting CO_2 emissions are calculated[5] to be:

- 91,000MWh of electricity
- 191,000MWh of heating
- 76,010 tonnes CO_2 per year[6]

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[2] BERR 2006 energy sales figures for Winchester

[3] Assumption: all gas, oil and coal consumed in the district used for heating (no further breakdown of usage per fuel type available)

[4] Based on DEFRA's April 2008 carbon emission factors (gross calorific values where applicable) of 0.537 tonnes CO_2 per kWh for electricity (grid rolling average); 0.185 for gas; 0.268 fuel oil; 0.298 for domestic coal and 0.330 for industrial coal.

[5] This is based upon a collection of benchmark's from CIBSE, Carbon Trust, London Renewable's Toolkit and The Energy Saving Trust.

[6] Long-term marginal carbon factor of 0.43 $kgCO_2$ /kWh for electricity is used by Government for evaluating future energy consumption

Table 2: CO_2 emissions from existing and new development in Winchester District

CO_2 emissions from existing and new development in Winchester District			
	Existing stock	New development by 2026	**Total**
No. of dwellings	44,420	12,740	57,160
Area of non-residential (floor area m2)	2,537,680	563,108[7]	3,100,788
BAU CO2 emissions (if all new development built to Building Regulations 2006 standards (tCO_2 pa)	613,307 tCO_2 pa	76,010 tCO_2 pa[8]	689,317 tCO_2 pa

New development in Winchester District could potentially increase emissions by 12.4% if built to today's standards.

This sets the context against which the renewable energy potential of the district can be set, and enables us to calculate the percentage of the district's energy demand that can be met from renewable energy, and the carbon reduction percentage that can be delivered through renewable energy generation with the district.

[7] Assumption: new non-residential buildings will be built, as well: 5% of the number of new dwellings; average floor area: 884m^2 (which is average floor area of existing non-residential stock in Winchester)

[8] Using CIBSE Guide F good practice carbon benchmarks (kWh/m^2) for retail, offices and light industry (average of these three)

2 Renewable Energy Policies and Targets

2.1 Climate Change Bill

The UK is introducing a long term legally binding framework to reduce greenhouse gas emissions. The Climate Change Bill, which is expecting Royal Assent late 2008, will put into statute the UK's targets to reduce carbon dioxide emissions through domestic and international action by at least 80 per cent by 2050 and at least 26 per cent by 2020, against a 1990 baseline in line with recent Intergovernmental Panel on Climate Change recommendations.

2.2 Energy White Paper 2003

Achieving the commitments set within the 2003 'Energy White Paper' will require at least 40% of electricity to be generated from renewable sources by 2050. In the shorter term the Government is committed to the achievement of 10% renewable electricity by 2010 and is aiming for 20% by 2020.

2.3 Renewable Energy Strategy (in consultation)

Currently in consultation, the Renewable Energy Strategy is likely to call for 15% of the UK's electricity, heat and transport fuel to come from renewable sources by 2020. This is likely to comprise of a 35% target for electricity and a 14% target for heat.

2.4 Planning Policy Statement on Renewable Energy PPS22

Planning Policy Statement 22 (PPS22) sets out the Government's policies for renewable energy, which planning authorities should have regard to when preparing Local Development Documents and when taking planning decisions.

Local policies should reflect paragraph 8 of PPS22 which says:

> *8. Local planning authorities may include policies in local development documents that require a percentage of the energy to be used in new residential, commercial or industrial developments to come from on-site renewable energy developments. Such policies:*
>
> *(i) should ensure that requirement to generate on-site renewable energy is only applied to developments where the installation of renewable energy generation equipment is viable given the type of development proposed, its location, and design;*
>
> *(ii) should not be framed in such a way as to place an undue burden on developers, for example, by specifying that all energy to be used in a development should come from on-site renewable generation.*
>
> *Further guidance on the framing of such policies, together with good practice examples of the development of on-site renewable energy generation, are included in the companion guide to PPS22.*

2.5 Planning Policy Statement on Planning and Climate Change Supplement to PPS1

PPS1 expects new development to be planned to make good use of opportunities for decentralised and renewable or low-carbon energy. The supplement to Planning Policy Statement 1 'Planning and Climate Change' highlights situations where it could be appropriate for planning authorities to anticipate levels of building sustainability in advance of those set nationally. This could include where:

- there are clear opportunities for significant use of decentralised and renewable or low carbon-energy; or
- without the requirement, for example on water efficiency, the envisaged development would be unacceptable for its proposed location.

Most importantly PPS 1 requires local planning authorities to develop planning policies for new developments that are based on:

"an evidence-based understanding of the local feasibility and potential for renewable and low-carbon technologies, including microgeneration".

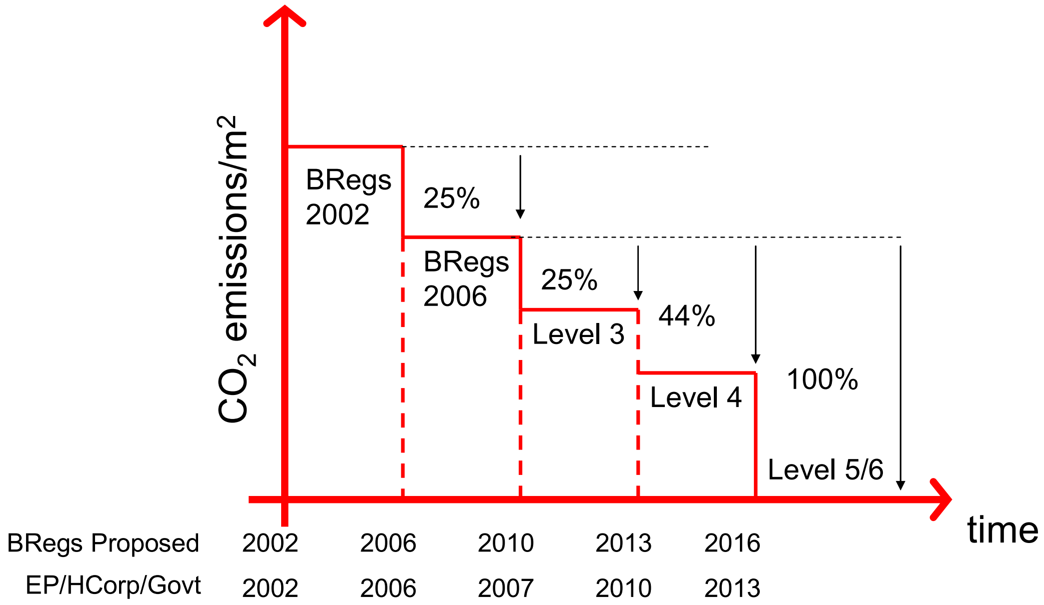
The PPS1 supplement also states that:

“alongside any criteria-based policy developed in line with PPS22, consider identifying suitable areas for renewable and low-carbon energy sources, and supporting infrastructure, where this would help secure the development of such sources, but in doing so take care to avoid stifling innovation including by rejecting proposals solely because they are outside areas identified for energy generation”.*

2.6 Building Regulations

The Government has set out its intentions for improving the carbon performance of new developments into the future with its announcement of the tightening of Building Regulations for new homes along the following lines:

- 2010 – a 25% carbon reduction beyond current requirements;
- 2013 – a 44% carbon reduction beyond current requirements; and,
- 2016 – 100% carbon reduction beyond current requirements.



In the March 2008 budget Government also announced its intentions for all non-domestic buildings to be zero carbon by 2019. Therefore, the various phases of development in the district will face stricter and stricter mandatory requirements, and all development after 2016 is likely to need to be zero carbon. However, the aspiration for zero carbon development by 2016 is challenging and will require innovative approaches from both the public sector as well as the development industry.

2.7 South East Plan

The draft South East Plan was submitted to the Government in March 2006, and the Government published its modifications in July 2008 and has undertaken a 12 week consultation. The South East Plan contains a number of policies promoting sustainable and low carbon development. It specifically encourages local planning authorities to include policies that promote renewable energy and combined heat and power and district heating within their LDF, as is outlined in Policies NRM 11, NRM 12 and CC4.

POLICY NRM11 (formerly EN2)

‘In advance of local targets being set in Development Plan Documents, new developments of more than 10 dwellings or 1000m2 of non-residential floorspace should secure at least 10% of their energy from decentralised and renewable or low-carbon sources’

POLICY NRM 12 (formerly EN2)

'Local Development Documents and other policies should encourage the integration of combined heat and power (CHP), including mini and micro–CHP, in all developments and district heating infrastructure in large scale developments in mixed use.'

Policy CC4 of the South East Plan mirrors the policy recommendations of PPS 1 in stating that local planning authorities can set site specific carbon reduction requirements that are stricter than national requirements if the evidence base demonstrates that this is possible.

Policy CC4

'There will be situations where it could be appropriate for local planning authorities to anticipate levels of building sustainability in advance of those set out nationally…. When proposing any local requirements, local planning authorities must be able to demonstrate clearly the local circumstances that warrant and allow this and set them out in Development Plan Documents'

The draft of the South East Plan submitted to Government in March 2006 had a sub regional target of 100MW by 2020 for renewable energy in the PUSH area but this has been removed in the Government's subsequent modifications.

2.8 Sub regional policy

The PUSH energy strategy provides a strategic overview of potential sources of carbon emissions into the future by developing a number of high level scenarios of alternative economic, social and environmental conditions. The energy strategy document looks at a series of potential carbon reduction wedges for the South Hampshire sub region which highlight possible approaches to reducing carbon emissions in line with future reduction targets.

The PUSH Sustainability Framework was produced in March 2008 and states that new development in the area should follow standards slightly ahead of the national standards with development achieving CSH Level 4 from 2012 rather than from 2013 as proposed for future Building Regulation changes. The Sustainability Framework also states that a sub regional 'carbon offset contribution' could be established for smaller developments which struggle to achieve high levels of carbon reductions.

3 Renewable Energy Resource Assessment for Winchester District

3.1 Assessing the technical potential and target potential for renewable energy

3.1.1 Overview of technical potential

The technical potential for renewable energy within the district is the total resource that is technically available. The study has calculated the technical resource available which outlines the total renewable energy resource that could be exploited within the district if all opportunities were taken advantage of.

Definition of Technical Potential

For the purpose of this project, Technical Potential means the amount of renewable energy possible according to the constraints imposed by the:

- physical resource, that is, the wind, solar, hydro, biomass and waste resource actually available currently within Winchester;
- limits of the technology and their current efficiencies at converting the renewable resource into energy;
- limits of the existing environment in Winchester, that is, roof space and number of buildings for building integrated technologies (solar PV, solar thermal hot water and ground source heat pumps) and, for wind energy, distance from existing buildings and infrastructure, distance from radars and air fields, distance from telecommunications links, avoidance of important ecological and archaeological features, avoidance of steep topography etc.*

The technical potential does not consider the likely uptake of the technologies and how the market, economics, technology and in the case of biomass, the resource, may change over time: potential scenarios for these are considered for deriving suggested targets.

*Note that for wind energy the technical potential does not include the constraints imposed by what might be considered acceptable on landscape and visual grounds. This important criterion has been considered for the proposed targets.

The renewable energy and low carbon technologies assessed were:

- wind energy – large scale and smaller scale turbines;
- energy from biomass and waste - both combined heat and power (CHP) and heat only;
- hydro energy – from the River Itchen;
- solar photovoltaic electricity (PV) – roof top potential only although PV on facades and PV fields may become more viable in future if prices drop;
- solar thermal hot water (STHW) – roof top potential;
- ground source heat pumps (GSHP) – that can provide low carbon heating to housing off the gas network.

There are only a limited number of potentially accessible geothermal energy resources sites across the UK, such as that found beneath Southampton, and there is not one known within the Winchester District.

The methodology for calculating the technical potential for each of the above is provided in each of the respective sections.

The table below summarises the technical potential of all RETs (Renewable Energy Technologies) considered in the scope of this study.

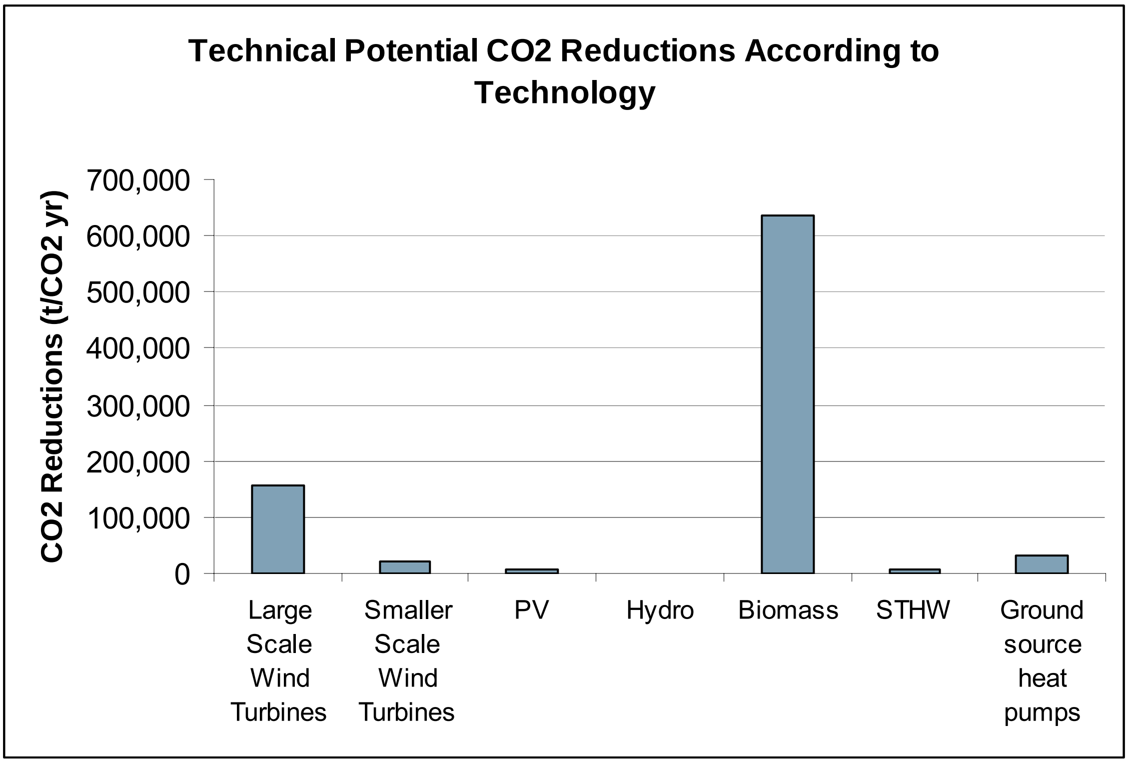
Table 3: Summary of Technical Potential for Winchester District

Technology	Technical Potential							
	Technical Capacity		Potential Energy Generation		Potential CO2 reductions	% of total Winchester building related energy demand and CO2 emissions		
	Electricity (MWe)	Heat (MWth)	Electricity (MWh)	Heat (MWh)	tCO2/yr	Electricity (%)	Heat (%)	CO2 emissions (%)
Large Scale Wind Turbines	165.6		290,131		155,800	45.2%		22.6%
Smaller Scale Wind Turbines	22.6		39,595		21,263	6.2%		3.1%
PV	19.7		14,315		7,687	2.2%		1.1%
Hydro	0.078		618		332	0.1%		0.05%
Biomass			625,294	1,250,589	635,924	97.4%	96.5%	92.3%
Solar Thermal Hot Water				31,929	6,865		2.5%	1.0%
Ground source heat pumps		172.3		344,535	31,746		26.6%	4.6%
Totals	158.8	172.3	871,516	1,627,052	859,618	136%	126%	125%

As illustrated in table 3, the technical potential for renewable energy in the district could provide 136% of its electricity demand and 126% of its heat demand, and therefore the district could become zero carbon. Two specific technologies dominate this renewable energy technical potential – large wind turbines and biomass. 45% of the renewable electricity potential is from large wind turbines, and biomass CHP energy could supply over 95% of both heat and power needs in the district, with over three quarters of this biomass resource coming from energy crops. The technical potential of the other renewable energy technologies amount to a much smaller percentage of approximately 10% of the district's energy consumption and carbon emissions. Hydropower has a very small technical potential due to the fairly limited opportunities for hydropower in the district and the diminutive power generation potential of small scale hydropower installations. More detailed analysis of each renewable energy technology is outlined below.

The resulting CO_2 reductions according to technology are illustrated in figure 1 below.

Figure 1: Technical Potential CO_2 Reductions According to Technology



3.1.2 *Overview of target potential*

The potential technical renewable energy resource provides a thorough baseline from which to consider the practical resource within Winchester District, and from which to set informed targets for renewable energy development within the district.

Definition of Target Potential

For the purpose of this project, Target Potential means the amount of renewable energy possible once market conditions and landscape and visual considerations have been considered in addition to the technical potential. Market conditions could be defined by policy and political will, economics, technological advancement and consumer behaviour; hence it is difficult to predict how these may change over time. Likewise, landscape and visual considerations can be highly subjective and political opinions can change over time.

Turning the available resource (e.g. wind speed or solar irradiation in the district) into practical targets involves a 3-step process. The first step is -based on the available resource in the district for each renewable energy technology- to determine the technical potential. The second step involves applying constraints, such as market conditions or landscape and visual considerations to the technical potential in order to identify the target potential of each renewable energy technology. The final step makes use of the target potential of each technology considered in this study to turn these into practical targets for the district.

The table below summarises the target potential by 2026 of all RETs (Renewable Energy Technologies) and the resulting CO_2 reductions.

Table 4: Summary of target potential by 2026

	Target Potential 2026							
Technology	Target Capacity		Potential Energy Generation		Potential CO2 reductions	% of total building related energy demand and CO2 emissions		
	Electricity (MWe)	Heat (MWth)	Electricity (MWh)	Heat (MWh)	tCO2/yr	Electricity (%)	Heat (%)	CO2 emissions (%)
Large Scale Wind Turbines	46.0		80,592		34,655	10.9%		5.0%
Smaller Scale Wind Turbines	3.8		6,570		2,825	0.9%		0.4%
PV	2.95		2,144		922	0.3%		0.1%
Hydro	0.077		605		260	0.1%		0.04%
Biomass			40,086	234,472	73,510	5.4%	15.9%	10.7%
Solar Thermal Hot Water				4,789	1,030		0.3%	0.1%
Ground source heat pumps		17.2		69,585	3,175		4.7%	0.5%
Totals	42.8	17.2	110,115	308,846	116,376	15%	21%	17%

The suggested targets for the different renewable energy technologies amount to 17% of the district's current carbon emissions. In the same way as the technical potential, large wind turbines and biomass dominate this target. Over 50% of the target is from biomass and approximately one third is from wind, and it corresponds with 10% of agricultural land being utilised for energy crops and 20 large wind turbines. If energy crops are entirely removed from the renewable energy target then it would be possible to deliver the target but only if the other biomass resources were almost fully exploited. More detailed analysis of the target for each renewable energy technology is outlined below.

Figure 2: Target Potential CO_2 Reductions According to Technology

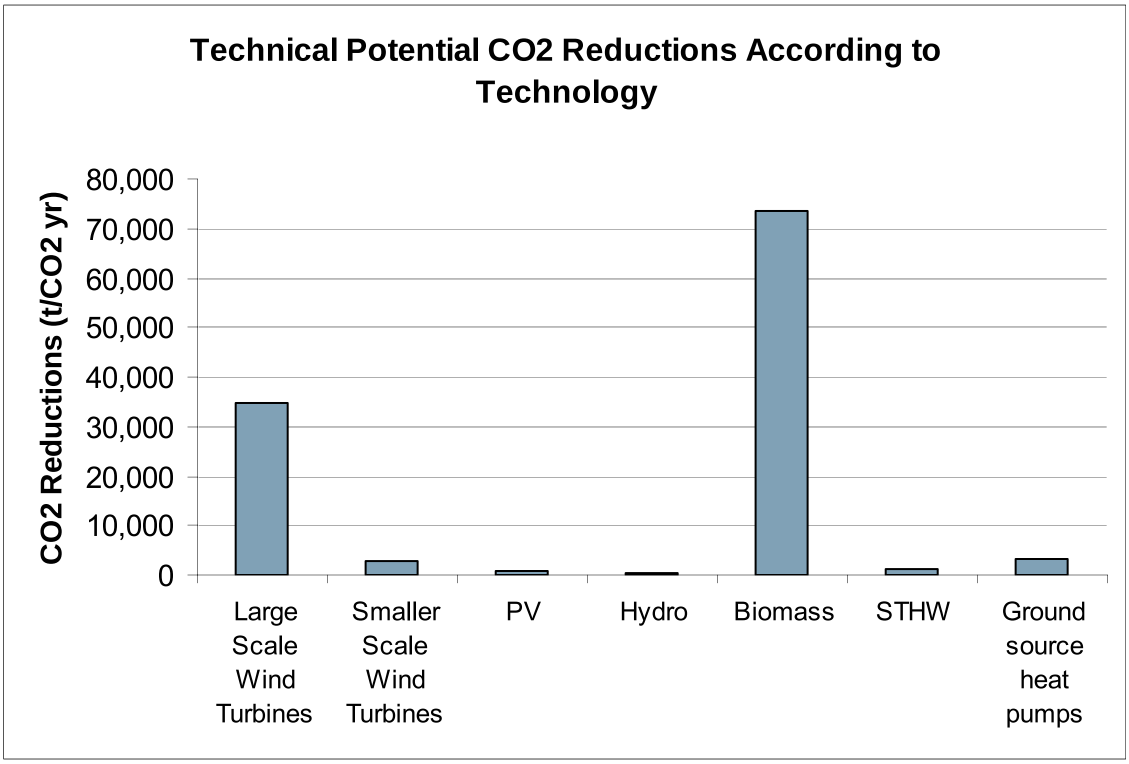


Figure 3: Plotting an 80% carbon reduction target for Winchester for 2050, and the potential contribution of the technical renewable energy resource[9]

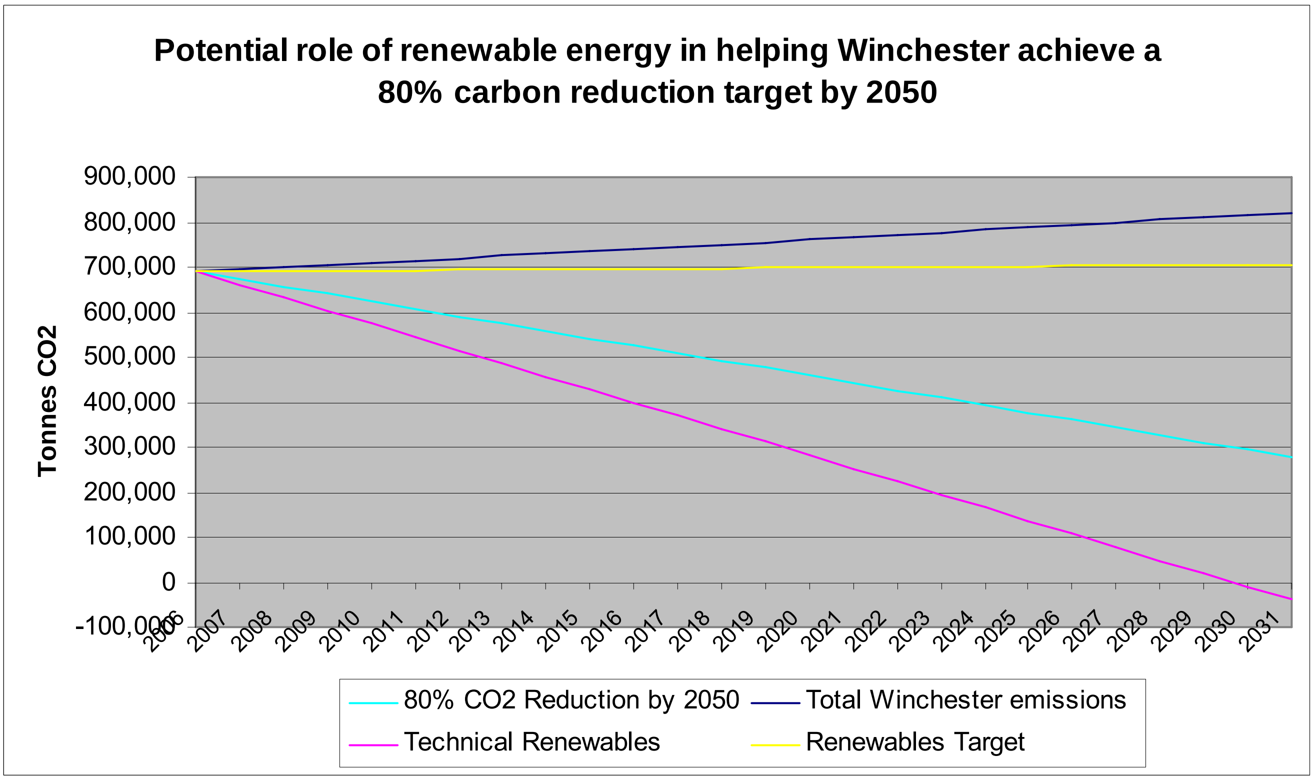


Figure 3 outlines that if the total technical potential for renewable energy in the district is exploited then it could deliver a zero carbon district and could thereby contribute entirely to achieving the 80% carbon reduction target for 2050 (which equates to a 60% reduction target for 2031 target). However, the practical potential will be a lot

[9] A 1% annual growth is assumed, based on growth factor for energy consumption in buildings from DTI Energy Paper 68

smaller and the suggested target potential of 116,000 tonnes of CO_2 reductions would only equate with stabilising carbon emissions over the next 15 years (due to the business as usual growth in energy consumption as indicated by the yellow line in figure 2). Nonetheless, the suggested target corresponds with 17% of the current energy demand in the district which is in line with Government targets for renewable energy to generate 20% renewable *electricity* by 2020 (although as outlined in section 2 above this is currently in flux due to the Renewable Energy Strategy consultation). This illustrates the challenge of managing renewable targets that have been developed from a bottom-up analysis as opposed to top-down target setting.

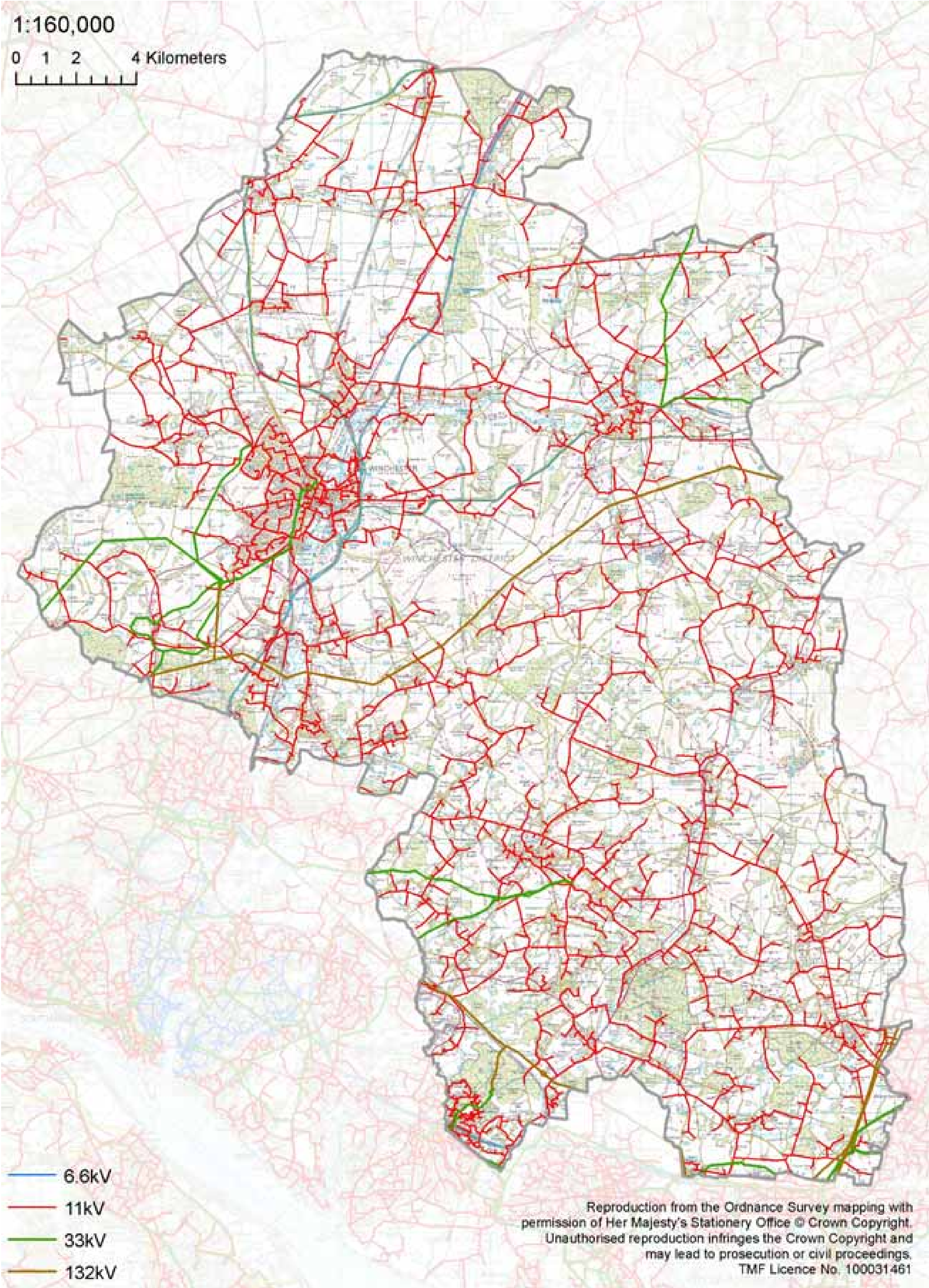
3.2 Distribution network within the district

When evaluating the feasibility of large renewable energy power generation, the distance from potential generation location sites to sections of the electricity network of suitable voltage is important. This does not account for capacity (thermal and load flow) characteristics of any particular connection point, which would need to be considered at the project level. Proximity to the electricity network (usually at the 11kV and 33kV level network) is a significant constraint to the viability of individual development sites.

The map below -initially obtained from Scottish and Southern, the Distribution Network Operator (DNO) owning and operating the distribution networks within the district and subsequently GIS-adapted - shows the distribution network within the boundaries of Winchester.

Whilst in general the distance to the next grid connection point is necessary for the assessment of potential opportunities from all types of renewable energy developments that feed into the grid, such a distribution network map does not give an indication about the possible availability of connection capacity. This issue would normally only be addressed on an individual scheme basis. Therefore, this map is provided to illustrate the existing distribution network in the district, however, it has not been taken into account for the wind GIS constraints analysis undertaken as part of this study.

Figure 4: Distribution network in the Winchester district



Other aspects important with respect to grid connection for renewable energy projects include:

- Local loads
  - The more similar the generator capacity is to the magnitude of local loads, the more cost effective the grid connection; this is due to the network usually being designed and sized for the local load in a certain area.
  - The annual charges that the generator incurs when using the distribution system can be saved if the generation can be connected into an existing customer network.
  - Using energy on-site can triple its value as this is the equivalent higher factor that suppliers charge for selling energy in comparison to purchasing energy.
- Voltage
  - If the generating voltage differs from network voltages, transformers might be required which in turn, however, can increase connection costs significantly.
  - Purchasing additional equipment is generally only worth if losses on the cables are significant; if that's not the case, connection should happen at the generator voltage.
  - Determining the most suitable connection voltage for various generator capacities can be done by applying the following rule of thumb:
    - Less than 3.6kW – 240V (1-phase)
    - Less than 400kW – 400V (3-phase)
    - Between 400kW and 8MW – 11kV
    - Over 8MW – EHV connection (33kV or higher)
- Switchgear and ratings
  - Extending an existing switchboard (used for isolation of electrical equipment) might be less cost effective than connecting into a cable with a ring main unit – depending on required civil works and distance from generation.
- Regulatory requirements
  - When connecting renewable generation to the distribution network, there are two Electricity Networks Association guidelines, i.e. G83 and G59.
  - G83 is for very small embedded generators (up to 16A per phase) , whereas G59 is for medium-sized embedded generators, i.e. up to 5MW, connection up to 20kV.
- Connection applications
  - Generators installed under the G59 guidelines -or multiple smaller generators-, require the submission of a generator connection application to the local distribution network operator (DNO). Within a maximum of 90 days upon receipt of the application, the DNO will assess the effect of the proposed generation on the remaining network.
  - Upon successful detailed assessments, a connection offer will be made by the DNO indicating the non-contestable work and costs (to be undertaken by the DNO) and contestable work (to be undertaken by either the DNO or an accredited third party) and their respective timeframes.

3.3 Wind Assessment

3.3.1 Methodology

Two approaches have been chosen to determine the potential for small and large-scale wind energy in the district.

For large scale wind, the assessment is based on a spatial analysis undertaken in the form of a GIS constraints analysis.

The GIS mapping considered 38 constraints relevant to large scale wind turbines. The key constraints include:

- Wind speeds >5.9m/s @ 45m above ground level
- International, national and local designations for heritage

- International, national and local designations for landscape
- International, national and local designations for ecology
- Designations for archaeology
- Space requirements, including proximity to buildings (for noise and visual reasons) and other turbines (to avoid wind turbulence)
- Air safeguarding and radar constraints from MOD and civil aviation interests
- Electromagnetic interference to communications radar (TV, radio, weather, mobile phone, etc.)
- Distribution network
- Landscape and visual constraints were not part of the GIS constraints mapping.

The assessment of the energy potential for small scale wind is based on the most likely application for such turbines. Sites in rural and windy areas have been therefore been chosen that would have an adequate load profile, i.e. farms. Farms over 5ha are assumed to have space for a 100kW turbine and farms under 5ha to have space for a 25kW turbine. Other potential sites for small-scale wind turbines could be

- small rurally located hamlets or villages or locations on the edge of larger settlements
- municipal buildings such as community centres or schools (an additional advantage of these "community" sites would be that these would also serve an educational purpose)

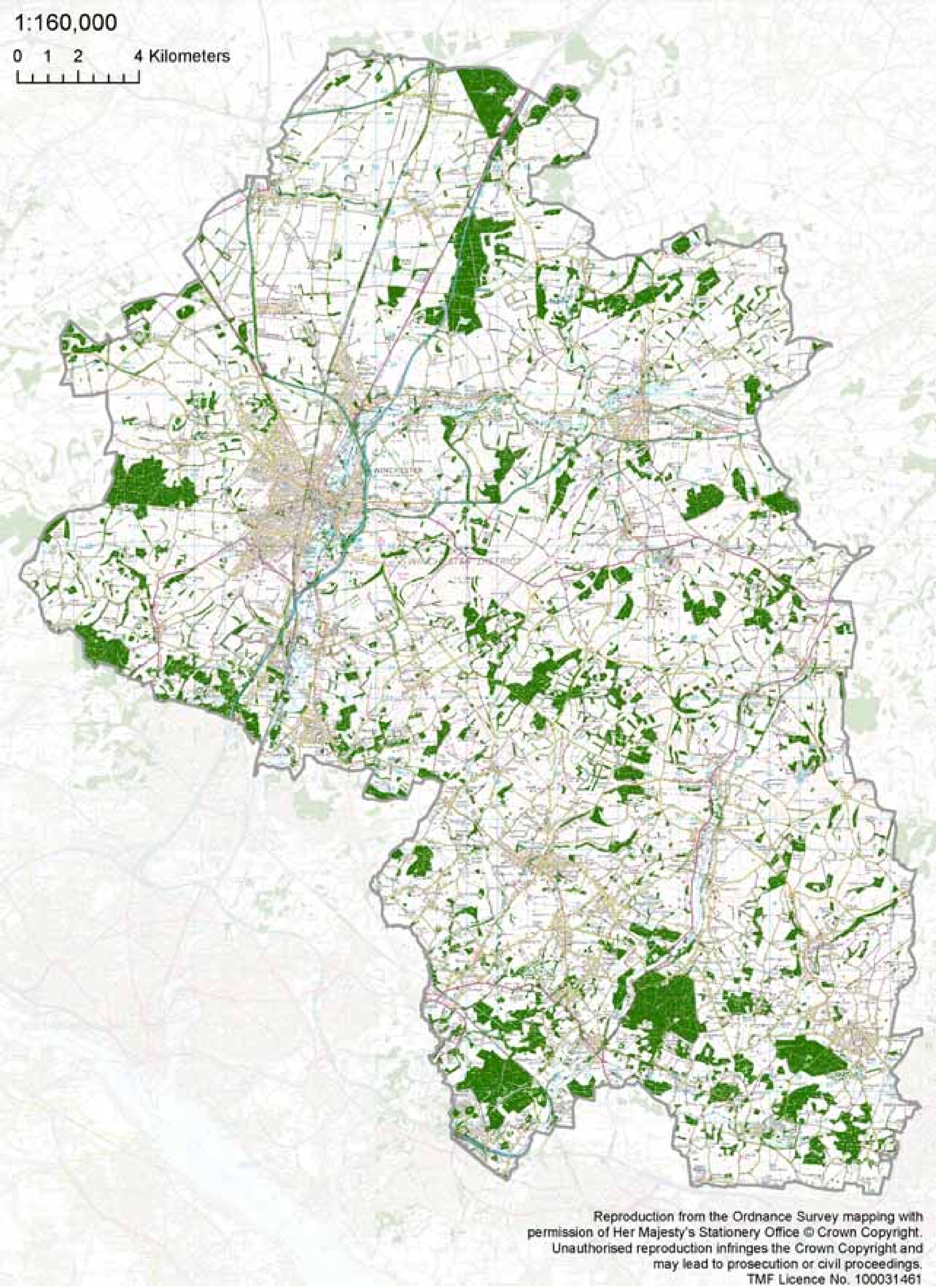
However, given lack of availability of data of such sites in the district, only farms were used to determine the potential for small-scale wind in Winchester.

3.3.2 Large-Scale Wind Turbines

Based on the GIS constraints analysis, the district was subdivided into constrained zones, i.e. absolute constraints which would definitely prevent wind energy developments (illustrated in red in the map below) and less constrained zones, i.e. constraints which would not necessarily prevent wind energy developments, but which would rather result in consultations with the respective stakeholders (illustrated in blue in the map below).

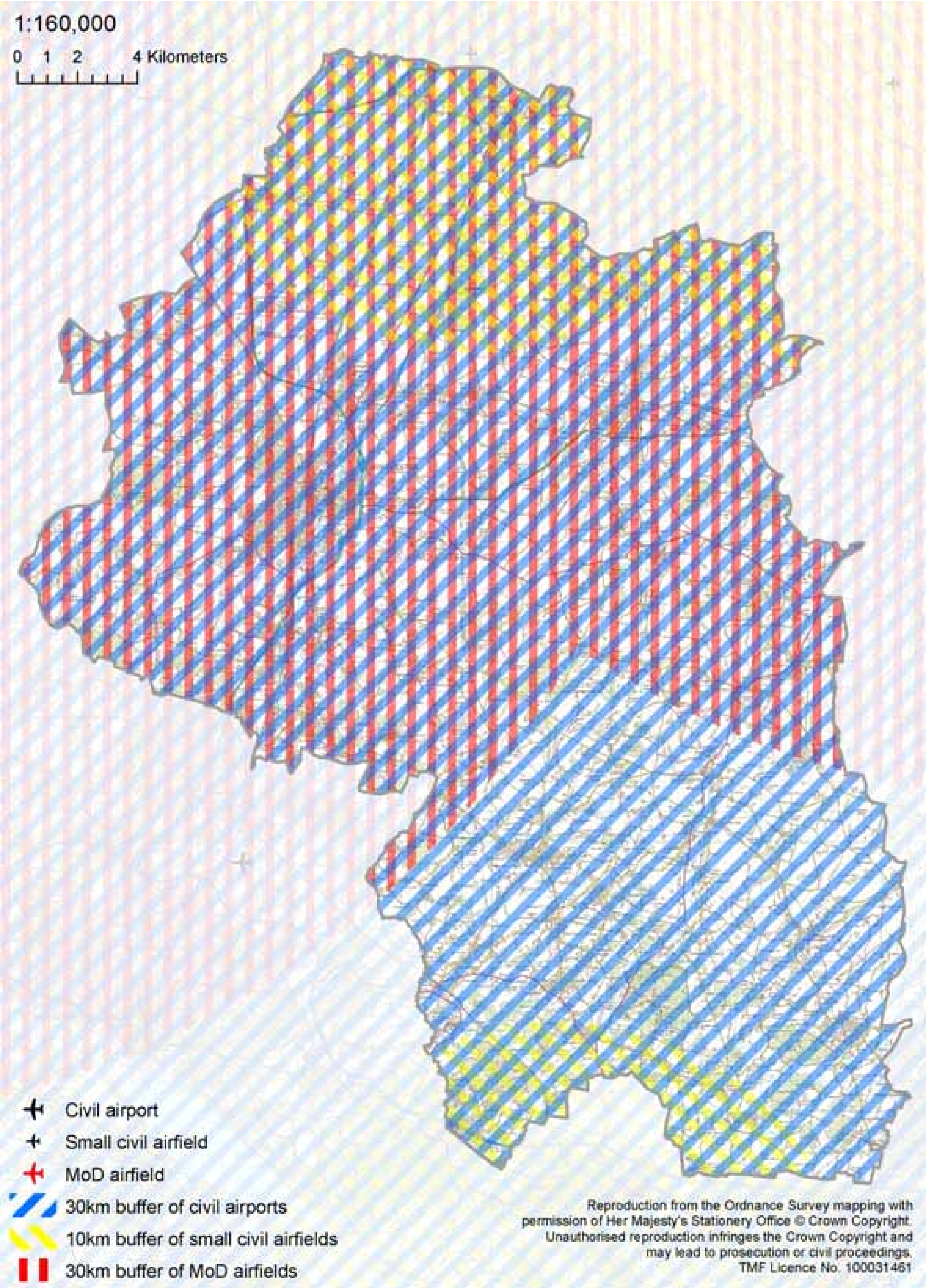
One example for an absolute constraint would be those areas in the district covered by woodland as illustrated in the GIS map below.

Figure 5: Absolute constraint: Woodland areas in the district



An example for a less constrained zone (i.e. one that would not necessarily prevent wind energy developments in the district, but which would rather result in consultations with the respective stakeholders) is illustrated in the GIS map below which shows those areas in the district possibly affected by radar issues.

Figure 6: Consultative zones: Air Safeguarding zones in the district



Air safeguarding zones are ‘consultation zones’, i.e. local planning authorities are required to consult the Civil Aviation Authority (CAA) upon any proposed developments with tall structures that would fall within safeguarding map-covered areas. Regarding this issue, the British Wind Energy Association’s (BWEA) ‘Wind energy and aviation guide’ points out that the aviation community has “procedures in place to assess the potential effects … and identify mitigation measures”. Furthermore, the guide states that while both wind energy and aviation are important to UK national interests, the ‘overall national context’ will be taken into account when assessing the potential impacts of a wind development upon aviation operations.

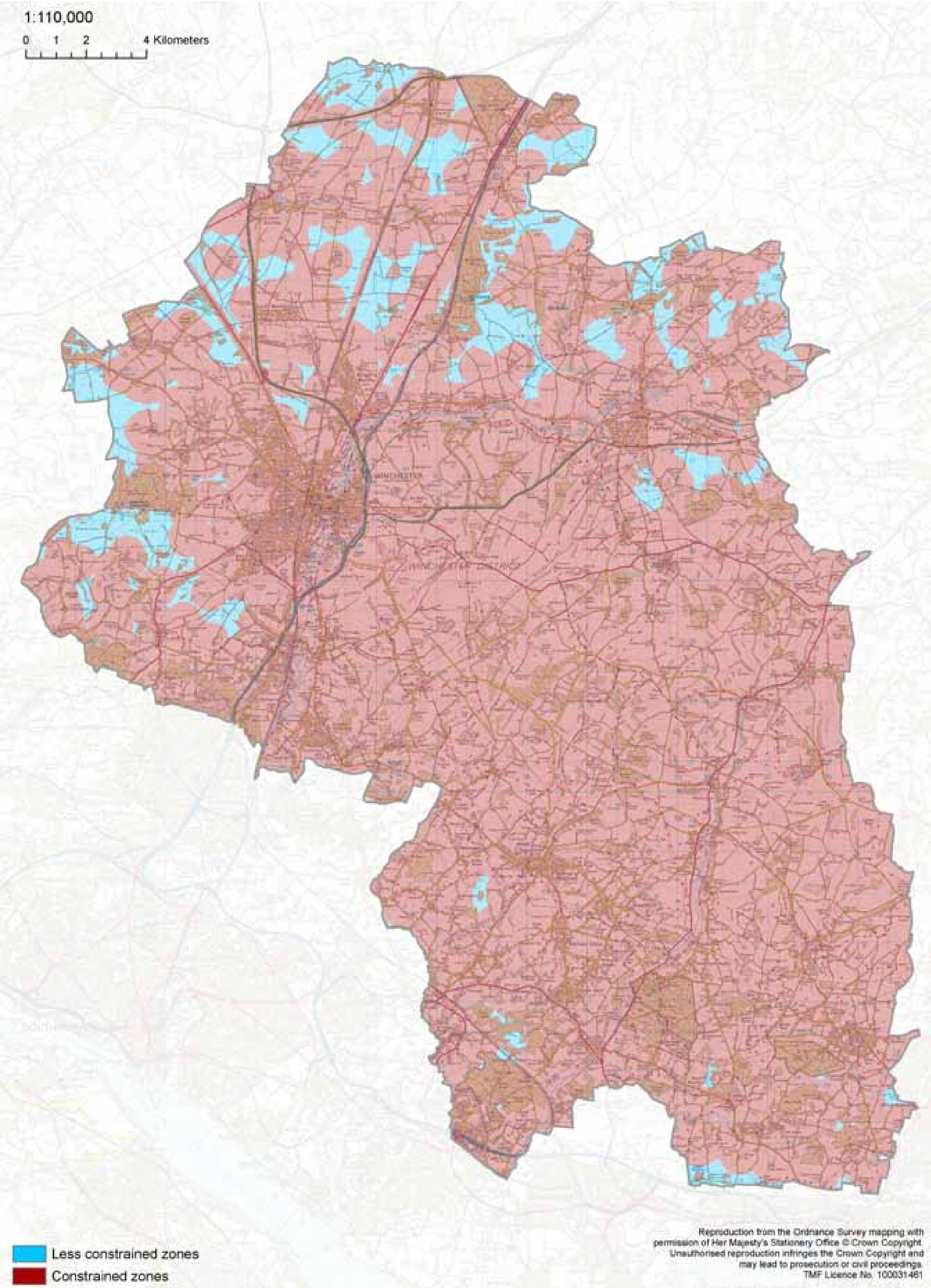
Therefore, the air safeguarding zones are only considered ‘consultation zones’ and were therefore excluded at this stage from the wind energy constraints analysis.

However, despite air safeguarding zones not being constraints per se, they need to be addressed by developers early in the process of wind energy site development. It is, therefore, advised for developers to start a pre planning consultation process with the relevant aviation stakeholders early in the feasibility process.

3.3.3 Technical and target potential for large-scale wind

Combining all absolute constraints resulted in potential sites identified for 72 large wind turbines in the district. This is based on an industry-wide spatial benchmark of an average of three wind turbines per km^2. These **72 wind turbines** represent the **technical potential for large-scale wind in the district**, as graphically illustrated in the map below (i.e. if all of the blue area was to be filled with 3 wind turbines per km^2). Overall, the areas in blue in the map below (the ‘less constrained zones’) represent those areas that are suitable for large-scale wind turbines in the district, whereas the areas in red represent those areas that are unsuitable for the development of large-scale wind turbines in the district. Please note that the area of the planned National Park is already included in this map.

Figure 7: GIS constraints analysis – constrained and less constrained zones for large-scale wind in the district



The technical potential of 72 large-scale wind turbines in the district can be expressed in terms of installed capacity and generated output, as outlined in the approach below.

- 72 large wind turbines using 2.3MW turbines = 166MW
- Based on an industry-wide used average capacity factor[10] for onshore large-scale wind turbines in the UK of 25%, the potential energy generation from these 72 large wind turbines in the district would be 362,664MWh. However, this figure has been -after consulting local knowledge regarding local capacity factors- reduced to 20% capacity factor, which results in a potential energy generation from these 72 large wind turbines of 290,131MWh.

However, this many turbines is not likely to be acceptable on landscape and visual grounds (hub heights of large-scale wind turbines are usually around 60 to 80m with their maximum height to the blade tip ranging from 100 to 125m). Factors such as visual impact, but also public accessibility and topography will therefore reduce the technical potential.

Obviously, undertaking detailed site visits is beyond the scope of this study, so based on a detailed landscape, visual and cumulative impact assessment that could be undertaken for the potential sites following this study, it will eventually be the political will that will determine how many of the 72 large-scale wind turbines will be realised in the district.

For the purposes of setting a target we have assumed a practical scenario of three to four potential sites within the district with a total of 20 turbines. Undertaking detailed site visits was beyond the scope of this study, but Winchester City Council could undertake a detailed landscape, visual and cumulative impact assessment in addition to a consultation of local and political opinions if it wanted to set a fully informed wind target. This assessment does not assume that Winchester City Council would necessarily endorse this 20 turbine scenario, and environmental assessments and planning applications would be required before the development of any wind turbines would occur.

Following on from this, the technical and target potentials (based on the scenario outlined above) for large-scale wind in the district are summarised in the table below.

Table 5: Potential for large scale wind turbines[11]

Technical Potential		**Target Potential 2016[12]**		**Target Potential 2026**	
Number of turbines	Capacity (MW)	Number of turbines	Capacity (MW)	Number of turbines	Capacity (MW)
72 large turbines	166	9 large turbines	20.7	20 large turbines	46

[10] Capacity factor is the ratio of the actual yearly electricity generated had the wind turbine operated at full capacity the entire time

[11] For both technical and target potential turbines are assumed to have individual capacities of 2.3MW (current average capacity of onshore turbines); however, with turbines capacities increasing over time, capacities and therefore energy generation will increase over time, as well, i.e. beyond the target capacity in 2026. However, this effect has not been taken into account for the purpose of this study in order to make the target setting process not unnecessarily complex.

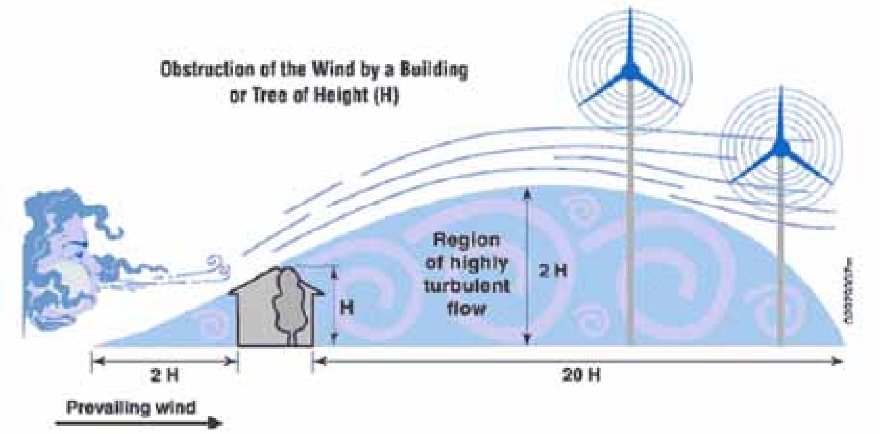
[12] The target potential in 2016 has been set to 44% of the target potential in 2026 (time ratio)

3.3.4 Small-Scale Wind Turbines

When considering small wind energy schemes - which can also include building-mounted wind turbines, in the Winchester District, the following aspects need to be taken into consideration:

- Surrounding obstacles create turbulence which a) decreases a wind turbine's output and b) increases both the load and vibration effects on the building / site. These turbulences are obviously mostly prevailing in urban areas, making these potential sites often less suitable for small wind turbines than areas in rural regions, such as farm houses, small rurally located hamlets or villages or locations on the edge of larger settlements. The figure below illustrates the turbulences that obstacles, such as buildings or trees create which can result in much lower wind speeds for small-scale wind turbines.

Figure 8: Effects of wind shadowing (Source: www.awea.com)



- Wind imposes considerable dynamic loads on a roof-mounted wind turbine and conventional buildings are not designed to deal with these, so care must be taking when planning installations.
- It is much easier to install a wind turbine on a new building instead of retrofitting it to an existing building (structural engineers must be consulted in both cases).
- Access for inspection and maintenance is important for building-mounted wind turbines.
- The electricity for small scale turbines can either link to the grid or charge batteries, the former being more cost effective.
- The availability of grants (such as through the Low Carbon Buildings Programme[13]) for the installation of microgeneration technologies, can increase the affordability of the development of small wind schemes for potential target groups, such as community groups, schools, supermarkets, council buildings, industrial estates or other large commercial customers.
- At present national planning legislation requires that planning permission is obtained for domestic wind turbines and similar small wind energy installations, which do not benefit from Permitted Development Rights: different conditions and limitations apply depending on whether a small-scale turbine is fixed to a house, on a wall, to the roof or whether it is a free standing turbine. The main criteria to take into consideration include turbine height; location, age and impact on the host building; shadow flicker; noise; interference with electromagnetic interference; highway safety; visual impact; environmental considerations and site access.
- With respect to potential sites for small-scale wind in the area of the Winchester District, small-scale wind is particularly suitable for farms, but also for municipal buildings such as community centres or schools (above all in rural areas where the effects of wind shadowing would be smaller than in urban areas and where schools usually have more land to place the turbine on). An additional advantage of these "community" sites would support education. However, for the purpose of this study, only farms under 5ha and over 5ha have been considered.

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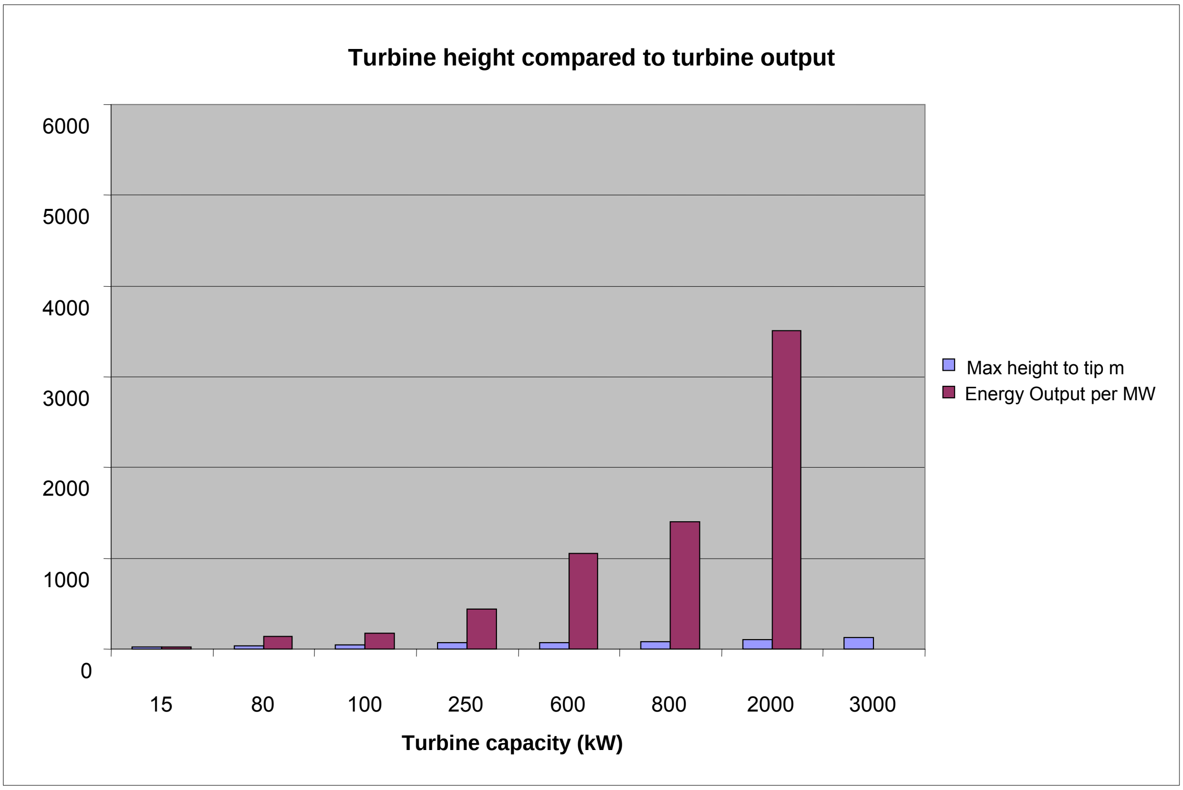
[13] http://www.lowcarbonbuildings.org.uk/home/

- There is a significant difference in terms of electricity output based on the height and capacity of a turbine. The figure below illustrates that the energy output per MW installed grows exponentially with increasing turbine height.

Figure 9: Turbine height compared to turbine output in MWh



3.3.5 *Technical and target potential for small-scale wind*

The following aspects have been applied to determine the technical potential of small-scale wind in the district:

- Farms over 5ha have space for a 100kW turbine, and farms under 5ha have space for a 50kW turbine
- An industry-wide average capacity factor of 20% has been assumed for each small-scale turbine
- Building integrated wind turbines have not been considered in this study, as they are currently not well suited to built up areas, as low output, noise and vibration issues still need to be resolved.

Out of the total of 892 farms in the district, 466 of these are over 5ha. A farm of that size can install a 100kW turbine which could result in 466 turbines. With respect to the farms under 5ha in Winchester District, these farms sizes can install a 50kW turbine which could result in 426 turbines.

The total technical potential for small-scale wind in Winchester has been determined based on the above numbers adjusted by local expertise (i.e. Alex Templeton) reflecting the fact that only an estimated one third of all farms in the district actually have sufficient wind resources to make small scale wind energy development viable.

Based on this, there is a technical potential for 297 small-scale wind turbines with a cumulated capacity of 22.6MW (155 x 100kW and 142 x 50kW). However, this many turbines are not likely to be acceptable on landscape and visual grounds (tower heights of these kinds of small-scale wind turbines are usually around 30m (50kW) to 35m (100kW)). Keeping in mind that the eventual number of turbines that may be acceptable in Winchester is liable to change, we have -for the purpose of this study- assumed a possibly realistic scenario of up to 50 small-scale turbines, evenly split between farms over and under 5ha. This does not in any way mean that Winchester City

Council would endorse this scenario and the required assessments would need to be undertaken before the development of any small-scale wind turbines would occur.

Table 6: Potential for small scale wind turbines

Technical Potential		Target Potential 2016		Target Potential 2026	
Number of turbines	Capacity (MW)	Number of turbines	Capacity (MW)	Number of turbines	Capacity (MW)
297 small turbines	22.6	22 small turbines[14]	1.65	50 small turbines[15]	3.75

3.3.6 Key actions to deliver the wind target

There are a number of actions that Winchester City Council should undertake to develop an implementation plan for achieving the wind target:

- Develop a business strategy in order to incentivise wind developers to operate within the district
- Bring together landowners and wind developers - when approaching landowners to incentivise them to have large scale turbines on their land, developers will need to offer return in the form of an annual rent
- Bring together housing developers and wind developers
- Consider the following key elements within the implementation plan:
    - In view of high fixed cost related to wind farm development in general, the greater the number of turbines at one site the more interesting for wind developers
    - When choosing specific sites, financial viability can be increased through proximity of the wind farm to new developments or to high constant electricity demand (industrial).

3.4 Solar thermal, Photovoltaics (PV) and Ground Source Heat Pumps Assessment

Three technologies are looked at in this section. The differences between them are as follows:

- Solar thermal hot water (STHW) systems (sometimes referred to as solar collectors, or active solar systems) convert solar radiation into thermal energy (heat) which can be used directly for a range of applications, such as hot water provision and low temperature heat for swimming pools.
- Solar photovoltaic (PV) panels are semi-conductor panels that convert light directly into electricity. This DC power is normally passed through an inverter which converts it into AC power which can be used to power the normal range of domestic appliances or be exported to the local electricity network. The amount of power that a PV panel will deliver is proportional to the amount of sunlight that falls upon it.
- According to the Energy Saving Trust[16], ground source heat pumps (GSHP) make use of the constant temperature that the earth in the UK keeps throughout the year (around 11-12 degrees a few metres below the surface). These constant temperatures are the result of the ground's high thermal mass which stores heat during the summer. This heat is transferred by (electrically powered) ground source heat pumps from the ground to a building to provide space heating and in some cases, to pre-heat domestic hot water. A typical efficiency of GSHP is around 3-4 units of heat produced for every unit of electricity used to pump the heat.

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[14] 11 x 100kW turbines for farms over 5ha and 11 x 50kW for farms under 5ha

[15] 25 x 100kW turbines for farms over 5ha and 25 x 50kW for farms under 5ha

[16] http://www.energysavingtrust.org.uk/uploads/documents/myhome/Groundsource%20Factsheet%205%20final.pdf

3.4.1 Solar technologies and GSHP

Solar energy can be exploited through three different means: solar photovoltaics (solar PV), active solar heating (solar thermal) and passive solar design. The least widespread of these is passive solar design: only a few thousand buildings in the UK have been designed to deliberately exploit solar energy - resulting in an estimated saving of around 10 GWh / year[17].

The key advantages of photovoltaics and solar thermal compared to non-solar renewable technologies are:

- they can be integrated into buildings so that no extra land area is required,
- they can be used in a variety of ways architecturally, ranging from the visually unobtrusive to clear expressions of the solar nature of the building,
- they are modular in nature so that any size of system can be installed and
- there are fewer transmission losses since the electricity / hot water is used 'on site'.

Other important characteristics of photovoltaics and solar thermal technologies include:

- Compared to retrofitting existing buildings, it is significantly easier to integrate solar energy technologies into new buildings
- Building-integrated PVs offset some of the costs of the roof construction and save space. Some of the most promising applications include:
    - New, high profile commercial office buildings
    - New housing developments (preferably incorporating low energy design features)
    - Schools and other educational buildings
    - Other large high profile developments (such as sports stadiums)
- PV can be utilised in two ways:
    - Stand-alone PV – for remote uses such as monitoring and telemetry systems, where mains electricity is too difficult or expensive to supply.
    - Grid-connected PV – where the PV system is connected to and generates into the mains electricity system.

Characteristics of GSHP include:

- Sizing of the heat pump and the ground loop depends on the heating requirements.
- GSHP can meet all of the space heating requirements of a house, but domestic hot water will usually only be pre-heated.
- GSHP can work with radiators, however, underfloor heating works at lower temperatures (30-35 degrees) and is therefore better for GSHP.

3.4.2 Methodology

The methodology for both PV and STHW is based on the same approach:

- Available roof and façade area
- Suitable roof and façade area
- Facing S, SW, SE
- Application of space and efficiency limitations
- Calculation of capacity (kWp) and energy generated (kWh) per year

[17] BERR, Digest of UK Energy Statistics 2007: http://stats.berr.gov.uk/energystats/dukes07_c5.pdf

The methodology for GSHP is based on the following approach:

- It is assumed that buildings could have GSHP even if it meant boreholing in pavements/roads for houses without gardens. Exceptions being if there is a protected aquifer underneath or for multi-storey buildings (assume over 4 floors).
- Assume each viable entire house has a 5kWth system
- Assume 5kW for every 150m^2 of non-domestic floor area
- Assume the systems are run for an average of 2000 hours per year

3.4.3 Technical and target potential

PV / STHW

Based on the information gathered, it has been assumed for the purpose of this study that there is a technical potential for 30% of all dwellings and 30% of all non-dwellings in the district to have solar PV / STHW. This is based on buildings facing south-west, south and south-east. Furthermore, each suitable dwelling could have a 1kWp PV panel / 4m^2 STHW panel (flat plate collector) and each suitable non-dwelling could have a 3kWp PV panel / 8m^2 [18]STHW panel. This would result in a technical potential for PV of 19.7MWe for the district (based on an average annual energy factor for solar PV of 727kWh/kWp per annum) and a technical generation potential for STHW of 31,929MWh (based on an average yearly output for solar flat plate collectors of 454 kWh/m^2).

However, not all of the technical potential can turn into target potential. Reasons include economic viability grant availability, consumer behaviour. Keeping in mind that the eventual number of solar PV, STHW and GSHP systems that may be realised in Winchester is liable to change, we have -for the purpose of this study- assumed a practical target of 15% uptake of each solar technology (based on technical potential).

GSHP

Based on the information gathered, it has been assumed for the purpose of this study that there is a technical potential for 50% of all dwellings and 50% of the floor area of all non-dwellings in the district to have GSHP. This is based on an estimate of buildings without sufficient space for a trench or borehole to accommodate a ground loop and where the ground material is unsuitable for digging. Furthermore, multi-storey buildings (i.e. more than four floors) have also been considered unsuitable for GSHP. For each suitable 'entire' house (i.e. assuming 4 flats per entire house) and for every 150m^2 of non-domestic floor area a 5kWth system can be installed. This would result in a technical potential for GSHP of 162.9MWth. However, it has to be kept in mind that electricity is required to pump the heat, i.e. for every unit of electricity used to pump the heat, 3-4 units of heat are produced (source: Energy Saving Trust). This has been integrated into the analysis.

As with all technologies considered in this study, not all of the technical potential can turn into target potential. Reasons include economic viability, consumer behaviour (e.g. for GSHP: necessity to replace the heat distribution system for existing dwellings), grant availability and the fact that heat pumps are especially useful for off gas grid areas. Keeping in mind that the eventual number of solar PV, STHW and GSHP systems that may be realised in Winchester is liable to change, we have -for the purpose of this study- assumed a possibly realistic scenario of up to 15% uptake of each solar technology (based on technical potential) and of up to 10% uptake of GSHP. This does not in any way mean that Winchester City Council would endorse this scenario and the required assessments (e.g. roof / ground suitability at each potential house) would need to be undertaken before the development of any solar PV, STHW or GSHP scheme would occur.

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[18] This is based on various factors, including average floor area for non-dwellings and average hot water demand for different types of non-dwellings (e.g. offices, banks and agencies, hospitals and hotels)

Following on from this, the technical and target potentials (based on the scenarios outlined above) of solar PV, STHW and GSHP for the district are summarised in the table below.

Table 7: Potential for PV / STHW / GSHP

	Technical Potential		**Target Potential 2016**		**Target Potential 2026**[19]	
	Number of buildings	Capacity (MWe/MWth) / Generation (MWh)	Number of buildings	Capacity (MWe/MWth) / Generation (MWth)	Number of buildings	Capacity (MWe/MWth) / Generation (MWth)
PV	15,454[20]	19.7MW$_e$[21]	811[22]	1.03MWe	2,318[23]	2.95MWe
STHW	15,454	87,355MWh	811	2,107MWh	2,318	4,789MWh
GSHP	24,118	162.9MWth	1061[24]	7.6MWth	2,412[25]	17.2MWth

3.4.4 Key action for progressing building integrated micro-renewables

Winchester would need to set up a high profile, discounted installation scheme for each of the technologies, in order to establish a simple one stop process for households and businesses in the district to install these technologies.

3.5 Hydropower Assessment

3.5.1 Hydro technologies

Power has been generated from water for centuries, and there is theoretical potential for energy generation wherever there is water movement or difference in height between two bodies of water. The resource available depends upon the available head, i.e. the height through which the water falls (in metres) and flow rates, i.e. the volume of water passing per second (in m^3/sec).

The figure below illustrates the concepts of head and flow graphically.

[19] Assumption: 15% of technical potential

[20] 30% of 7,094 non-dwellings and 30% of 44,420 dwellings

[21] 6,384kW for non-dwellings (each non-dwelling assumed to have 3kWp PV panel) and 13,326kW for dwellings (each dwellings assumed to have 1kWp PV panel)

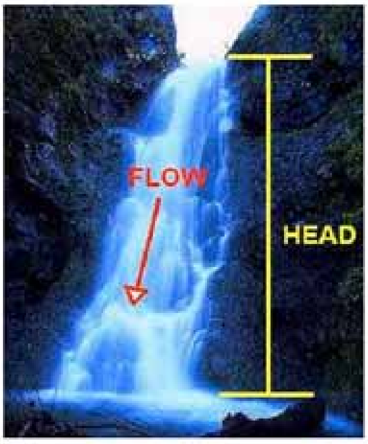
[22] Of which 697 dwellings and 114 non-dwellings

[23] Of which 1,993 dwellings and 325 non-dwellings

[24] Of which 13.77% or 146 are non-dwellings and 915 are dwellings

[25] Of which 13.77% or 332 are non-dwellings and 2080 are dwellings

Figure 10: Hydropower – Head and Flow (Source: British Hydropower Association – UK Mini Hydro Guide)

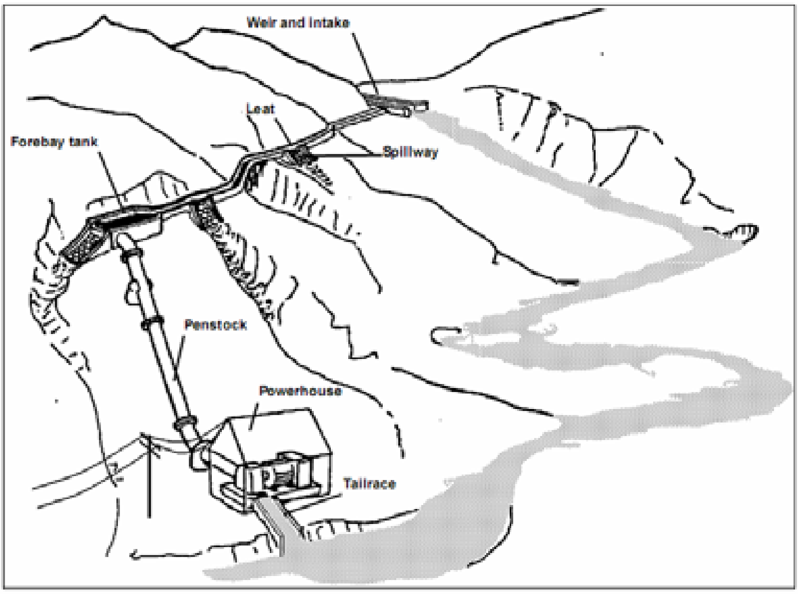


Power can be extracted by the conversion of water pressure into mechanical shaft power which, in turn, can drive a turbine to generate electricity. Power can also be extracted by allowing water to escape, for example, from a storage reservoir or dam through a pipe containing a turbine. The power available is in all cases proportional to the product of flow rate, head and the mechanical power produced by the turbine.

As for the efficiencies of hydro power schemes, these are generally in the range of 70 to over 90%. However, hydraulic efficiencies reduce with scheme size. Furthermore, schemes with a capacity of less than 100kW (micro-hydro) are generally 60 to 80% efficient.

There is a variation of different hydro energy site layout possibilities (e.g. canal and penstock; penstock only; mill leat; barrage), but, as illustrated by the figure below, a hydro energy scheme typically consists of the following components:

Figure 11: Components of a hydro scheme (Source: British Hydropower Association – Guide to UK Mini-Hydro Developments)



The technology for realising the potential from hydro is well established in the UK. Most of the UK's hydropower comes from large hydro projects; these are defined as those greater than 10 MW. These days large hydro is generally discounted from consideration for new construction due to the high environmental impact associated with constructing large dams and flooding valleys.

There are a number of benefits of hydro schemes (adapted from British Hydro Power Association (BHPA)), including:

- No direct CO_2 emissions
- Small hydro schemes have a minimum visual impact on surrounding environment
- One of the most inexpensive ways to generate power
- Bigger hydro schemes can include a possibility to store energy (reservoir storage, pumped storage)
- Hydro schemes can have a useful life of over 50 years
- Hydro is the most efficient way of generating electricity, as between 70 and 90% of the energy available in the water can be converted
- Hydro schemes usually have a high capacity factor (typically > 50%)
- A high level of predictability (however, varying with annual rainfall patterns)
- Demand and output patterns correlate well, i.e. highest output is in winter

3.5.2 Background & Methodology

The main river in the district is the river Itchen, but there are also smaller rivers, i.e. river Meon, river Dever, river Hamble and river Wallington. Furthermore, there are a number of mills which could potentially be converted for hydro energy exploitation.

However, -compared to the other technologies that are part of this study- the overall potential for hydro energy in the district is very small. This is mostly due to the small number of potential sites, the district's topography and the rivers' low heads and flow rates. As for converting mills, several sites have been and are being looked at, including City Mill (Segen Hydro Generation produced a feasibility study for this site which includes flow data based on 21 years of Environment Agency gauged flow data measurements), Durngate Mill and Abbey Mill (on the 24th of Oct 08, a company called Manhydro looked at these sites in more detail). Two further sites with potential for energy exploitation in the district are Wharf Mill and the rowing channel of Winchester College (bottom of St. Catherine's Hill; part of Itchen Navigation Channel).

Technologies for sites with medium and high heads and flows are well established, however with some of the sites only having a low head, finding suitable technology entails having to rely on less established technologies[26], such as Archimedes Screw turbines or VHL turbine (which is a very low head Kaplan turbine). Generally, impulse turbines are used for high head schemes whereas reaction turbines are used for low head schemes.

The methodology for determining the technical potential of hydro energy in the district is based on the following approach:

- Determine suitable locations from map e.g. weirs and local knowledge from e.g. Environment Agency and Alex Templeton
- Depending on data availability, determine head
- Get flow rate from National River Flow Archive website (http://www.nwl.ac.uk/ih/nrfa/station_summaries/map.html)
- Determine how much flow can be utilized (flow factor) as some may be needed for navigation or flood defence (use 0.5 as default)
- Determine combined turbine and generator efficiency (use 0.7 as default for low head rivers)
- Apply formula Power = gravity x head x density of water x flow rate x flow factor x efficiency

Specific data of potential sites in the district has been obtained particularly from the Environment Agency's local. Furthermore, the Hampshire Mills Group was contacted and they offered to provide contact data for mill owners in

[26] Southampton University is also active in the area of very low head turbines

the district. Other local actors consulted include Alex Templeton who estimated an overall potential in the district for up to eight mills to be converted for energy exploitation.

3.5.3 Technical potential

Based on the information gathered, it has been assumed for the purpose of this study that there is a potential for 10 hydro sites in the district – three specified mills (City Mill, Durngate Mill and Wharf Mill), six so far unspecified mills and the Winchester College Rowing Channel site. The Abbey Mill site has not been included in the technical potential as initial analysis undertaken -based on head and flow rate data provided by the Environment Agency- revealed that a head of 1m and a flow rate of 0.5m^3/s is unlikely to be sufficient to make the site economically viable.

As for the six so far unspecified mill sites that could be converted, as well, assumptions have been made of 1m head and 1.8m^3/s flow rate for each of these three sites. These assumptions are based on average head and flow rate values of all sites for which data has been provided.

As illustrated in the table below, there is a technical potential for 10 hydro schemes with a cumulative capacity of 0.078MW. The annual energy yield of 618MWh would cover 0.08% of the district's total existing building related electricity demand and save 0.04% of overall CO_2 emissions.

Table 8: Technical potential hydro

	Technical Potential						
Site	**Head**	**Mean flow Qm (m3/s)**	**Flow availability taking navigation and flood defence into account**	**Efficiency of turbine and generator**	**Capacity (Mwe)**	**Availability**	**Annual energy yield (MWh/yr)**
River Itchen:							
City Mill	0.67	5.3	0.5	0.35	0.006	0.900	48
Durngate Mill	2	2.5	1	0.35	0.017	0.900	135
Abbey Mill	1	0.5	0.5	0.35	0.002	0.900	14
Wharf Mill	1.3	2.5	1	0.35	0.011	0.900	88
Winchester College rowing channel site	3	0.5	1	0.35	0.005	0.900	41
Mill 5	1	1.8	1	0.35	0.006	0.900	49
Mill 6	1	1.8	1	0.35	0.006	0.900	49
Mill 7	1	1.8	1	0.35	0.006	0.900	49
Mill 8	1	1.8	1	0.35	0.006	0.900	49
Mill 9	1	1.8	1	0.35	0.006	0.900	49
Mill 10	1	1.8	1	0.35	0.006	0.900	49
Hydro total					**0.078**		**618**

Due to the relatively small number of hydropower opportunities within the district, we have assumed that the practical target incorporates all these potential sites except the Abbey Mill site which is deemed not to be economically viable. There will be challenges to this target, including lack of funds, lack of support from the Environment Agency or land-ownership and water rights.

Following on from this, the technical and target potentials (based on the scenario outlined above) for hydro in the district are summarised in the table below. The 2026 target potential for hydro energy would be equivalent to 0.08% of the district's electricity requirements and 0.04% of its CO_2 emissions.

Table 9: Potential for hydropower

Technical Potential		Target Potential 2016		Target Potential 2026	
Number of sites	Capacity (MW)	Number of sites	Capacity (MW)	Number of sites	Capacity (MW)
10 sites, 9 of which mill conversions	0.078	9 sites, 8 of which mill conversions[27]	0.077[28]	9 sites, 8 of which mill conversions[29]	0.077[30]

3.5.4 *Realising the target for hydropower*

There are a number of actions involved in progressing hydropower installations so as to achieve this target:

- Getting support from the Environment Agency (EA) will be crucial to the development for hydro energy schemes in the district; the EA is responsible for aspects such as licensing e.g. the water abstraction or for ensuring that each site has a fish passage
- Securing the necessary funds (possibly through a community-owned fund) will be important for project developers
- Economics of hydro energy schemes are absolutely site-specific, critically depending on the topography, geology, and hydrology of each site, which in turn requires feasibility studies for each potential site; this is especially important since civil works can be significantly more expensive for low head hydro developments
- Possible local resistance needs to be addressed accordingly
- For mill conversions it is important to ensure that all required hydro energy equipment and potential civil works could be integrated into the existing mill structure.
- Land ownership and water rights can be complex and time-consuming issues to be resolved
- In view of the complexity of developing hydro schemes, long lead times are required, most of all for hydrological studies, environmental impact assessments and getting the required permissions (flood prevention, fishery rights)

3.6 Biomass and Waste Assessment

3.6.1 *Methodology*

This resource assessment looks at the potential biomass resource from a number of different sources within Winchester. To undertake the assessment a variety of data sources are used. So that the data for different resources can be compared each is converted into an oven dry tonne equivalent (ODTe) resource. It is then further assumed that each oven dry tonne of material has an energy content of 5MWh/odt[31], so that the energy equivalence of each resource can be measured.

For the purposes of measuring resource the following assumptions are made

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[27] The only hydro site that isn't included in the target potential is the Abbey Mill conversion site, as this one is assumed to economically not be viable with an installed capacity of only 2kW

[28] Due to rounding, the overall target potential is 0.077MW and not 0.076MW as it should have been at first glance (0.078MW – 2kW)

[29] The only hydro site that isn't included in the target potential is the Abbey Mill conversion site, as this one is assumed to economically not be viable with an installed capacity of only 2kW

[30] Due to rounding, the overall target potential is 0.077MW and not 0.076MW as it should have been at first glance (0.078MW – 2kW)

[31] Average value determined from Phyllis database (http://www.ecn.nl/phyllis/)

- Biomass and waste within Winchester District boundary were counted as the resource
- Dry biomass – woodchip (from managed woodland, saw mill wastes and energy crops), straw, municipal waste
- Wet biomass – silage from cattle, poultry litter, garden wastes, supermarket food wastes
- Desk based assessment using maps, statistics and assumptions as appropriate
- Local experts contacted to verify assumptions
- Resource divided into marginal markets. Two for heat: pellet and dry chip, and five for combined heat and power: wet chip, off-cuts, straw, anaerobic digestion (AD) and municipal solid waste (MSW)

3.6.2 Technical potential

The current technical potential for biomass in Winchester District is estimated at 1,875,883 MWh of fuel, which equates to 90% of Winchester's current CO_2 emissions. This fuel is expected to come largely in the form of dry chip, and mainly from energy crops which have the theoretical potential to be grown on 100% of available agricultural land. There are also smaller amounts of material available for anaerobic digestion and straw based CHP plant. A substantial quantity of municipal solid waste of which a portion will be from renewable sources is already directed toward waste to energy plant under Project Integra. There is no resource currently identified for producing pellets for the domestic market.

The 4 main sectors of biomass fuel within Winchester District are:

- Dry wood chip – potential to use in biomass CHP if schemes come forward or of use in small scale biomass heating systems (although this wouldn't deliver as substantial carbon savings). Percent of total resource = 77%
- Straw – from cereals, used in biomass CHP if schemes come forward = 9%
- Anaerobic digestion – several sectors could potentially be involved: e.g. Farming (cattle silage), Supermarkets (food waste), waste collection (garden Waste). Percent of total resource = 9%
- Municipal solid waste – some renewable resource already going to incineration with energy recovery (Project Integra). Percent of total resource = 4%.

The technical potential of all potential sources within Winchester are summarised in the table below.

Table 10: Technical potential from biomass in Winchester

	Technical Potential (MWh/year)
Pellet 2kW+ heat	0
Dry Chip 10kW+ heat	1,451,575
Wet Chip 500kWe CHP	13,000
Offcuts 100kWe+ CHP	125
Straw 2MWe+ CHP	169,170
AD Plant 500kWe+ CHP	172,013
MSW plant 10MWe+ CHP	70,000
Total	**1,875,883**

The main biomass resource within Winchester would come in the form of dry woodchip, and the majority of this from energy crops. Table 11 below outlines the balance between energy crops and forestry in terms of the potential technical resource for Winchester, and illustrates that energy crops constitute 75% of the biomass resource.

Table 11: Sources of dry woodchip in Winchester

Unit	Crops & bare fallow used for energy crops	Marginal land (former set-aside) used for energy crops	Forestry	Total
Ha	26,092	2,598	3,415	32,105
Oven dry tonne equivalent per year	260,920	25,980	3,415	290,315
MWh/year	1,304,600	129,900	17,075	1,451,575

There is no substantial sawdust resource within Winchester District. Some small amounts of sawdust may come from local joinery operations but it is likely to be uneconomic to convert these resources into pellets or briquettes for woodfuel. The local authority area does not host a fixed sawmill, however there are several sawmills in close proximity which could house pellet production facilities to service the Winchester pellet market. This facility could provide pellet fuel for blown delivery to the existing stock of houses and or businesses within Winchester.

There is a considerable potential to develop a dry chip source within Winchester. If 10% of the former set-aside, crop and bare fallow land were used for energy crops then a substantial resource could be realised. There is also considerable resource which could be obtained from local woodlands. The issue in the woodland sector is that only a small quantity of woodland is likely to be under management and therefore available for harvesting wood for wood-fuel. Because of this conservative estimates of only 1 tonne per Ha of woodland and 10% of the available (non-ancient) woodland is used. This assumes that large parts of woodland are inaccessible and that most of the woodland is uneven-aged so that extraction is on a fairly ad-hoc rather than commercial basis. There is also a small amount of resource which is assumed to come from clean wood waste.

3.6.3 Energy from biomass and waste – turning technical resource into practical target

Table 12 below outlines suggested targets for the different biomass fuel sources for 2026. These targets have been calculated from the technical potential, and table 12 also outlines the percentage of the technical resource that the practical target equates to. These targets have been arrived at through a consideration of what is likely to be possible based on consumer behaviour, current government policy and market conditions for biomass and biomass supply chains, and inertia and potential speed of change in the development of the industry.

Table 12: Approach of turning technical potential of biomass into target potential

Fuel source	Target Potential (MWh/year)	Explanation of suggested target
Pellet 2kW+	0	Sawdust from small mobile Sawmill considered negligible. Would need to join up with local sawmills and/or other pelletising business (BALCAS).
Dry Chip 10kW+	147,719	Large potential resource from various sources (energy crops, forestry). • 10 oven dry tonnes per hectare per year on 10% of marginal land (former set-aside), crop and bare-fallow land.

		• 25% of non-ancient forest thinned down by one oven dry tonne of wood per hectare per year
Wet Chip 500kWe	6,438	More modest resource coming from tree surgery but should be adequate for about 700kW of capacity for large district heating scheme. • 100% of material from council parks. • 25% of material from private tree surgeons
Offcuts 100kWe+	125	Sawmill offcuts from small mobile sawmill, however this could be an alternative market for the Dry or wet chip product
Straw 2MWe+	16,917	Inadequate resource for a straw fired power station, and uncertain how much of this resource ends up going to other uses. May be of use in an anaerobic digestion plant. • 10% of straw from cereal, assuming two oven dry tonnes per hectare
AD Plant 500kWe+	36,649	Lots of resource around. An AD plant will attract double ROCs for the electricity generated. Typical costs of plant are £5m/MW installed depending on what goes in the plant. Economics could be good particularly if plant fed electricity to a new development, but may require coordination of activity across a number of different sectors (farming, supermarket, waste collection). • 10% of manure from cattle • 25% of poultry waste • 100% of supermarket food waste assuming this is equivalent to 10% of estimated food intake in the area.
MSW plant 10MWe+	70,000	Resource already goes to incineration with energy recovery through project Integra. • No figures were available on how much of the project Integra waste is renewable so 50% has been assumed
TOTAL	277,847	

The target potential for biomass in Winchester is approximately 278,000 MWh of fuel. This is equivalent to 56,000 oven dry tonnes of fuel. In broad terms this fuel is expected to come largely in the form of dry chip (30,000 ODT) with 10% of agricultural land being assumed to be utilised for energy crop production. The second largest resource is the assumed renewable component of the municipal solid waste stream already being burnt as part of Project Integra (estimated at 14,000 ODT). There is also a substantial resource which could be used for anaerobic digestion (estimated at 7,000 ODT), and a small amount of wet chip (c. 1,000 ODT). There is no resource expected for the pellet market nor are there expected to be substantial amounts of larger wood and off-cuts available to the market. A summary of the quantities of resource (in oven dry tonne equivalent) are shown below.

Table 13: Summary of the quantities of resource (in oven dry tonne equivalent)

Market	System size	Tech. Potential (ODT)	Target Potential (ODT)	Percentage of technical potential turned into target potential

Pellet	2kW+	0	0	n/a
Dry Chip	10kW+	290,315	29,544	10%
Wet Chip	500kWe	2,600	1,288	50%
Offcuts	100kWe+	25	25	100%
Straw	2MWe+	33,834	3,383	10%
AD Plant	500kWe+	34,403	7,330	21%
MSW plant	5MWe+	14,000	14,000	100%
Total		**375,177**	**55,569**	15%

The initial assumption in this analysis is that pellet and chip resources will be used for generating heat in wood boilers on the small scale whilst the other five resources will be used for biomass CHP. However, since wood chip is the largest biomass resource then it would be appropriate if a significant proportion of this resource is used in CHP plant to contribute to electricity generation within the district. Further analysis could be undertaken to obtain a clearer understanding of what biomass target is possible and desirable in the district, including:

- Analysis to be undertaken to assess if any, or how much, arable land could be used for biomass; this analysis will need to take into account a) market forces with demand from new development, b) farmers' choices and c) CO_2 reductions from biomass versus CO_2 reductions from local food
- Analysis to be undertaken to assess the impact that encouraging the reduction and recycling of waste will have on energy from waste potential.

3.6.4 Key actions for progressing biomass energy within the district

Policy measures needed to implement the target potential of biomass in the district include:

- Incentivisation schemes for farmers to provide farm wastes
- Incentivisation schemes to encourage woods and forests to become managed for woodchip supply - could make more former set-aside, crop and bare fallow land available for energy crop production. This could possibly be done by using an integrated agri-forestry system so that forestry and livestock or crops could be grown on the same piece of land. Such systems are commonly used in for example the permaculture type systems used by many small scale farming cooperatives where enhanced management practices enable higher yields to be obtained from the land. A yield of 10 ODT/Ha may be difficult to achieve within an agri-forestry situation, but 5 ODT/Ha should be achievable. For illustrative purposes if this yield could be achieved, then if all the 28,690 Ha of former set-aside, crop and bare fallow land were used for biomass production through an agri-forestry system then 143,450 oven dry tonnes of fuel could be produced equivalent to 717,250 MWh or about 28% of the anticipated energy use in 2026.
- Bring more woodland into management and manage as commercial forestry for woodchip production. 3,415 ha of non-ancient woodland was identified in this study. If all of this was managed as commercial forestry for the express purpose of woodfuel creation then 170,000MWh of woodfuel could be produced per year. This would be enough to meet 7% of the anticipated energy requirements of the Winchester District by 2026. This would require major investment in the woodland resource and increase in the number of foresters working in the area.
- Establish a biomass fuel group to help set-up a wood-fuel supply chain for the district and the promotion of agri-forestry systems which allow for food and wood production on the same land. This could be based around the current Farm Energy Project, a Winchester based organisation whose role is to develop renewable energy and fuel production on farms.

3.7 Summary of Target Potential

The table below summarises the target potentials for 2016 and 2026 for all technologies considered in this report.

Table 14: Summary of target potential

Technology	2016	2026
Wind power (all sizes)		
Capacity - Electricity (MW_e)	22.35	49.75
Energy - Electricity (MWh_e)	39,157	87,162
CO_2e abatement (tCO_2 per year)	16,838	37,480
Solar PV		
Capacity - Electricity (MW_e)	1.03	2.95
Energy - Electricity (MWh_e)	748	2,144
CO_2e abatement (tCO_2 per year)	322	922
Hydro power		
Capacity - Electricity (MW_e)	0.041	0.077
Energy - Electricity (MWh_e)	320	605
CO_2e abatement (tCO_2 per year)	138	260
Biomass CHP		
Energy - Electricity (MWh_e)	17,638	40,086
Energy - Heat (MWh_{th})	38,171	86,753
CO_2e abatement (tCO_2 per year)	16,746	38,058
Biomass Heating		
Energy - Heat (MWh_{th})	64,996	147,719
CO_2e abatement (tCO_2 per year)	15,599	35,453
Solar thermal hot water		
Energy - Heat (MWh_{th})	2,107	4,789
CO_2e abatement (tCO_2 per year)	853	2424
Ground Source Heat Pumps		
Capacity - Heat (MW_{th})	7.6	17.2
Energy - Heat (MWh_{th})	30,617	69,585
CO_2e abatement (tCO_2 per year)	1,397	3,175
Total Renewable Energy		
Capacity - Electricity (MW_e)	*23.4*	*52.8*
Capacity - Heat (MW_{th})	*7.6*	*17.2*
Energy - Electricity (MWh_e)	*57,863*	*129,997*
Energy - Heat (MWh_{th})	*135,891*	*308,846*
CO2e abatement (tCO2 per year)	*51,853*	*117,772*

3.8 Potential economic benefits of renewable energy in the district

Research in America by the Wisconsin Energy Bureau indicates that renewables create three times as many jobs as the same level of expenditure on fossil fuels:

“Investment in locally available renewable energy generates more jobs, greater earnings, and higher output ... than a continued reliance on imported fossil fuels. Economic impacts are maximised when an indigenous resource or technology can replace an imported fuel at a reasonable price and when a large percentage of inputs can be purchased in the state.”

Renewables tend to be more labour intensive and more local than generating energy at a national level or meeting demand through imports. The renewable energy sector comprises:

- Manufacture/installation/repair of generation equipment;
- Supply of renewable energy;
- Modifications to grid for transmission of renewable energy;
- Supply of renewable fuels;
- Distribution/storage of renewable fuels;
- Supply of agricultural feedstock for biomass/biofuels;
- R&D of new/improved renewable energy technologies;

- R&D of cleaner/more efficient non-renewable energy technologies; and
- Process engineering to make non-renewable generation cleaner/more efficient.

The most up-to-date and comprehensive methodology for establishing job creation by renewable energy is set out in a study for the government in 2004[32] examining the supply chain of renewable energy. Industry activity has been built up from current project activity, deriving the value added per megawatt and jobs per megawatt for each technology through development, construction and operation. A weighted industry average of ten jobs is created for every megawatt of renewable energy that is produced, applied across the development, operation and construction of the project cycle for each technology. The majority of jobs are created during construction. This is based upon empirical research for the government by Mott McDonald and the Bourton Group.

However, the majority of these jobs are associated with manufacture and most of the design and manufacture, and even installation of technologies such as wind turbines are likely to be created outside of the district with a corresponding 'leakage' of these potential jobs. This is leakage is assumed to be very high at 75% as the majority of jobs created in the design and manufacture is assumed to be outside the district. This 75% figure is based upon guidance to English Partnerships and the Regional Development Agencies "A Standard Approach to Assessing the Additional Impact of Projects" and Treasury Green Book principles for undertaking economic appraisal.

Applying the figure of 10 jobs per installed MW throughout the supply chain for the suggested renewable energy target for Winchester district provides a job creation potential of 600, and applying the leakage of 75% provides a job potential of 150.

The UK renewable energy sector was estimated to be worth £290m in 2005[33] and the economic benefits of this sector will be reaped best by those regions and localities that are most proactive in stimulating the development of renewable energy. The South West of England recently undertook an assessment of the economic contribution that energy efficiency and renewable energy make to the region and assessed that the renewables industry is worth £215million to the region[34]. Although the renewables resource in the South East of England is not as large as the South West, the sustainable energy sector has the potential to also provide a significant economic contribution to the south east economy.

Another point to consider is the effect of rising energy prices on the local economy. At present, the District imports nearly all its energy. In 2008, the District will spend approximately £82m on 642 gigawatts of electricity. Each time the price of electricity rises by 1 pence per kilowatt hour, an additional £6,400,000 is spent on energy within the district. Generating electricity and heat locally will ensure that a portion of the District's energy budget is spent locally, thus boosting or at least safeguarding the local economy, especially if that energy generation is owned by local individuals and organisations.

The renewables sector requires a well trained, productive, innovative and competitive workforce which will drive forward economic growth in the economy. It is likely that the changing demand for the generation of renewable energy and the associated technology to achieve this will create opportunities for the development of the skills of the existing labour force. Future employment growth will also drive the demand for skill in renewable energy.

According to work by the Department of Trade and Industry the renewables industry requires a wide range of skills including:

- Professional skills to develop business (including business planning, project management legal skills, funding and finance, marketing and sales & services);
- Technical skills for the manufacture, construction and installation of renewable energy projects (e.g. electrical, mechanical, civil, combustion, process, electronics, software and environmental engineering);
- Specialist technical skills in engineering, environmental and planning at a professional level associated with consultancy services, project development and R&D activities;
- Specialist knowledge of complex forms of manufacturing, such as gear profile manipulations, modelling and design;

[32] Renewable Energy Supply Chain Gap Analysis, DTI, 2004

[33] Study of Emerging Markets in the Environmental Industries Sector, DTI, 2005

[34] The Economic Contribution of the Renewable Energy and Energy Efficiency Sectors in the South West of England, DTZ / Regen SW, April 2008

- Heavy engineering and specialist skills in marine offshore technology associated with the design, development and installation of offshore wind, wave and tidal projects;
- Skills necessary to develop and maintain a fuel supply system for energy crops; and
- Power system design and engineering which includes specialist software and hardware control skills to allow for monitoring more complex networks that result from increased renewable projects.

4 Technical Approaches to Low Carbon Development

4.1 Delivering low and zero carbon development through communal energy systems

4.1.1 Introduction

Combined heat & power systems, with a district heating network, enable the greatest carbon reductions in new developments. However, the viability and effectiveness of CHP is dependent on the scale, density and mix of development. In general, CHP requires large numbers of units at high density with a good mix of building types with a good spread of daily and seasonal energy demand. The recent guide ‘Community Energy: Urban Planning for a Low Carbon Future’ produced by the CHPA and TCPA[35] provides a useful overview of the types of development that suit CHP and district heating and the range of issues that need to be considered in the development of CHP and district heating networks.

Individual building-integrated low carbon technologies such as photovoltaics, solar water heating, ground sourced heat pumps and improved energy efficiency standards can deliver substantial carbon reductions in new developments, but will struggle to achieve the very low carbon requirements of Code for Sustainable Homes Levels 4, 5 and 6. Individual systems can achieve the 44% carbon reduction under CSH Level 4, but it would constitute a very expensive approach, particularly if rolled out over a large number of units. Taking into account current proven technologies, an individual system approach would not achieve zero carbon status for new developments due to the space requirements and extensive renewable energy installations that would be needed on each and every building.

Therefore, the practical achievement of very low to zero carbon developments requires a communal energy system as the basis of the energy strategy. Typically a zero carbon development will require a combination of either biomass CHP and PVs, or biomass heating with a large wind turbine.

The precise nature of the technical solution for a specific development will vary depending on the scale, density and mix of the development. Section 4.2 categorises different development types and considers the mix of different technologies that are likely to provide the optimum energy system for delivering low and zero carbon developments.

4.1.2 Suitability criteria for communal energy systems and CHP

District heating networks account for the majority of the capital costs of delivering biomass heating and CHP systems. However the costs vary according to the density and layout of the development, and the specific conditions of a development determine the economics of the communal energy and CHP system. The density of the development is the key determining factor in terms of the economics of a communal system. The Community Energy: Urban Planning for a Low Carbon Future report provides indicative costs of district heating systems calculated per dwelling, and illustrates that the cost of communal systems increase substantially in lower density development. However, these unit costs for communal systems in low density development may still be a lower cost approach to delivering zero or very low carbon housing than through individual building integrated renewable energy systems. The number of dwellings is also important to the economic viability of CHP and although it is possible to install small CHP systems, they tend to be expensive and larger developments are needed in order to install commercial CHP systems. In general, 300 dwellings is a minimum number for a CHP system (although it can be smaller for ideal applications such as sheltered housing or mixed loads) and at this size it is likely to require grant funding. Although commercial ESCOs are interested in CHP systems for developments under 1000 units, this scale of scheme tends to require some partial funding from the public sector. Above 1,000 dwellings (and at the appropriate density), CHP and communal heating schemes tend to have excellent commercial prospects.

[35] Community Energy: Urban Planning for a Low Carbon Future, TCPA & CHPA 2008

Table 15: Indicative costs of district heating systems[36]

	MEDIUM RISE APARTMENT BLOCK	PERIMETER BLOCK OF FLATS & TOWNHOUSES	TERRACED HOUSING	DETACHED/ SEMI-DETACHED HOUSING
FORM	Corridor access, 5-6 storeys	Stairwell or street level access, 3-4 storeys	Street level access, 2-3 storeys	Street level access, compact layout
NET DENSITY	120 units/ha	80 units/ha	80 units/ha	40 units/ha
PIPE LENGTH	8m	11m	13m	19-24m
COST PER DWELLING	£2,800	£4,100	£5,300	£7,700 - £9,550

4.2 Low carbon energy supply & different development types

4.2.1 Categorising development types

The following is a breakdown of the development types that are typically found in predominately rural districts such as Winchester. The development types vary mainly according to size but are also defined by their location and density. As the following table outlines, the larger and denser the development the more conducive it is for a combined heat and power system, and the greater the scope for delivering a zero carbon development. The development types are divided into 5 categories for indicative purposes only:

- Urban infill – up to 1,000 units ;
- Rural – 'village infill' of anything between 0 and 1,000 units within or on the edge of a village or small town;
- Small urban extension – up to 1000 units on the edge of a town;
- Medium urban extension – 1000 units to 4000 units;
- Large urban extension/ new settlement – over 4000 units.

These are only indicative categories, and developments can of course take a variety of densities, sizes and forms.

4.2.2 Allocating different technical approaches to different development types

The smaller developments that constitute urban and rural infill are typically not appropriate for communal systems and therefore the optimum energy strategy will consist of highly energy efficient buildings with individual building integrated technologies. The urban extensions are at the larger size and density necessary to support a communal system in some or all of their development areas, and are large enough to potentially establish a long term power purchase agreement with a wind turbine developer or justify the creation of a local community owned ESCo on behalf of the future development.

These are general rule of thumb categorizations and there will often be overlap between these development types within the characteristics of any specific development site. The specific characteristics of the site will also determine the technical and financial suitability of CHP and district heating systems, and the unit numbers and densities in table 16 are indicative only. Although high density developments are generally needed to reduce the costs of district heating systems, lower density developments can still install communal systems but at the higher costs per unit as illustrated in table 15 above.

Table 16: Indicative development types and typical low carbon energy strategies

Development type	**Key characteristics**	**Options for low carbon/ renewable energy supply and carbon reduction**

[36] From Community Energy: Urban Planning for a Low Carbon Future, TCPA & CHPA 2008

		potential
Urban infill	Small numbers of typically around 1-1,000 housing units dotted around the urban environment – few other building types. High density (range of densities).	o Individual rather than communal systems – with building integrated micro-renewables, such as SWH, PV, GSHP. Ultra energy efficient passive house design would compliment these technologies. Difficult to achieve very low or zero carbon development. o Option for linking new buildings with existing buildings via a communal system, with potentially good mix of building types in town centre environment. Would need community ESCo to be established.
Rural	Small numbers of housing units added to villages - ranging from 1 to 1,000. Low density.	o Individual rather than communal systems – with building integrated micro-renewables, such as SWH, PV, GSHP and biomass/ wood stove. o These same technologies could equally be applied to existing homes, particularly those off the gas network, to deliver significant carbon savings. o Ultra energy efficient passive house design would compliment these technologies well. o Difficult to achieve very low or zero carbon development.
Urban extension – mainly domestic up to 1000 units.	Up to 1,000 dwellings adjoined to existing town or village with limited mix of other building types. Medium to high density.	o More suited to communal biomass heating rather than current biomass CHP technology due to scale and mix of uses, although biogas (from anaerobic digestion) CHP starts to become more suitable at the larger end of this development type. o If outer area is less dense, individual systems may become favoured for the less dense buildings. o Potential contribution from medium to large scale wind. o Potential to achieve low carbon development,. Harder to achieve zero carbon unless a medium to large scale wind turbine is viable.
Urban extension – over 1000 units with good mix of building type & use	Over 1,000 housing units adjoined to existing town and mix of other building types. Medium to high density.	o Meets indicative criteria for biomass/biogas CHP in terms of size and mix. o Should have good enough mix and high enough density to support efficient communal systems with smaller CHP system based on gas or liquid biofuel, sourced from anaerobic

		digestion. o Also potential contribution from medium to large scale wind and possibly hydro. o Good potential to achieve very low carbon developments
Large urban extension/ New settlement	Large number of housing units adjoined to existing town – up to 4,000 dwellings – and good mix of other building types. High density.	o Communal systems based on biomass / biogas CHP supported by high density & good building mix, with contributions from micro-renewables such as PV & small scale wind o Also potential contribution from medium to large scale wind and possibly hydro. o Good potential to achieve very low or zero carbon developments.

4.2.3 Relating these development types to proposed developments within Winchester District

There are a number of developments within Winchester District which correspond to these development types and it may be appropriate for the Winchester District Development Framework to encourage or require the relevant developers to incorporate these technical approaches with their energy strategies. It would certainly be useful to ensure that large developments opt for communal systems rather than individual systems during the early development phases so that they do not jeopardize the ability of the development to achieve low to zero carbon status in the long term.

The Issues and Options for the Core Strategy of the Winchester District Development Framework defines three key areas for the spatial distribution of new development within the district;

- Southern part of the District that lies within the Partnership for Urban South Hampshire (PUSH)
- Winchester City
- Market Towns and the rural area.

The issues and options paper provides a number of potential options for the spatial distribution of the proposed new development of 12,740 housing units by 2026. These development options include development types that correspond with the development types categorized above. The proposed key developments within the PUSH area include the development West of Waterlooville, and also Whiteley and Knowle. The development options being considered include spreading new development across existing towns, focusing even more development at West of Waterlooville and/ or focusing more development at Whiteley. For the rest of the district (Winchester City and the market towns and rural area) options include focusing development within the existing boundaries of Winchester City or potentially the 'step change in Winchester option' which would involve substantial new development on the edge of Winchester City, with up to 4,000 new dwellings.

Chapter 5 below considers the types of planning policies that may be needed within the LDF to encourage developers to adopt the optimum low carbon solution for their development type, and planning policies that can generally assist in supporting the development of low carbon infrastructure.

4.2.4 Typical carbon emissions associated with homes achieving CSH Levels 4, 5 and 6

The average carbon emissions of flats and houses built to different Code for Sustainable Homes Levels is outlined in table 13 – this is expressed as kilograms of carbon dioxide per square metre per annum for flats and for houses. These average emissions are based on representative SAP data taken from ESD's modeling work for a large number of housing projects built to Building Regulation 2006 standards. The actual emissions will vary depending on the precise nature of the development, but these typical square metre emissions can be applied to the total floor area of a new development to provide an indicative figure of the carbon footprint of a new development. This emissions schedule for Code levels 4, 5 & 6 is also dependent on the development supplying adequate amounts of renewable energy in order to reduce carbon emissions to the required standards.

Table 17: Carbon emissions associated with different CSH Levels per m^2 of floor area for flats and houses

Code for Sustainable Homes Level	Typical carbon emissions ($kgCO_2$ per m^2)	
	Flat	House
Level 3	32.18 $kgCO_2/m^2$	28.44 $kgCO_2/m^2$
Level 4	27.95 $kgCO_2/m^2$	23.70 $kgCO_2/m^2$
Level 5	15.49 $kgCO_2/m^2$	9.70 $kgCO_2/m^2$
Level 6	0 $kgCO_2/m^2$	0 $kgCO_2/m^2$

5 Recommendations for Local Development Framework Policies

5.1 Obtaining the views of key stakeholders

5.1.1 Dialogue with stakeholders

In undertaking the renewable energy resource assessment we held conversations with the following individuals to obtain key relevant data and opinions:

- Alan Rutter, GI Systems Manager at Winchester City Council for core GIS data for the wind resource study;
- Linda Thomas, Landscape Architect at Winchester City Council to discuss the landscape character of the district and the potential impact of wind turbines on landscape
- Matthew Barton, Waste Management Officer at Winchester City Council for information on waste collected in the district
- Ian Cupper and Ivan Gurdler, Tree Officers at Winchester City Council
- Andrew Herring, Planning Officer at Hampshire County Council for the 2004 Hampshire wind assessment
- Frank Campbell at Havant Council who is managing the PUSH energy study
- Christine Watkins at The Environment Centre in Southampton for information on the current renewable energy infrastructure within the district
- Andy Roberts, local representative at the Environment Agency, and Eleanor Yates at the Hampshire Mills Group, to discuss hydropower opportunities within the district
- Alex Templeton, Winchester Action on Climate Change about hydropower and a range of other renewable energy technologies
- Jonathan Rau at the Forestry Commission
- Julian Prime, Regional Energy Data Statistician at BERR – on the most up-to-date data sources on energy consumption within the district
- Discussed with a local sawmill owner the current situation regarding forestry within the district and region.

5.1.2 Stakeholder workshop

Interim findings for this study were tested with a multi stakeholder workshop held at Winchester Guildhall on 5 September 2008. Its aims were to obtain the opinions of key stakeholders regarding obstacles and opportunities for realising the renewable energy resource within the district and the types of planning policies that will be needed in order to facilitate the development of renewable energy.

The first session considered the potential renewable energy resource within the district. Following a presentation on the technical potential within the district of a range of renewable energy technologies, breakout groups discussed the most suitable technologies, and potential quantities and locations for renewable energy in the district.

Key discussion topics included:

- Key barriers to renewable energy development within the district;
- Main opportunities for renewable energy development within the district;
- Appropriate types and locations for renewable energy in the district;
- Appropriate target for renewable energy in the district.

The second session considered the planning requirements for new developments in order to ensure that housing growth within the district is low carbon.

Key discussion topics included:

- Aspirations within the council and the district for sustainable low carbon development;

- Most appropriate renewable energy and low carbon technologies for new developments – and different types of development - within the district;
- Appropriate level of burden to place on developers in the district.

The workshop was organised as an interactive event to maximise the opportunity for comment and feedback. The notes from the workshop are found in Appendix 2, but below is a summary of the key issues raised at the workshop. The views expressed in the workshop fed into the consideration of policy mechanisms outlined below.

5.1.3 Summary of workshop outcomes

Renewable energy potential in the district

The general principle of siting large wind turbines in the district was deemed as acceptable by most participants at the workshop, although a few participants stated that they felt it was not suitable to install any large turbines within the district. However, it was recognised that the planning and political process would judge where and if a turbine or turbines were to actually go ahead. Some participants felt that smaller scale turbines might be most appropriate for the district and that the scope for multiple smaller turbines could be further investigated – however, they recognised that the smaller turbines have a substantially smaller energy output than the large turbines.

It was felt that although a high target for building integrated technologies, such as solar photovoltaics and solar water heating, would be acceptable, it would have little impact on the uptake of the technologies. Participants felt that a national 'feed-in tariff' policy measure, similar to the one in Germany, would be needed to incentivise householders and building owners of existing buildings to install solar technologies. The planned new developments within the district will provide the best opportunities for increasing the output from these technologies.

Participants felt that although biomass is a resource that should be exploited, this should be harnessed from existing resources such as forestry residues and organic waste, rather than using agricultural land to grow energy crops.

Planning policy in new development

All participants felt that the Winchester District Development Framework must assist and encourage developers to build excellent low carbon developments. However, two of the groups felt that the national policy for improving carbon standards over the next 8 years, with all development from 2016 being zero carbon, is strict enough – and that the Winchester LDF should concentrate on helping developers to achieve these challenging standards. The other two groups felt that Winchester should have higher aspirations than the national targets, with zero carbon requirements potentially coming earlier than 2016. It was felt that all renewable energy technologies have a role to play and should be encouraged in the district. It was also felt that the existing building stock should be the key focus for improving energy performance and installing renewable energy technologies – and that the council shouldn't take its eye of this when concentrating on policies for new developments.

Undue burden on developers

Although participants recognised the challenges for developers in the current economic climate, they felt that strict sustainability requirements should now be accepted as a standard component of development costs. However, they felt that the public sector would need to assist developers wherever possible in achieving these standards, and that a partnership approach should be adopted in delivering exemplar low carbon development.

In order to support developers in achieving low carbon developments, it was felt that the public sector should encourage energy service companies, the development of specialist infrastructure, such as anaerobic digesters, and knowledge transfer between key stakeholders within the district.

5.2 Planning policy for new development

5.2.1 Building Regulations driving low and zero carbon development

As outlined above, the phased housing growth in the district over the next 15 years will be shaped by a changing set of carbon performance standards in the Building Regulations. The Government has set out its intentions for improving the carbon performance of new developments into the future with its announcement of the tightening of Building Regulations for new homes along the following lines:

- 2010 – a 25% carbon reduction beyond current requirements;
- 2013 – a 44% carbon reduction beyond current requirements; and,
- 2016 – 100% carbon reduction beyond current requirements.

In the March 2008 budget Government also announced its intentions for all non-domestic buildings to be zero carbon by 2019. Therefore, the various phases of development in the district will face stricter and stricter mandatory requirements, and all development after 2016 is likely to need to be zero carbon. However, the aspiration for zero carbon development by 2016 is very challenging and will require innovative approaches from both the public sector as well as the development industry.

The delivery of low and zero carbon development for 12,740 homes will require substantial growth in the renewable energy output of the district, and the renewable energy assessment has considered the various approaches for delivering this. In addition, the delivery of large scale zero carbon development will require a suite of policy changes going well beyond the Building Regulations – as, in addition to thermal property improvements, it necessitates overcoming technical and commercial barriers related to renewable and low carbon energy supply.

5.2.2 Setting renewable energy and carbon reduction policy within the LDF

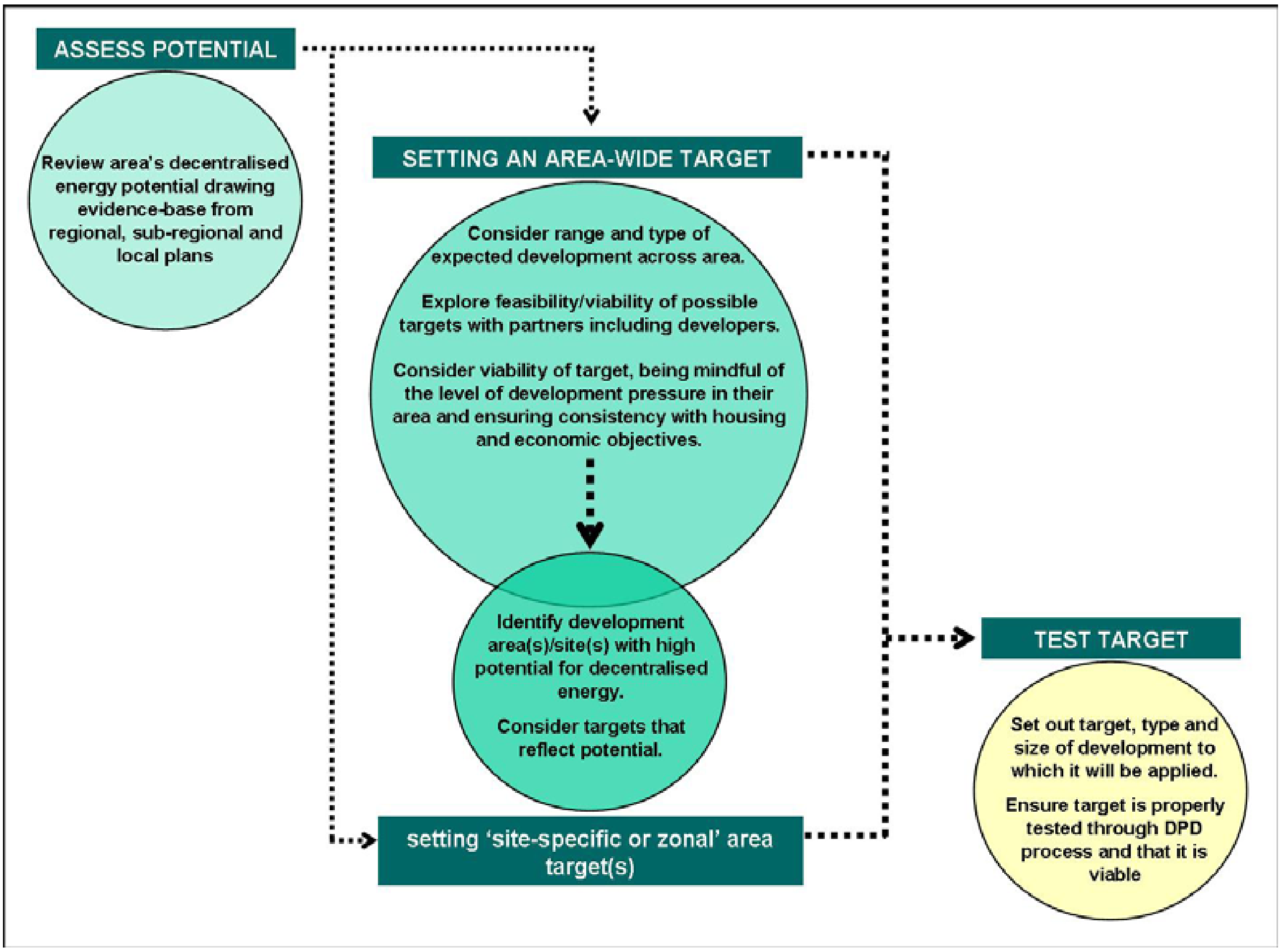
The tightening carbon requirements in the Building Regulations will nonetheless allow developers flexibility in terms of their choice of technology and approach to meeting carbon targets. Winchester needs to determine how to embed these carbon requirements within its LDF and to shape the interpretation of the Building Regulation requirements within the district.

The two key variables in terms of crafting LDF policies for new developments are the level of carbon reductions required and the flexibility allowed in meeting these requirements. Although it represents an example of regional planning policy, the London Plan is a very good example of highly prescriptive planning policies that even prescribe the balance of technologies required depending on the nature of the development. If planning policy is only prescriptive over carbon targets and is not able to exercise some degree of control over the choice of technology, then developments may opt for technologies that may be inappropriate for the particular location or 'sterilise' the ability of the development to achieve very low to zero carbon status in the long term. As outlined in chapter 4, the type of development and the scale of the development all determine the most appropriate technical approach and the level of carbon reductions that are achievable. In general, larger developments are able to achieve significant carbon reductions more cost effectively than small developments.

When considering carbon requirements within the Winchester District Development Framework, the key question is whether the proposed Building Regulation improvements are adequate or whether Winchester would like to set stricter requirements. Tighter requirements could be set for all new development in the district or site specific policy could be set for specific developments. The site specific policies would need to be evidence based policies that are underpinned by analysis of what is possible for the development considering its size, density and mix, and the renewable resource at that locality.

The figure below outlines the approach of using the evidence base of the low carbon and renewable energy potential resource within the district to set carbon standards for new developments. The carbon targets for specific developments would not only be based on the potential renewable resource around the district, but also, perhaps more importantly, the specific characteristics of the developments themselves and the specific characteristics of the development sites.

Figure 12: Approach to setting low carbon targets for new developments[37]



5.2.3 Regional Policy Guidance – South East Plan

The South East Plan provides guidance on the types of policies that local planning authorities in the south east should include in their LDFs. The South East Plan encourages local planning authorities to include policies that promote renewable energy and combined heat and power and district heating, as is outlined in Policies NRM 11 and NRM 12.

POLICY NRM11 (formerly EN2)

'In advance of local targets being set in Development Plan Documents, new developments of more than 10 dwellings or 1000m2 of non-residential floorspace should secure at least 10% of their energy from decentralised and renewable or low-carbon sources'

POLICY NRM 12 (formerly EN2)

'Local Development Documents and other policies should encourage the integration of combined heat and power (CHP), including mini and micro–CHP, in all developments and district heating infrastructure in large scale developments in mixed use.'

[37] From Working Draft of Practice Guidance to support the Planning Policy Statement: Planning and Climate Change, CLG (ERM & Faber Maunsell) March 2008

Therefore the South East Plan recognizes the importance of CHP and district heating in terms of enabling larger development to attain high carbon standards. However, different planning authorities might take different approaches to the encouragement of CHP and therefore this policy could be undermined by developers unless it is strongly promoted by the planning authority.

Policy CC4 of the South East Plan mirrors the policy recommendations of PPS 1 in stating that local planning authorities can set site specific carbon reduction requirements that are stricter than national requirements if the evidence base demonstrates that this is possible.

Policy CC4

'There will be situations where it could be appropriate for local planning authorities to anticipate levels of building sustainability in advance of those set out nationally…. When proposing any local requirements, local planning authorities must be able to demonstrate clearly the local circumstances that warrant and allow this and set them out in Development Plan Documents'

The larger developments in the district could aim for tighter carbon standards than the national requirements require in the period before 2016. All developments that are large and dense enough to support CHP systems are theoretically able to achieve zero carbon performance through biomass CHP and PV or a large wind turbine. However, a detailed study of each specific development site will highlight whether or not the conditions are appropriate for a biomass CHP system and a wind turbine, and whether zero carbon status can be achieved at an acceptable cost.

5.2.4 Timescales of Winchester District housing growth and the changing Building Regulation standards

The various phases of housing growth in the district over the next 15 years will be captured by these differing Building Regulation standards. When determining whether there is a need for carbon reduction policies in the LDF that are in advance of national requirements, it is a useful exercise to assess the projected timescales of the housing growth and identify the numbers of units which will precede 2013 and 2016. If most of the development will come after 2016 then the benefits of prescribing and justifying tighter requirements in advance of this date will be minimal.

If Winchester is keen to encourage zero carbon developments before 2016, then it will need to provide an evidence base that demonstrates the local circumstances that enable zero carbon status to be achieved at the particular location. As outlined above, zero carbon developments are theoretically possible at any location if the size, density and mix of uses suit biomass CHP – as the biomass fuel can be brought from outside the district. PV or a large wind turbine contractually linked to the development are also likely to be needed.

If the phased build-out rate of new housing within Winchester follows the projection figures outlined in the Winchester District Annual Monitoring Report 2007[38], then approximately 7,500 housing units will be constructed before 2016 and approximately 5,000 units will be built after 2016. Therefore, less than half of the development would be captured by the 2016 zero carbon requirement. Winchester City Council needs to assess the likelihood of these build-out rates being achieved, and also the specific developments that are likely to come forward earliest. If the first phases of the larger scale developments are coming forward in the earlier years, and these first phases are planning energy solutions that are only achieving relatively small carbon savings, then they might miss the opportunity for putting in place zero carbon infrastructure across the whole of the large scale development. Under the current economic conditions, the pace of housing development within the UK has slowed right down, and therefore it is very likely that the housing projection figures will fall back a few years. In which case, the number of housing units which will be built after 2016 will be larger than 5,000 units and the effect of tighter carbon requirements, and carbon standards that are in advance of national policy, will have a smaller corresponding impact on carbon emissions.

[38] Winchester District Annual Monitoring Report 2007, December 2007

5.2.5 Potential requirements for large new developments

It is technically feasible for all the developments, apart from the small scale urban infill, to achieve zero carbon status, i.e. reduce the net CO_2 emissions over the course of the year, resulting from all energy consumption within the buildings, to zero by using renewable energy on or near the site.

As outlined in section 4 above, it is very difficult with current technology for the average small scale urban infill to achieve very substantial carbon reductions unless the development can share energy systems with existing neighbours. This is mainly due to the fact that PV will be relied on to generate electricity and with limited space to integrate PV in dense urban infill it may not be technically feasible. However, for larger urban extension developments of over 1000 dwellings, the chances of achieving zero carbon status are greater if biomass or gas CHP can be used to generate renewable electricity. The large developments, such as urban extensions, are more easily able to achieve zero carbon status using a range of renewable technologies and communal heat networks, with the majority of electricity provided by wind energy, biomass/gas CHP and PV.

The key issue regarding whether the larger developments in Winchester District can achieve zero carbon status, is whether they can be built in conjunction with large wind turbines that can provide large amounts of zero carbon electricity? The available wind resource for the district has been shown to reside primarily in the north of the district, whilst the large scale new development will be located mainly in the PUSH area in the south. Nonetheless, this does not mean that the district's wind resource is incompatible with the energy demands of the new development, and in fact the new developments can still establish a contractual relationship with wind turbine installations located away from the site. Winchester City Council and PUSH could pay a role in stimulating and sanctioning such relationships between housing developers and commercial wind developers, or between developers and a local community owned wind farm. The council could play a key role facilitating community owned wind farms, thus reducing opposition to renewable energy development among residents. Keeping the facility under community ownership could also keep the revenues from energy production in the local economy. The Code for Sustainable Homes requirement for all energy to be generated 'on site' presents a challenge to the inclusion of renewable energy supply that is located elsewhere within the district. However, the Department of Communities, Local Government and the Regions is aware of the difficulty of all renewable energy generation having to be located within the boundaries of the site, and is currently considering the potential of local renewable energy generation that is physically off site but contractually linked to development sites. In addition, there is nothing to stop the Council from defining renewable energy that is generated from within the district as being a legitimate source of local zero carbon energy for all new housing development in the district.

5.2.6 Planning policy to support developers in achieving low carbon standards

Even if Winchester decides that the carbon requirements within the phased Building Regulation improvements are strict enough, there are still a number of measures and policies that need to be implemented within the LDF to help ensure that developers meet these standards. A key issue is ensuring that developers install the correct energy supply systems so as to enable continued carbon reductions into the longer term. It is important that developers do not opt for cheaper strategies in the earlier phases which jeopardise the ability of the development to achieve significant carbon savings in the longer term (post 2013/ 16). In particular, developers need to plan for a communal system from the outset so as to ensure that greater carbon reductions are achievable. If developers concentrate on individual building systems for the earlier phases in the period pre-2016, then it will be difficult to introduce successful communal systems in the later periods.

The technical energy solutions for different development types outlined in chapter 4 provide a useful guide to the energy strategies that developers will need to install in order to achieve very high carbon standards. A detailed understanding of the technical requirements for different development types will also enable the planning authority to outline in detail what they expect from developers - which will aid planning negotiations. It will also help ensure that energy strategies for phased developments are future-proofed so that they do not opt for individual building solutions in the early phases which jeopardise the viability of a development-wide CHP and district heating scheme.

The inclusion of a large wind turbine can be an important element of a low carbon strategy, but in order to progress this option the developer will need to arrange a contract with a wind turbine developer and a land-owner. This presents additional challenges for the developer and the Council may need to assist the developer in forming relationships with adjacent land-owners and in encouraging land-owners to opt for installing turbines on their land. It is unlikely that a large wind turbine can be located on the actual development site as it would be too close to housing, and it will therefore need to be located on land close to the site. This will require the LDF to specifically allow for 'offsite' renewable energy in supplying energy to new developments, so that developers can use a wind turbine located on land nearby to provide power for the development. There are additionality issues that will need careful consideration for each development.

5.2.7 Supporting CHP and district heating infrastructure

Characteristics of communal infrastructure

As outlined in chapter 4, shared low carbon infrastructure has an essential role to play in enabling carbon reductions in the built environment and in facilitating the exploitation of renewable energy. District heating networks are particularly important in terms of enabling the efficient use of biomass fuel through combined heat and power (CHP) systems or enabling advanced technology energy-from-waste CHP plants to provide heat and power to communities. Planning policy needs to be proactive in encouraging these networks, and in encouraging buildings to connect to these networks – and the approach can vary from prescriptive requirements to more general policies of encouragement.

Combined heat and power and biomass heating are vitally important low carbon technologies, and yet their use is generally dependent upon district heating networks in order to distribute the heating to housing and other buildings. CHP and district heating suffer a general lack of support policy and are not favoured by the UK's energy market place. The challenge of realising the carbon savings from CHP and biomass heating within the existing built environment is generally wrapped up within the challenge of developing district heating networks which require high capital investment and long payback periods. CHP and district heating require support from both planning policy and financing mechanisms. The public sector can further assist heat network development by using their buildings as 'anchor heat loads' to form the basis of heat network development. Large buildings with fairly constant heat demand such as leisure centres, hospitals, prisons and hotels are all effective anchor loads.

Heat mapping

It is possible to quantify the potential for district heating, and the associated carbon savings of connecting existing buildings to a heat network, through producing a 'heat map' for the Winchester District. The heat map would quantify the areas of greatest heat demand within the district and thereby highlight where CHP and district heating networks would be most effective. The data collected includes what building types and floor areas are present and what their, heating, cooling and power demands are. This helps to build up an existing heat, cooling and power density map which identifies where CHP can provide an excellent carbon reduction solution within the district.

Linking existing communities to emerging heat networks

CHP and district heating has the greatest scope for delivering carbon reductions in existing buildings which are more energy inefficient than new developments and are therefore responsible for greater carbon emissions. In addition, the more energy efficient a building is, then the lower its heating demand, and therefore the less significant the carbon savings from a CHP plant. The establishment of CHP and heat networks within existing communities is very difficult however, due to the competition provided by the incumbent heating system. New policy mechanisms will be required in order to capitalize on the low carbon infrastructure for new communities, and develop this into existing communities. Measures will be needed to encourage and enable the roll out of district heating, through planning policy and enforcement, through connecting public sector buildings and through establishing a financing mechanism to help reduce the level of risk and help integrated networks get started.

Overcoming project risk and enabling commercial delivery

The installation of low carbon infrastructure, such as heat networks for large developments, requires considerable financial investment, and yet due to the long term phased construction of the development the returns on this investment will not be received until many years into the future. For this reason a support mechanism may be required to provide infrastructure funding for combined heat and power and district heating systems under current market conditions.

The government has established the Community Infrastructure Levy (CIL) to provide funding for long term infrastructure. However, the CIL is currently focussing on other types of infrastructure, such as transport and social infrastructure, and is unlikely to provide any finance for energy infrastructure. Nonetheless, the structure and management of the levy is a useful example of how local or sub regional funds could be established to support the development of low carbon infrastructure.

Infrastructure funding could be partly achieved through capturing the increase in land value that occurs when development is permitted, which means that developer contributions can be harnessed without stifling development incentives. However, general funds raised in this way will have many demands placed on them and therefore a separate fund for energy infrastructure is likely to be needed with the public sector providing the initial lump sum which is then repaid through developer's energy contributions (see Non-Planning Policy section below).

This council operated ring fenced 'carbon investment fund' could provide the upfront capital needed for financing large scale low carbon infrastructure such as CHP and district heating networks that can supply phased developments. The carbon investment fund would bring forward the value of staged developer contributions to early stage investment and would be reimbursed through payments from private sector developers as their developments are rolled out.

5.2.8 Consideration of low carbon development through on site and off site renewable energy

It can be difficult to achieve very low or zero carbon developments through generating all energy needs within the boundaries of the development site – known as on-site renewable energy. To deliver low to zero carbon developments through on-site renewable energy for 12,740 housing units and associated infrastructure in the district is likely to be very expensive and require large numbers of micro-renewable energy installations in new developments with consequences for the appearance of the new developments and the urban landscape of the district.

A balanced approach to energy supply with contributions from both onsite and offsite low carbon energy could help achieve the optimum technical and financial solution. Allowing off-site renewable energy generation for new developments could improve the technical potential of achieving low to zero carbon development and also substantially reduce the cost of doing so. However, it would raise a number of questions such as how to link the off-site renewable energy to the specific development (would it need to be a physical link or only a contractual link?) and whether financing mechanisms would need to be established in order to enable developers to invest in renewable energy projects within the district.

The policy considerations for enabling on site and off site energy generation for low to zero carbon developments are outlined in the tables 18 & 19 below. The Government is currently considering the definition of a zero carbon development and the potential for allowing offsite renewable energy within the definition of a zero carbon site.

In order to allow a contribution from offsite renewable energy, the Council may need to draft rules to ensure that offsite installations are additional to any commercial renewable energy developments that may have occurred anyway within the district. This could involve the establishment of a centrally held registry of offsite schemes in the district so as to monitor the developments that are benefiting from more distant installations.

Table 18: Policy considerations for enabling greater **onsite** renewable energy generation within developments

PLANNING	INFRASTRUCTURE	FINANCE
Large quantity of micro-renewables installed on buildings Redirect S106 from other areas to renewables Need to allow innovative, new housing design Requiring district heating in all large new developments	Displaced finance from other infrastructure needs, eg education/ affordable housing Local district heating Grid connections	Very expensive approach Challenge for embedding CHP & DH within phased construction Cashflow Heat/ power/ carbon contract uncertainty

Table 19: Policy considerations for delivering greater **offsite** renewable energy generation (within the district) for developments

PLANNING	INFRASTRUCTURE	FINANCE

Need to agree planning mechanism for 'connecting' offsite renewables to specific developments	District heating network for connecting offsite CHP plant to development, and linking into other existing development	Need financing mechanism for developers to subsidise offsite renewables – wind, biomass, energy-from-waste
Revised criteria for wind development targets/ allowances in LDF		Carbon purchase/ additionality arrangements
Buy-in from councillors and public		Financing vehicle may need to be hosted by public sector

5.2.9 Impact on Developers of renewable energy requirements - consideration of 'undue burden'

Consideration of undue burden is a key element of assessing what carbon requirements are acceptable for the district, or for specific developments within the district. The Department of Communities and Local Government published a cost analysis of the Code for Sustainable Homes in July 2008 which estimates the cost of achieving the carbon requirements within the different levels of the Code. Due to the different costs associated with different development types, the cost analysis has been undertaken for different sizes and types of development, and different housing types. It also highlights the lower costs of achieving the carbon reductions when wind energy can be utilised. This analysis illustrates that if contracts are established with large wind turbines to supply the development, then the unit cost of achieving CSH Levels 5 & 6 could be relatively low.

Table 20: Costs of achieving the carbon requirements of CSH Levels 4, 5 & 6 WITHOUT wind[39]

	Code Level	**Detached**	**End terrace**	**Mid terrace**	**Flat**
Small development	4	£10,914	£5,880	£5,133	N/A
	5	£22,367	£13,292	£11,933	N/A
	6	£40,228	£29,393	£29,172	N/A
Market town	4	£9,868	£7,115	£6,187	£5,054
	5	£17,132	£12,353	£10,742	£9,962
	6	£32,752	£24,822	£24,696	£18,996
Urban regeneration	4	£8,223	£5,930	£5,156	£4,782
	5	£14,254	£10,278	£8,938	£8,289
	6	£31,125	£23,631	£23,569	£16,775

Table 21: Costs of achieving the carbon requirements of CSH Levels 4, 5 & 6 WITH wind[40]

	Code Level	**Detached**	**End terrace**	**Mid terrace**	**Flat**

[39] Cost Analysis of The Code for Sustainable Homes, DCLG July 2008

[40] Cost Analysis of The Code for Sustainable Homes, DCLG July 2008

Small development	4	£7,458	£5,586	£5,500	N/A
	5	£18,722	£10,687	£8,539	N/A
	6	£36,583	£24,721	£24,756	N/A
Market town	4	£2,600	£2,000	£1,782	£1,593
	5	£3,053	£2,600	£2,600	£2,600
	6	£13,065	£8,771	£8,950	£8,685

The additional cost on developments consists of the capital costs of enhanced energy efficiency measures, building integrated technologies (PV, STHW, GSHP) and communal infrastructure (heat networks, additional cabling). These costs illustrate that the marginal cost of delivering further carbon reductions in new developments gets higher as you progress towards CSH 6 and achieving a zero carbon development. The cost of achieving the carbon standards under CSH 5 & 6 assumes that a communal system approach is adopted, and the costs of achieving zero carbon status through individual building systems would be significantly higher than the figures presented. Therefore communal systems can help reduce the burden on developers in achieving carbon reduction standards. An assessment of the cost implications of achieving CSH levels 4 – 6 would need to be undertaken for each specific development, and the issue of undue burden would therefore also vary from site to site. Developers can work in partnership with an Energy Services Company (ESCo) to finance, maintain and operate the energy system for a new development and therefore reduce the costs and the level of burden that they face.

The onus should be on the developer to prove if and why they cannot meet certain carbon targets. In evaluating the impact of the carbon costs on the viability of the development, the developer would need to consider the current state of play of all other development costs as well the market sales prices and land value at that time. Interpretation of the results also requires a judgement being made as to whether the additional costs will be born by the end consumer (the buyers of the homes and buildings), the landowner (who could take a drop in sales price) or the developer. This requires analysis on a case by case basis depending on what is likely to be born by the market at time of selling and if the developer either already owns the land or has an option on it.

The impact on developers isn't only that of cost, and there is also the challenge for developers of installing energy infrastructure, understanding the energy supply business and working with ESCos. Many developers have considered the recent focus on low carbon developments to be a huge burden due to their lack of understanding of the issues. Nonetheless, the knowledge of the development industry is advancing all the time and as a result the knowledge barrier is decreasing all the time. Even though the carbon standards in the Building Regulations will continue to get tighter, the skills and knowledge burden on developers is unlikely to increase because their understanding is constantly increasing.

The sections below on ESCos and special purpose vehicles outline the approach that developers need to take in order to reduce the costs of delivering low carbon developments – and thereby manage the degree of burden that is caused by low and zero carbon building requirements.

5.2.10 Diverting finance to more cost effective carbon reduction measures within the district

If it is considered too expensive to deliver zero, or very low carbon developments immediately, then the LDF could require developers to pay to offset all the residual emissions from their developments following the approach taken by Milton Keynes Council. Therefore, if the Council sets a policy requiring developers to achieve CSH Level 4, rather than 5 or 6, then it could also require all developers to pay money into the offset fund to offset the residual emissions – note that the difference in cost between CSH 4 and 6 can be up to £30,000, whereas similar reductions in carbon emissions within existing houses can be delivered at a far smaller cost. The Council would need to establish a 'carbon offset fund' into which these payments are deposited, and then distributed to energy saving schemes within the district, such as insulation, renewable energy projects or district heating infrastructure. Milton Keynes Council has set a cost per tonne of carbon that it requires developers to pay which is based on the cost of delivering carbon savings through loft and cavity wall insulation in existing homes. If this money is invested in loft and cavity wall insulation then it will exactly offset the carbon emissions from the new build, which could then be viewed as a 'carbon neutral' development.

However, in order to claim that the new developments are carbon neutral, it is essential that these carbon reductions in existing housing are 'additional' savings – ie that they wouldn't have happened unless they were financed by the carbon offset fund. It is difficult to judge whether these improvements would have happened even without the financing from the carbon offset fund, but there are a number of national home insulation schemes that are already operating, and that also seek to finance the lower cost measures of loft and cavity wall insulation. Further to this, as the policy focus on climate change continues to increase, the number of measures and funding targeted at existing housing is also likely to continue to increase so that the lower cost measures are further targeted.

The carbon offset fund could nonetheless be a very effective mechanism in the years up to 2016 if a planning authority feels that it is too expensive a demand to expect developers to deliver zero carbon developments. They could require the developers to provide carbon neutral developments by covering the costs of their residual carbon emissions based on an agreed market price per tonne of carbon. The definition of a 'zero carbon development' adopted here is that of all heating and power needs being supplied from local renewable energy, whereas a 'carbon neutral development' is one which offsets its (remaining) carbon emissions through investment in external carbon saving measures.

5.3 Overview of potential policy measures for the LDF

5.3.1 Low carbon requirements for new development

Key policy options consist of:

- Follow Government's projected improvements in Building Regulations
- Prescribe stricter requirements for all development in the district
- Allocate site specific targets (eg bringing in zero carbon requirement before 2016) - Site specific targets in advance of national standards could be set for the large sites as it will be technically possible to achieve zero carbon status due to the potential for large wind turbines within the north of the district

Issues to consider when drafting the LDF policies include:

- Decision depends on the aspirations within the council and the district for sustainable low carbon development
- Planned Building Regulation improvements are challenging for developers – and they are likely to argue against even tighter targets
- Would the tighter standards deliver significant carbon savings? The housing projections within the 2007 AMR outline that approximately 7,500 units will be built before 2016, and therefore the carbon savings of requiring that these 7,000 units are built to zero carbon standards rather than 2006 Building Regulation standards could amount to approximately 40,000 tCO_2 pa.
- Site specific targets can be informed by energy studies for those specific sites – and these studies can prove what carbon reduction target is practical for the specific site. For this reason, a site specific target that is stricter than national requirements, could be feasible whereas a stricter requirement for the whole district would be very difficult to justify (this is also stated within the South East Plan). The use of biomass CHP plant for the large new development sites could deliver very low to zero carbon developments, but the ability to achieve zero carbon status at an acceptable financial cost will require a specific assessment of each specific development site. If wind turbines located offsite are contractually linked to developments that it would be possible to achieve zero carbon status at any large development site.

5.3.2 Future-proofing for low to zero carbon developments

Key policy recommendations are:

- The LDF should prescribe the energy systems/ renewable energy/ low carbon technologies that it expects developments of particular scales, density and mix to incorporate as defined in section 4, and ensure that developers are installing communal systems where applicable
- Allow developers to utilise 'offsite' as well as 'onsite' renewables in order to achieve high carbon standards

- Develop rules to ensure that offsite renewables are additional to any commercial renewable energy developments that would occur anyway within the district
- Encourage housing developers to work with wind turbine developers so as to establish contractual relationship with offsite wind turbines that are located within the district or county

Issues to consider when developing these policies include:

- The assistance it will provide to planning negotiations, as the LDF will outline in detail what is expected from developers
- It will also help future-proof energy strategies for phased developments – so that developers don't opt for cheaper strategies in the earlier phases which jeopardise the ability of the development to achieve significant carbon savings in the longer term (post 2013/ 16)
- Developers may be unhappy that the LDF prescribes the type of energy supply strategy that they should follow for their development – and they may argue that they should be allowed flexibility in how they meet carbon reduction targets
- Allowing offsite generation that is linked to the development either through a physical connection or contractual arrangements will make it financially & technically easier for a zero carbon development to be achieved, and thereby help reduce carbon emissions from new development in the district
- Offsite generation is currently not allowed under CSH rules and so this will need to change in order to enable planning authorities to establish the offsite mechanism
- Would require careful development of arrangements that link the renewables to the new development and ensure additionality
- Would the offsite infrastructure need to be within the district to count as local renewable energy generation, or would the wider sub region or county also be acceptable?

5.3.3 Facilitating the development of shared infrastructure and renewables

Key policy recommendations are:

- LDF requirements to focus on CHP for large developments rather than building-integrated renewables
- Undertake heat mapping for the whole district to show where CHP and heat networks may be feasible in both planned and existing development
- Requirement for CHP and district heating in all new mixed use developments above a certain scale and density
- Ensure that the master plans for the key growth sites contain comprehensive zero carbon methodologies addressing buildings and low carbon infrastructure.

Issues to consider when drafting these planning policies include:

- In terms of achieving CSH levels 3 & 4 carbon standards, the Council could outline that developers should focus on communal energy infrastructure rather than just opting for the smaller building integrated renewables. Developers may not like being constrained by these technology requirements and may try to argue against them.
- Heat mapping will highlight where heat networks could be feasible, and this could form the basis for encouraging ESCOs to establish networks within the district. The Council will still need to provide policy support that enables ESCos to develop networks, and in particular provide support in creating a local heat demand – through using public sector buildings as an anchor load and encouraging other building owners to join the network.

5.3.4 Managing 'undue burden' on developers

Key policy issues are:

- Incorporating Government intentions for Building Regulation improvements within the LDF should not be considered an undue burden on developers in Winchester.
- Site specific targets in advance of national standards could be set for the large sites as it will be technically possible to achieve zero carbon status due to the potential for large wind turbines within the north of the district. This should not be considered an undue burden as it is an affordable option and would have the benefit of stimulating renewable energy development within the district.

- The LDF should outline that the low carbon energy supply market is developing all the time and that what constitutes an ‘undue burden’ is therefore reducing over time.

Issues to consider when drafting the policies include:

- Developers might argue that the low carbon requirements are an undue burden and that the requirements jeopardise housing growth targets for the district
- The long term Building Regulation upgrades provide a clear message of development requirements and any additional costs that this leads to should be fed through into land value. Conversely, if the LDF demands stricter requirements in the short term then there won’t be time for any potential additional costs to feed through into land values.

5.3.5 Enabling carbon neutral developments through a Carbon Offset Fund

In order to ensure that all developments are carbon neutral from now onwards the Council could establish a ‘carbon offset fund’ in a similar way to Milton Keynes Council which requires developers to pay to offset all the residual emissions from their developments. The Council would need to establish a ‘carbon offset fund’ into which these payments are deposited, and then distributed to insulation schemes within the district. The issues to consider include the decision concerning the cost per tonne of the offsets and the challenge of ensuring the carbon savings are additional to what would have happened anyway.

5.3.6 Encouraging district wide renewable energy installations

In order to encourage the delivery of district renewable energy targets the Council could potentially set renewable energy approval or growth targets in the same way as housing growth targets. However, achieving these approval rates for renewable energy installations would be very difficult to enforce as they would be dependent on renewable energy developers finding commercial opportunities within the district. Approval rates would, however, encourage the planning authority to look favourably on planning applications for renewable energy developments.

6 Non-planning delivery mechanisms for enabling low carbon development

6.1 Introduction

Planning policy alone will not be able to deliver renewable energy targets for the district, and a range of policy measures covering economic development to council initiated energy projects will also be required. The Winchester District Climate Change Strategy and action plan covers a number of these areas, but they will need to be developed further in order to ensure that renewable energy development is facilitated and encouraged within the district.

6.2 Planning low carbon infrastructure

6.2.1 Coordinating the development of low carbon infrastructure

Managing and financing energy infrastructure for long term, phased development projects is extremely challenging. Large combined heat and power systems are a very cost effective low carbon strategy but they are difficult to establish in phased development. The Council needs to encourage developers to engage with expert entities in order to most effectively progress energy infrastructure within their developments. Key steps include:

- Planning & delivery of low carbon infrastructure should be carried out by an entity with long term interest in assets, such as an Energy Services Company (ESCo);
- Developers should be encouraged to engage early with ESCos to facilitate a more effective approach to rolling out low carbon infrastructure;
- A Special Purpose Vehicle could be established to lead early client negotiation and mitigate risk before bringing proposals to market.

6.2.2 ESCOs within the district?

The Council and its partners could also seek to establish an ESCO for the district which works to install sustainable energy systems within both the new development and existing buildings. A special purpose vehicle for Winchester could particularly help in rolling out CHP and district heating to existing communities, and thereby help realize the substantial carbon reductions that CHP can deliver to existing buildings. This ESCo could either be established at the district level or at the PUSH level. The term ‘Energy Services Company’ or ESCO is applied to many different types of initiatives and delivery vehicles that seek to implement energy efficiency measures or local energy generation projects. ESCOs are established in order to take forward projects that the general energy market place is failing to deliver – and in this way ESCOs are designed to overcome the market and policy failures that affect local sustainable energy projects. There are a number of commercial ESCOs in existence which can support developers in designing, installing and operating a communal energy system for a new development. These ESCOs may either operate the energy system entirely themselves or enter into an arrangement with the developer and other entities in order to establish a new ESCo specifically designed to operate the energy infrastructure of the new development. These development specific ESCOs tend to be arranged so that they are part, or wholly, owned by the residents of the development, and are therefore often referred to as ‘community ESCOs’.

An ESCO can take many forms and be designed to progress small energy projects or large projects. Different ESCO applications include:

- Low carbon energy supply for a new development
- District heating or CHP scheme for social housing and / or other community and private sector customers
- Community renewables projects
- Retrofitting energy efficiency measures into buildings or energy management in buildings
- Pre-commercial energy development/ projects and small bespoke projects.

There is no standard definition of an ESCO in the UK, but existing ESCOs can be categorised in a number of ways. Perhaps one of the most informative approaches to categorisation is to consider the balance of private and public sector involvement and ownership. An ESCO can be entirely owned by the public sector or be an entirely private entity.

There are essentially three different types of ESCO:

- Public sector driven
- Private sector driven
- Community driven.

For an ESCO established to progress an energy system within a new development, it will generally be given a long lease for the energy centre building and plant and the distribution systems with the responsibility to operate, maintain, and replace as necessary. A key benefit of a community ESCO being wholly owned by a residents' management organisation is that a commercial ESCO's assets could be sold off in the event of bankruptcy. Implementing a full ESCO project is a long and complex process which relies upon expert business, procurement, legal and technical advice. Contracts bring together the procurement, finance and management arrangements for an ESCO. The particular procurement strategy that is followed for an ESCO will differ from case to case, but will follow the basic contract structure of a relationship between a technical energy expert company and the entity that requires their services. Contract Management will be an important element of the long term monitoring of the successful delivery of the output specification and the successful relationship with the expert energy services partner. Good partnership working is essential to the viable and successful operation of a CHP and decentralised generation scheme.

6.2.3 Public sector led ESCOs

Public authorities can lead the establishment of ESCOs generally with the desire to bring-on the market for energy services, particularly with respect to low carbon, decentralised energy supply, where they identify gaps in the commercial market. Local authorities are the principal candidates for this but other public agencies including regeneration organisations, NHS Trusts, Regional Development Agencies and the sub-regional partnerships can drive them forward. Local authority led ESCOs are typically established to progress energy efficiency refurbishment and CHP in social housing or council buildings, or to deliver renewable energy projects for council buildings or the local community. There are a number of local authority ESCO facilitated projects which have overseen the roll-out of CHP services to include private sector customers, such as in Woking and Sheffield town centres. More recently local authorities have begun to set-up ESCOs to install sustainable energy infrastructure as a component of large regeneration projects.

Typical features include:

- Led by Local authority, RDA or other public organisations such as NHS Trusts and sub-regional partnerships
- Private sector partners often also involved
- Umbrella approach – where a series of projects being brought forward over time
- Focus on initial delivery to own stock / estate
- Roll out of services to town or new growth areas
- Long term view of payback
- Public sector discount rates

A local authority is able to set-up an ESCO by using the following powers and duties:

- Well being power permitting local authorities to do anything which they reasonably consider will improve the well-being of their area;
- The duty of a local authority to secure best value in the performance of its functions.

Local authority ESCO activity is controlled by the rules governing local authority borrowing, trading and charging for services and public procurement legislation. Key relevant legislation concerns the supply of utilities, and particularly electricity which is heavily regulated with complex licensing arrangements. Although a local authority led ESCO might be entirely public sector owned and operate as a public body or quasi-public body, it may deliver its services through contracting private sector companies.

An ESCO or special purpose vehicle led by a public sector organisation may be needed if a low carbon project is not being taken forward by the market place due to financial or technological risks. An ESCO can be designed so as to manage these risks and enable a project to proceed. Nonetheless, a local authority or community group will only want to go down the path of establishing an ESCO if the energy project they wish to pursue is of no interest to an existing ESCO or if certain market risks cannot be reduced through other actions by the public sector, such as guaranteeing revenue streams for the heat or electricity generated by a renewable energy installation. Establishing an ESCO is not a simple short term task and the there are risks involved so it is important the need for an ESCO is fully established at the outset.

When developing the plans for a low carbon project, it is sensible to test the business case with energy experts and existing commercial ESCOs that have implemented similar projects. Nonetheless, the local community or local authority might want to maintain a significant degree of control over the project to ensure that it delivers certain social and environmental objectives, and therefore might wish to establish its own ESCO in partnership with an existing private sector ESCO which could undertake the technical implementation.

6.3 Financing low carbon infrastructure

6.3.1 Addressing investment challenge for communal infrastructure such as district heating

A 'carbon investment fund' could help overcome the high upfront costs of energy infrastructure with the public sector providing the initial lump sum which is then repaid through developer's energy contributions. This council operated ring fenced carbon investment fund could provide the upfront capital needed for financing large scale low carbon infrastructure such as CHP and district heating networks that can supply phased developments. The carbon investment fund would bring forward the value of staged developer contributions to early stage investment and would be reimbursed through payments from private sector developers as their developments are rolled out.

Key actions to overcome potential investment shortages include:

- A ring fenced carbon investment fund may be needed to bring forward value of staged developer contribution to early stage investment (initially financed by the public sector, but reimbursed through payments from private sector developers);
- Contractual complexities & residual uncertainties need to be managed through secured rights to sell energy & carbon benefits to customers into the future (ESCos need to know the size of market for heat & power, timing of development, & price of future energy);
- Housing developer investment needs to be channeled towards shared offsite renewable developments and carbon investment fund could manage this role.
- Additional measures needed to mitigate early stage infrastructure development risk;
- Increased support for renewable energy development with mechanisms to contractually link offsite renewable energy infrastructure to new developments.

6.3.2 Managing contractual complexities & project uncertainties

Key actions to mitigate risk include:

- Council to work with developers and ESCos to help secure rights to sell energy & carbon benefits to customers into the future.
- Council to ensure that developers commit their buildings to the energy network with long term energy power & heat purchase contracts.
- Council to commit to long term power and heat purchase contracts with ESCos for their own buildings so as to help establish low carbon networks.

6.4 Council leading by example

The Council has a great opportunity to directly progress renewable energy installations and decentralized energy generation by taking forward projects on its own buildings and land. As outlined in section 6.2, the council could establish a local ESCO to help implement these low carbon energy projects.

The council has opportunities in terms of using its public buildings as an anchor heat load around which to establish CHP and a district heating network, establishing renewable energy installations on its buildings, such as

PV and solar water heating, and even a power supply agreement with a wind turbine located within the district. Key actions include:

- Public sector buildings to provide ‘anchor loads’ for district heating and low carbon infrastructure networks so as to lead the way in installing CHP and developing heat networks;
- Renewable energy installations on council buildings, including PV, solar water heating and small to medium wind turbines;
- Identify a number of public sector demonstration projects across the district;
- Develop an action plan for implementing these demonstration projects.

Appendix 1: Renewable Energy Workshop held at Winchester Guildhall

Renewable Energy Assessment for Winchester District Development Framework – Workshop Notes

Friday 5th September, 10am – 1pm at Winchester Guildhall

Group 1 – Breakout session 1

Wind resource

1. **How many turbines can be accommodated in the landscape?**
   - The concept of large wind turbines in the north of the district is perfectly acceptable. However, the political and planning processes would determine whether or not a turbine or turbines actually went ahead.
   - Challenge for wind is that the best wind sites are also in the most prominent/ visible places.
   - Grouping of turbines is likely to be best.

2. **How many landowners will be interested in having wind turbines on their land?**
   - Its very likely that farmers will be interested in having turbines on their land, as it will bring in extra income

3. **Will wind developers be interested in constructing and operating large scale turbines?**
   - The North of the district is more likely to get through planning process as the population is smaller and so there would be less political opposition
   - The housing developments in the district above Winchester – just south of Basingstoke – could connect to turbines in the north of the district
   - PUSH area in south of district has least wind potential but has most housing development….

Other comments

- Southampton Airport is likely to be a significant constraint for the district
- Could turbines be turned into an art feature?

Group 1 – Breakout session 2

Planning policy for new developments

1. **What are the aspirations within the council and the district for sustainable low carbon development?**
   - That government intended targets for zero carbon 2016 should be followed
   - LDF to support/enable this..

2. **What are the most appropriate renewable energy and low carbon technologies for new developments?**
   - CHP & biomass is needed for high standards, and zero carbon development
   - Need 'offsite' renewables for zero carbon development – CSH rules cause a problem here
   - Also need far more retrofit onto existing houses.

3. **What level of 'burden' is acceptable for developers in the district?**
   - What's possible in new developments? Is 2016 really achievable?

     - It will be difficult

     - Lots of competing objectives

- Doesn't have that much impact on house prices as average house price is £350k

- It's cost of land that matters – and the increased development costs need to be absorbed within land value

Group 2 – Breakout session 1

Solar resource

Notes

- Even if cost effective, will people be bothered?
- Many unknown variables e.g. elec. costs
- No feed in tariff – would require policy change/financial incentives
- Market likely to respond to demand
- Commercial → CSR?/bottom line if financial savings
- Who gains benefit in case of council housing?
- Are there better microgen technologies better for domestic customers?
- New products may make PV suitable for listed buildings
- Consistent policy for planning in cons. Areas
- Mandating unlikely – difficult to have blanket policy for all buildings
- Premium on the rent
- Opportunities in public sector in capital terms
- Likely to see more on new build due to CSH requirements

  - Fiscal incentives/grant for CC

  - Won't provide large scale power generation

Group 2 – Breakout session 2

Planning policy for new developments

1. **What are the aspirations within the council and the district for sustainable low carbon development?**
    - Strong social conscience in Winchester
    - Housing grant – Code 3
    - Climate Change policy in place
    - 30% reduction in Carbon Footprint by 2015

2. **What are the most appropriate renewable energy and low carbon technologies for new developments?**
    - D.H network(s)
    - Solar Thermal
    - GSHP
    - Biomass (Dry woodchip)
    - CHP – stand alone or in networks
    - Longer term – Biomass AD

3. **How can the LDF support developers in achieving CSH Levels 4, 5 & 6?**
    - Need for common policies in PUSH
    - Specify % Carbon savings for new developments
    - Possible AD infrastructures
    - Encourage establishment of an ESCO(s)

4. **What level of 'burden' is acceptable for developers in the district?**
    - Avoid disparities between PUSH authorities

- Solutions appropriate to the size and type of development

Group 3 – Breakout session 1

Biomass resource

1. **How much arable land should be used for biomass?**
    - Costs – providing facilities for generation
    - Exclude biomass from agricultural land from figures – as is likely to change over rapidly when food prices change
    - Other resources – residual waste from composting
    - Survey available woodland – hedgerow trimmings
    - Potential demand – appropriate uses boilers due for renewal transport impacts site access
    - Mapping for anaerobic digestion in preparation for economic viability later
    - Trans local authority agreements

Group 3 – Breakout session 2

Planning policy for new developments

1. **What are the aspirations within the council and the district for sustainable low carbon development?**
    - Consequences for following government timescales:

      - Higher fuel bills

      - Later need for retrofit

    - Want higher aspiration – bring forward targets – need to build in flexibility

2. **What are the most appropriate renewable energy and low carbon technologies for new developments?**
    - Technologies depend on cost-efficiency and is site specific

3. **How can the LDF support developers in achieving CSH Levels 4, 5 & 6?**
    - Knowledge transfer
    - Special purpose vehicles
    - ESCO

    Such initiatives should result in no extra burden for developers in the longer term

Group 4 – Breakout session 1

Wind resource

1. **How many turbines can be accommodated in the landscape?**
- SDNP – not a total constraint – see also SD Planning guidelines
- May be more potential for small-scale turbines
- How does potential relate to need?
- Prioritise different types of production?
- Need for more study on specific sites including EIA, bird impact, landscape etc

- Who develops them and is there demand in Winchester District?

Group 4 – Breakout session 2

1. **What are the aspirations within the council and the district for sustainable low carbon development?**
    - Danger of planning for 'do minimum' – requirements will increase
    - Justification for WCC to do more? - pollution, ecological footprint, environmental designations
    - CSH levels have been decided with industry, so why increase them or the local level?
    - CSH targets are challenging but perhaps better to raise renewables targets
    - Need to look at existing stock too
    - Gov't looking at requirements for this

2. **What are the most appropriate renewable energy and low carbon technologies for new developments?**
    - Best way of generating depends on size/type of scheme
    - Potential in larger town centres
    - Development has to be viable to go ahead
    - Question about efficiency of micro renewables for smaller schemes
    - Consider supply of wood alongside new development?
    - Will business use unmanaged woodland or new crops?
    - Requirements need to reflect type of developments to match best technology
    - Carbon reduction important as small scale, renewables at larger scale

Workshop Attendance

Group 1

Adrian Barker	North Whiteley MDA
Cllr Karen Barratt	Winchester City Council
Tony Langridge	Head of Estates Winchester City Council
Rob Parker	WinACC Renewable Energy Group
Cllr Frank Pearson	Winchester City Council

Group 2

Cllr Tony Coates	Winchester City Council
Chris Griffith-Jones	Head of Building Control Winchester City Council
Robert Hutchison	Winchester Action on Climate Change

Cllr Kelsie Learney	Winchester City Council
Beth Evans	Hurley Palmer Flatt
Mike Smith	Utilicom

Group 3

Cllr Eleanor Bell	Winchester City Council
Simon Finch	Planning Development Control Winchester City Council
Cllr Stephen Godfrey	Winchester City Council
Cllr Roger Huxstep	Winchester City Council
Steve Taylor	Radian Group
Alex Templeton	WinACC Renewable Energy Group

Group 4

Cllr Vivian Achwal	Winchester City Council
Michael Carden	City of Winchester Trust
Michael Emett	CALA Homes (South) Limited
Cllr John Higgins	Winchester City Council
Derek Moss	the Environment Centre
Martin Small	South Downs Joint Committee
Linda Thomas	Landscape Architect Winchester City Council