4. Physical Context: Renewable and Low Carbon Potential

4.1 INTRODUCTION TO THIS CHAPTER

This chapter considers the scale of potential for the introduction of renewable and low carbon technologies in Swale. Opportunities and constraints vary on a local level according to the features of the natural environment and the built environment.

Regional guidance

With the national government's abolishment of Regional Spatial Strategies (RSS), the role of regional planning has been diminished significantly. However, the information gathered at the regional level is still relevant and can help inform policy at the local and national levels. In January 2010 new guidance was published by the Department of Energy and Climate Change on undertaking **Renewable and Low-carbon Capacity Assessment Methodology for the English Regions** (2010). A capacity assessment, **Review of Renewable and Decentralised Energy Potential in South East England**, was undertaken.[11] This report contains the potential for renewable energy in the South East as a whole as well as for Swale specifically.

There are two recent background studies that include an assessment of the renewable resource potential that are of relevance to Swale. The **South East Regional Renewables Review** (June 2009) evaluates the applicability of the assumptions made in the **Development of a Renewable Energy Assessment and Targets for the South East** (2000) (which provided the basis for establishing the renewable energy targets set out in the South East Plan) against the latest thinking and provides an update to the resource assessment.

Progressing Renewable Energy in the SE of England (2008) was undertaken for the South East England Development Agency and in addition to reviewing the contribution and opportunity to meet renewable energy targets, it provides analysis on the drivers and barriers to the emerging renewable and low carbon energy sector.

Neighbouring Areas

The emerging PPS on low carbon planning promotes the incorporation of the renewable and low carbon opportunities in adjoining areas and an informed cross-boundary approach that supports coordination. Neighbouring Swale and also forming part of the county of Kent are the local authorities Medway to the northwest, Maidstone to the west, Ashford to the south, and Canterbury to the east.

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[11] South East Partnership Board (2010) Review of Renewable and Decentralised Energy Potential in South East England. Land Use Consultants and TV Energy. Available: http://www.se-partnershipboard.org.uk/page/5/view/175/sub/77/energy

Medway Council's Core Strategy is will be released in November 2010, and will include results from a study on renewable energy. While the study has not been completed, it is expected that it will recommend 20% renewable energy for all new major developments. The Core Strategy will likely also encourage district heating networks, where feasible.

Ashford Sustainable Energy Feasibility Study involved an analysis of the CO_2 savings potential for different developments. In depth analysis was undertaken on five pilot sites. The results came to a number of conclusions for developments in the Ashford Growth Area, including: heat networks are the most cost-effective solutions to meet maximum CO_2 reductions, including use of local biomass; economies of scale can be realised through a collective approach; and as developments increase in size, CO_2 emissions reductions become more cost effective and lower risk – this is particularly true for heat networks.

Both **Canterbury and Maidstone authorities** are in the process of producing their respective Core Strategies and, therefore, do not have any official guidance related to renewable energies.

Structure of Resource Assessment

This study will bring together an understanding of the current renewable and low carbon sector in Swale and undertake an assessment of future potential and how this relates to proposed development. This analysis can then be used alongside other planning and delivery considerations to develop a set of recommendations, policies and actions, in order to prioritise initiatives to reduce energy related carbon in the Borough.

The next section reviews the how renewable energy and low carbon technology currently contributes to Swale's carbon reduction strategy. This is followed by sections discussing the potential within the local authority for a range of technologies covering:

- Physical potential and constraints
- Delivery opportunities and constraints
- Possible carbon reduction over core strategy period
- Influence of planning
- Case study (where relevant)

4.2 CURRENT RENEWABLE AND LOW CARBON ENERGY GENERATION IN SWALE

Within Swale there are a number of organisations capable of installing a variety of technologies. There are many solar and solar thermal providers, a handful of wind installers, and a few businesses that specialise in wind, ground source heat pumps, or biomass. Their presence is evidence of demand for these services in the region and might represent a shift toward alternative forms of energy.

There are already a few renewable energy installations within the Borough. These include the Kent Science Park district heating network, the Kemsley Paper Mill CHP plant, and the Torry Hill Farm smaller district heating network. These are discussed below in the relevant resource section below in more detail.

Anticipated Development

There are a number of renewable energy projects, which have not yet been installed, but are anticipated in the near future. The Kent Science Park is in the process of installing a CHP plant, and the Kemsley Paper Mill has proposed an energy from waste plant. Ridham Biomass Steam turbines, which will have the ability to power 6,300 homes has been proposed, and Sheerness Port has also been granted planning permission to install 4 wind turbines (10MW). Partnerships for Renewables has put forth a proposal for wind turbines at the prison cluster on Sheppey. The Queenborough and Rushenden masterplan also includes plans to install a CHP plant. These proposed installations represent catalysts for increased adoption and installation of renewables in the Borough, and are discussed in the relevant sections below.

4.3 ESTIMATING BOROUGH WIDE LOW CARBON AND RENEWABLE ENERGY POTENTIAL

Before estimating the potential for the delivery of low carbon and renewable energy associated with future development, it is important to understand the opportunities and constraints around the use of different generation technologies across the Borough. Opportunities are likely to vary across the Borough, and its ability to meet the challenge set out above may be constrained.

As identified in the regional study, the greatest opportunities for renewable energy in the South East Region are in Thames Valley and Surrey, but Kent still has a significant role to play. The South East study does not consider or set targets for renewable heat, but there is also considerable potential for biomass fuelled heating, district heating and combined heat and power (CHP) in the South East. This chapter also considers the likely scale of renewable energy that will be brought forward by new development and the amount likely to be retrofitted to existing development.

This study focuses on the potential for renewables and low carbon technologies associated with wind, biomass, anaerobic digestion, district heating and combined heat and power. Other low carbon and renewable technologies that are applied at a smaller site scale associated with new development, such as heat pumps and solar technologies are also discussed in the micro-generation section of this chapter.. The following renewable technologies are excluded from the Borough-wide analysis for reasoning as follows:

- **Geothermal energy**: There is no known geothermal resource for large scale installations in Swale. Ground source heat pumps have been considered in the micro-generation and new development sections of this report.
- **Energy from sewage**: Energy from sewage requires coordination at a wider-scale and is heavily dependent on existing infrastructure; therefore, potential for energy from sewage has not been scoped.

- **Energy from waste**: While Kemsley Paper Mill has proposed an energy from waste plant, this utilises waste from the paper industry processes. Municipal waste is managed at a county level, and potential for energy from waste should be considered at a regional or county level, and is considered outside the influence of Swale Borough Council alone.

- **Energy from farm animal by-products:** The required data regarding number of farm animals in the Borough is not available, and generally does not contribute meaningfully to an LPA's renewable energy targets. Similarly, agricultural waste initiatives are best delivered at a wider scale.

4.4 ONSHORE WIND

Wind energy is a key opportunity to generate relatively large amounts of renewable electricity in the UK. Across the country, large-scale wind turbines are seen as a key part of carbon reduction. Wind turbines vary in size and the comparative amount of electricity they can generate. Different scales of turbine trigger different planning and delivery considerations. Accordingly, new guidance Renewable and Low-carbon Capacity Assessment Methodology for the English Regions (2010) recommends subdividing assessments of wind resource potential offered by both medium-large scale and small scale turbines. Medium-large scale turbines are likely to be free standing, individually or collectively as a wind farm. The largest scale wind turbine currently available is rated at 3MW and capable of generating electricity for thousands of homes. Small scale turbines are considered to be under 6kW and may be mounted on buildings. Within this differentiation there remains a wide range of turbines, although for the purposes of this study, and in line with the DECC methodology for regional renewable energy assessments we have considered these two broad types.

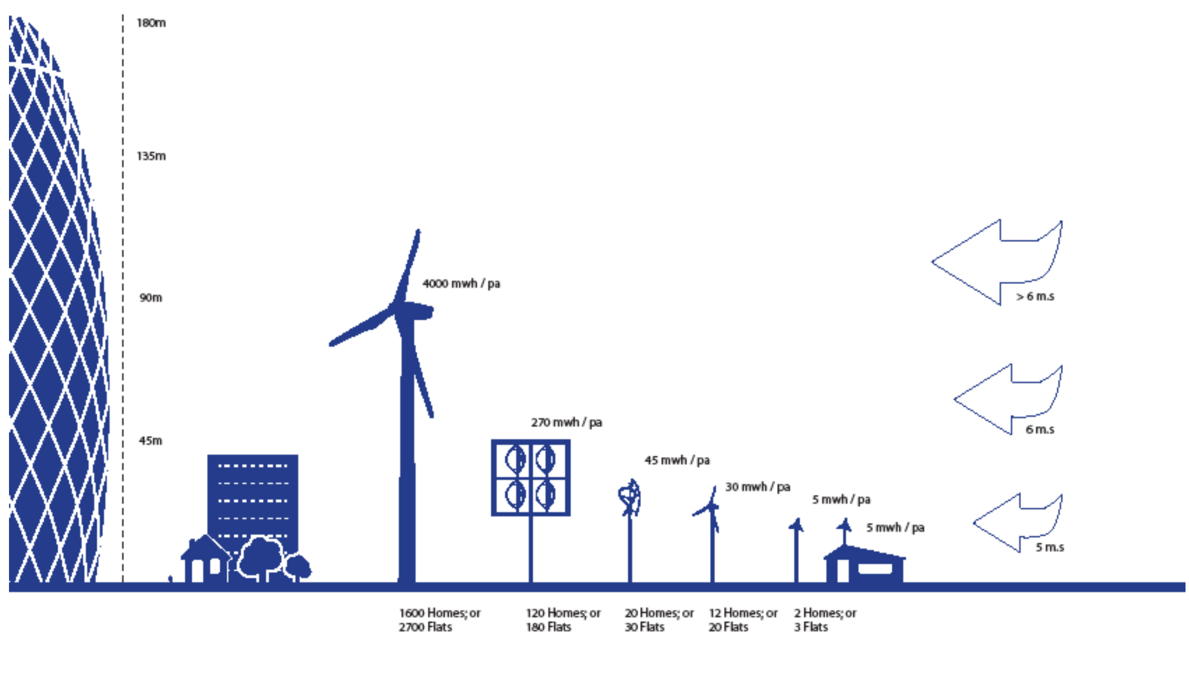

Figure 19: Difference in output relating to scale of wind turbine

This study considers the wind energy potential from both medium-large and small wind turbines across Swale Borough specifically from a desk-top study based on GIS modelling using data available below. **It should be noted that this study is not a sufficient evidence base for the actual siting and delivery of wind turbines, but it gives a high level assessment of promising geographical areas to look into further.**

4.4.1 MEDIUM-LARGE SCALE WIND TURBINES

Physical potential and constraints

The South East Regional Renewables Review found that assumptions used to inform the targets in the South East Plan underestimated the potential of onshore wind developments, primarily due to technological advances increasing viability from slower wind speeds and small wind farms. The rate of deployment of turbines was, however, less than had been envisaged in *Development of a Renewable Energy Assessment and Targets for the South East* due to non-technical barriers including planning. The recently completed ***Review of Renewable and Decentralised Energy Potential in South East England*** (2010)[12], prepared for the South East Planning Partnership Board, outlines the potential for all sources of renewable energy in the South East region. It identifies that Swale has the potential to contribute 8.4% (281 MW; 444 GWh) to Kent County's total wind energy production. In fact, Sheerness Port already has planning permission to install four wind turbines onshore with a 10 MW capacity – enough energy to power approximately 5,500 homes[13]. Combined with other wind energy potential, this proposal has influenced the installation of high voltage lines, which ensures good grid capacity.

However, in considering the potential for further development of wind energy, it is first important to understand the available wind resource and where the optimum locations for generation might be. Large to medium scale wind turbines are likely to be commercially viable at an average wind speed of 5m/s or above (measured at an elevation of 45m). For the purposes of this study, we have tested the viability of large-scale 2.5MW turbine with a blade height of around 130m. Higher wind speeds will be more desirable as available power from the wind is a cube function of wind speed velocity power output, and the potential of these sites should be investigated first.

The figure below shows the average wind speeds in Swale at 45 metres above the ground. As can be seen, the majority of the area is technically capable of generating energy from wind; however, some locations are likely to be restricted through other constraints.

[12] South East Partnership Board (2010) Review of Renewable and Decentralised Energy Potential in South East England. Land Use Consultants and TV Energy. Available: http://www.se-partnershipboard.org.uk/page/5/view/175/sub/77/energy

[13] http://www.renewables-map.co.uk/details.asp?pageid=1826&pagename=Sheerness

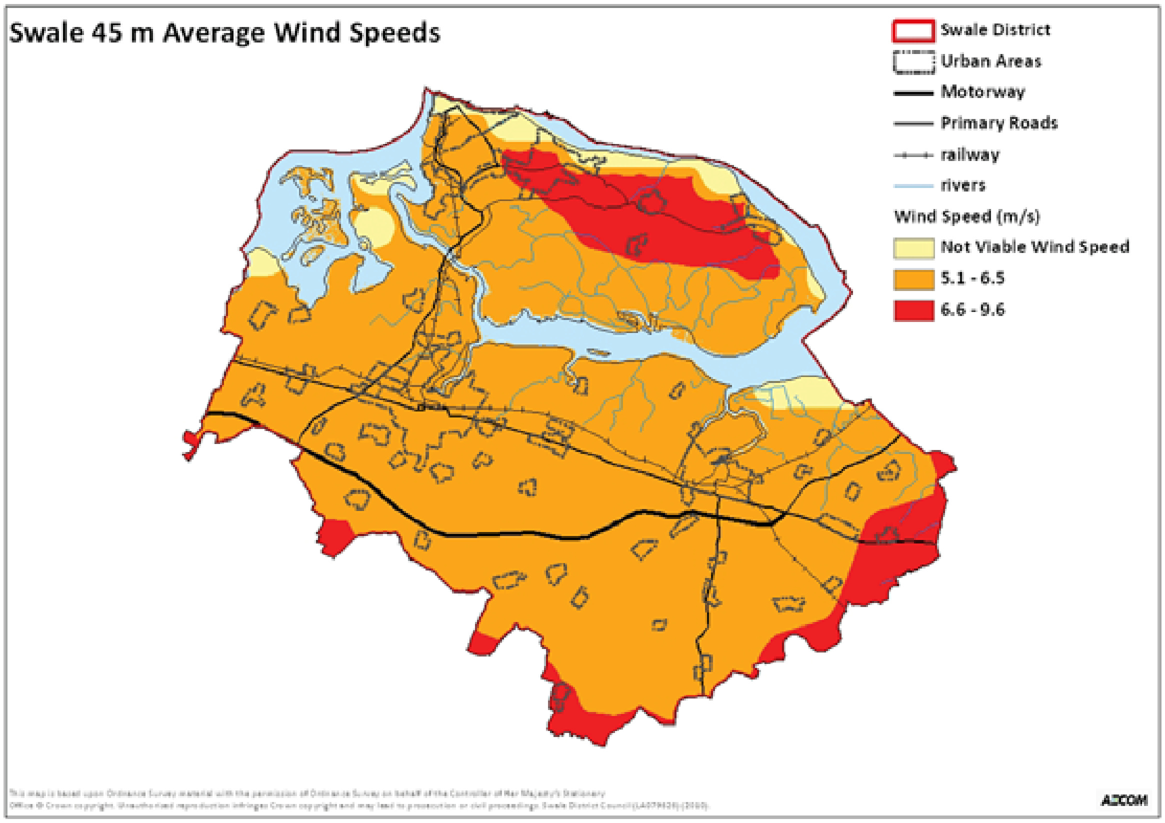

Figure 20: Average wind speed at 45m

A process of physical constraint mapping has been used to identify which sites are likely to have potential for large wind turbine location. Through GIS analysis, the constraints that have been included are listed below and conform with the DECC guidance:

- Non-accessible areas
    - Roads (A, B and motorways)
    - Railways
    - Water bodies
    - Built up areas
    - Airports
- Exclusion areas
    - Ancient semi-natural woodland
    - Sites of historic interest (but no buffer to be applied)
    - Buffer around road and rail line = turbine tip height +10%
    - Buffer around built up areas = 600m
    - Buffer around airports and airfields = 5km
    - Civil Air Traffic Control constraints

- Designated landscape and nature conservation areas, including the following classifications.
  - National Park
  - AONB
  - SAC
  - SSSI
  - RAMSAR
  - SPA
  - NNR
  - SINC
  - BAP habitats

Guidance specifies National Parks and Areas of Outstanding Natural Beauty as having the highest status of protection. In some cases, the Infrastructure Planning Commission (IPC) has the ability to grant consent to development in these areas, if the development is demonstrated to be in the public interest[14] Local development document policies discussing landscape character should be considered. However, local landscape designations should not be used in themselves to refuse consent, as this may unduly restrict acceptable development.[15]

It should be noted, however, Kent Downs AONB Unit will not support any scale of wind turbines as they will impact the sensitive nature of the area. They do qualify this policy by recognising that future wind turbine technologies might be appropriate and "future proposals may significantly reduce the likely impacts as well as more effectively reduce green house gasses."[16]

Constraints are mapped onto the wind speed map in the figure below. As can be seen, the majority of the wind potential in the south and west of Swale lies within the Kent Downs Area of Outstanding Natural Beauty, and is therefore constrained from installing wind turbines. There is some potential for wind generation on the Isle of Sheppey and in the southeast on the border with Canterbury. These areas should be studied further to understand their feasibility better.

[14] DECC (2009) Draft Overarching National Policy Statement for Energy (EN-1). Available: http://data.energynpsconsultation.decc.gov.uk/documents/npss/EN-1.pdf
15 DECC (2009) Draft Overarching National Policy Statement for Energy (EN-1). Available: http://data.energynpsconsultation.decc.gov.uk/documents/npss/EN-1.pdf
[16] Kent Downs Area of Outstanding Natural Beauty (2008) 'Kent Downs Area of Outstanding Natural Beauty Renewable Energy Position Statement'

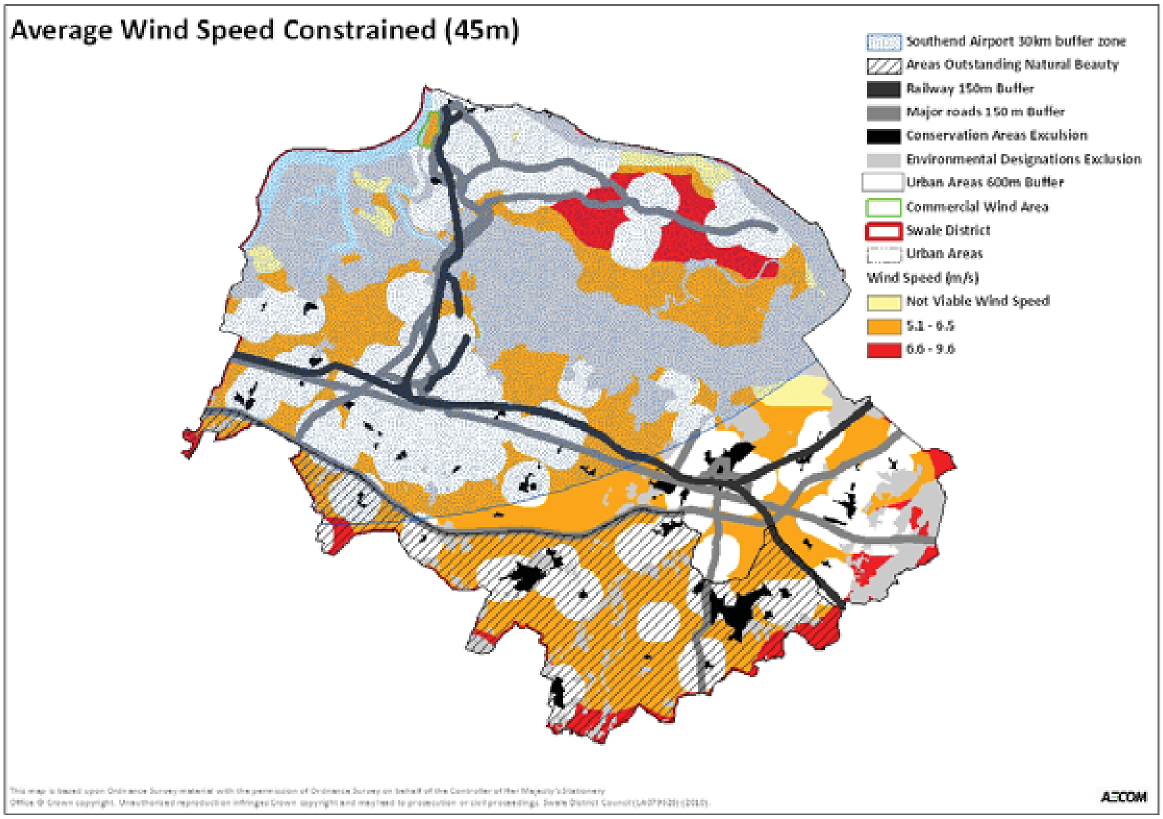

Figure 21: Average wind speed at 45m with constraints

Further detailed feasibility studies would have to consider a number of additional siting constraints in addition to these before any site could be confirmed, including:

- **Local Wind Resource Survey** - Wind speeds of 5m/s or above at turbine hub level are needed to operate a large scale wind turbine efficiently. The national dataset for wind speeds at a height of 45m above ground level was used to examine wind speeds across Swale. This study is not a sufficient evidence base for the actual siting and delivery of wind turbines, but it gives a high level assessment of promising areas to look into further.

- **Noise implications** - Concerns over noise can be related to perception rather than actual experience[17]. The noise impact of large scale wind turbines will depend on local sources of noise such as from major roads, rail lines, industrial areas etc. There are no required distances between wind turbines and residences, but 600m is a rough guideline that is often used and has been adopted within this assessment. Distances between turbines and non domestic buildings are not subject to the same restriction. More detailed studies will be required to map noise and identify areas of least impact for turbine development.

- **Aeronautical and Defence Impacts** – Wind turbines may interfere directly with the operation of aeronautical and defence equipment, for example, when located near aerodrome protected surfaces, runway takeoff points or within military low-flying zones. Radar systems associated with airports and military sites are also a significant issue; for example, radar technology that is unable to differentiate between rotating turbine blades and an approaching aircraft have contributed to

[17] Rand and Clarke (1990) The environmental and community impacts of wind energy in the UK. Wind Engineering 14, 319–330.

the rejection of a number of wind applications in the UK. Consultation will have to be undertaken with MOD and nearby airport authorities to determine particular constraints in the area and possible mitigation strategies, such as software upgrades to the radar technology. It is emphasised that the presence of local airports or military sites is not necessarily a critical constraint when considering the exploitable wind resource, but consultation is advised on a case by case basis.

- **Grid connection and Sub Station Requirements** –It will be necessary to carry out a detailed assessment of the opportunities and constraints presented by existing infrastructure in relation to each turbine site. And this information should feed into any development programme for turbines. Planning applications for sites close to a suitable grid connection should be prioritised

- **Flood risk -** Development of wind turbines on areas of high flood risk is currently restricted by PPS 25. This could potentially impact upon the construction of Turbines in the flood risk areas. The recently revised PPS 25 has reclassified wind turbines as essential infrastructure[18.] This, in principle, largely permits turbine development in flood zones and as such flood zones have not been considered a constraint in the above analysis.

- **Blade Glint Modelling** - This can be an issue at certain times of day when the wind is blowing, but effects can usually be mitigated against and has not been specifically considered at this stage. This would need to include driver distraction issues, in partnership with the Highways Agency and local highways services.

- **Telecommunication Impacts** - Wind turbines can interfere with radio signals, television reception and telecommunications systems. This has not been specifically assessed at this stage, but with consultation measures can be put in place to mitigate these effects.

- **Bird Migration** - An important element that will need consideration is the annual migration of birds, particularly due to the presence of important environmental sites in the area. A detailed migration survey must be conducted over a year period.

- **Transport Access Assessment per turbine** - Blade section is the longest/largest full section to be delivered on site. Some sites are restrictive.

- **Additional losses to turbine energy output** - A more detailed analysis would be required into the effect of local topography, clustering effects, inconsistent wind speeds, and local climatic conditions on the energy yield of the turbines.

- **Impact upon land use and land management** - The amount of land consumed by wind turbines is relatively small. Nevertheless, further study should be carried out to ensure that the turbines do not have a negative effect upon land use potential.

- **Ground Condition Survey** – The feasibility of the construction of a large turbine would have to be supported by geotechnical investigations

- **Gas pipelines and other sub terrain analysis** - The current assessment has not assessed the presence of utility pipelines beneath the sites which would have considerable impact on the ability to site turbines.

[18] Planning Policy Statement 25: Development and flood risk, Annex D
http://www.communities.gov.uk/documents/planningandbuilding/pdf/planningpolicystatement25.pdf

- **Archaeological Constraints** - Any impacts on archaeology in the area will have to be assessed in more detailed studies.

- **Listed Building and Conservation Area impact** – a detailed impact assessment has not been conducted at this stage and would be required for any further study.

- **Landscape and Visual Impact** - A detailed visual and landscape impact assessment with regard to wind turbine sensitivity has not been conducted at this stage. The specific sites of the turbines would have to be carefully considered to ensure that they do not detrimentally impact key view corridors and that they are integrated into the surrounding landscape. The following figure depicts the character of Swale's landscape based on its condition and sensitivity. Highly sensitive areas are shown in purple, moderately sensitive in blue and low sensitivity in green. Land that is in better condition is shown in darker shades.

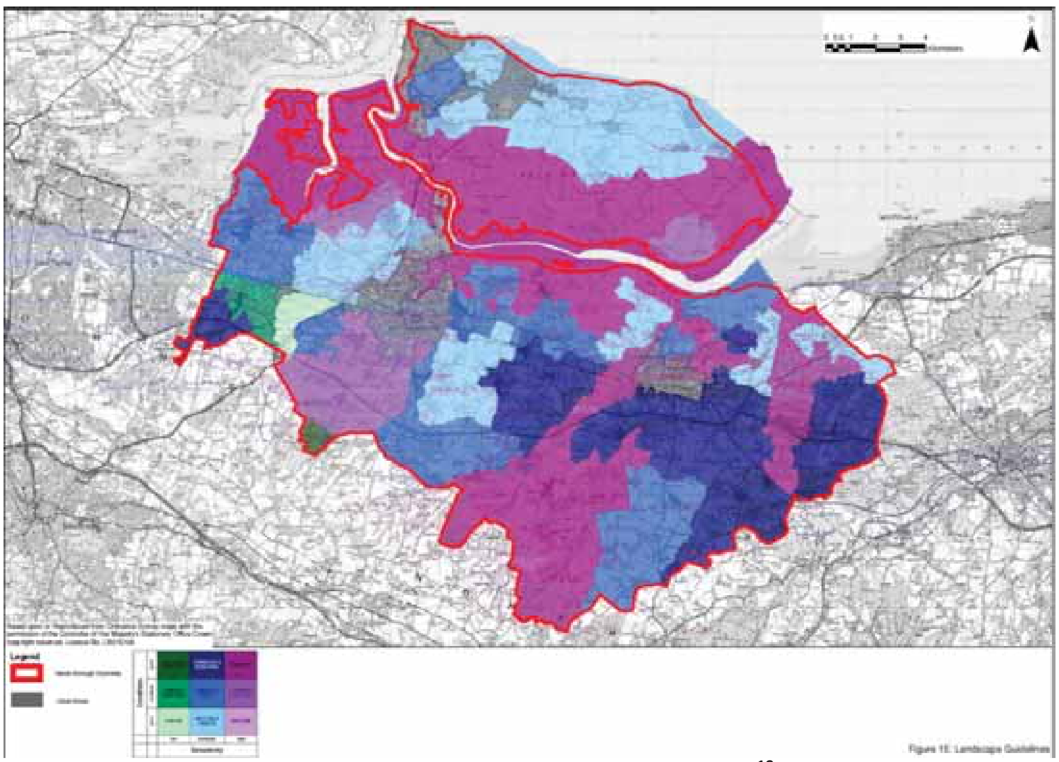

Figure 22: Landscape Sensitivity Classifications across the Borough[19]

Delivery opportunities and constraints

The majority of land that is capable of delivering large scale wind is located in designated land. This is the most significant constraint to its wide-spread delivery within Swale. The Kent Downs AONB constrains the land to the south of the Borough, while the internationally recognised wetlands constrain the viable land on the Isle of Sheppey. A large portion of land to the north is also within the Southend Airport 30 km buffer, and consultation with the airport authority would be required for any large scale wind opportunities.

[19] Swale Borough Council. 'Swale Landscape and Biodiversity Appraisal. June 2010.

While these lands are not expressly prohibited within AONBs, the managing body, Natural England, have advised in their report, **Making space for renewable energy** (2010) that *'the presence of statutory protected landscapes will substantially reduce the degree to which wind energy development can be accommodated'.*

Natural England considers that AONB and National Parks afforded equivalent importance. For development to take place in these areas it is important that the special qualities and purposes of designation are not compromised. They recommend that:

'The process of assessment and judgement is the same as for non-designated areas: the difference arises from taking into account the value society places on the special qualities of these areas and the additional determinative test of assessing whether major development is likely to compromise the objectives of designation'.

With this in mind, it is unlikely that large scale wind has potential in Kent Downs. Therefore, it is suggested that the Council work with the AONB to determine if medium-large scale wind turbine could be incorporated in certain locations, without adversely impacting its visual character. Surrounding areas, or less visible parts of the designated lands might prove suitable for wind turbines.

There is large scale wind potential on land in the southeast of the Borough, situated on the border with Canterbury. As Canterbury is currently in the process of producing a Core Strategy, Swale Borough Council should work with the Canterbury Council to determine if there is an opportunity to develop wind energy in the area.

While wind turbines are often installed in large, open areas, their adoption within an urban area should also be considered. Industrial sites are often situated far enough away public spaces that their installation does not present a safety risk. Lowestoft is one UK city that has built a turbine in an industrial area, and is presented as a case study below.

Possible carbon reduction over core strategy period

The DECC guidance for regional renewable energy assessments recommends that in areas where wind speeds are high enough for large wind turbines to be viable, that the capacity for turbines should be derived by applying distance between turbines a density benchmark of $9MW/km^2$. Deriving the annual output of all the potential turbines it is possible to estimate the annual carbon equivalent saving using a factor of 0.57kg/kWh for CO_2 reductions from displacing electricity supplied from the grid with renewable electricity. The table below shows the theoretical wind energy potential in Swale, firstly in all areas which are technically viable (excluding environmentally designated land, such as Kent Downs) and secondly just in the unconstrained rural areas.

Table 18: Wind Generation Capacity

	Capacity (MW)	Annual Electricity Generated (GWh)	Annual Carbon Saving (ktonnes)
Unrestricted capacity	96	446,393	144
Excluding designated areas	41	109	62

The SEEPB study[20] used a similar methodology for estimating large scale wind, but gives a higher estimate of potential in undesignated areas, estimating a capacity of 281MW (112 large turbines) in Swale. This seems to be an over-estimate given the limited areas of uncontained potential in the Borough. The reason for the higher scale of this estimation is unknown, but is assumed to be data error.

Influence of planning

The areas of Swale most viable for large wind development fall within areas covered by the Kent Downs. As Kent Downs AONB has authority over use of the land that falls within its borders, Swale Borough Council does not have the ability to impose policies here. The AONB's position in relation to renewable energy was clearly articulated in their renewable energy position statement, "Owing to the high sensitivity of the Kent Downs AONB the AONB partnership believes that large scale commercial wind turbine developments will be unacceptable." As such wind turbines feeding into the national grid would be opposed. In any case, the best sites for wind turbines are also likely to be in areas of heightened visual and landscape sensitivity.

While the Kent Downs AONB does not currently support wind turbines of any size due to their impact on the site, they are amenable to improvements in wind technologies. Therefore, efforts should be made to keep them apprised of any turbine innovation and research suggesting decreased impacts when available. More details on small scale wind development are outlined below.

For areas outside the AONB, the planning authority should encourage wind development where it is appropriate. Policies might encourage turbine installations on commercial properties and industrial sites, as well as in more rural areas. To ensure wind energy development is implemented effectively and well placed, planners and the Council should work with developers to ensure that wind energy generation is well placed,

[20] South East Partnership Board (2010) Review of Renewable and Decentralised Energy Potential in South East England. Land Use Consultants and TV Energy. Available: http://www.se-partnershipboard.org.uk/page/5/view/175/sub/77/energy

Case study

Setting a new precedent for large wind turbine development, the coastal district of Waveney erected an iconic 2.75MW turbine within the urban fabric of the town of Lowestoft. Situated within the port area of the town, and located with less sensitive industrial and commercial uses as neighbours, the hugely popular turbine demonstrates that wind energy development can be acceptable in areas often considered to be out of bounds. With a hub height of 80m and rotor tips reaching 126m, 'Gulliver' as the turbine is affectionately known, is the one of the largest turbines in England, generating electricity for around 1500 homes and displacing a reported 6000 tonnes of carbon each year.

4.4.2 SMALL-SCALE WIND ENERGY

Physical potential and constraints

Smaller wind turbines have a significantly reduced visual impact, and whilst their output is significantly less, they can contribute to the Authority's renewable energy generation capacity. Recent reports have shown that small-scale wind is not suitable for urban or suburban locations due to the effects of turbulence at low levels on power output. However, agricultural land, characterised by large fields with a relatively uninterrupted yaw, which will minimise the impact of turbulence on power output, presents better opportunities. Swale's large swaths of fertile agricultural land, present an ideal opportunity to install smaller scale wind turbines.

The figure below shows the areas of Swale where small-scale wind energy generation would be feasible based on wind speed measurements at a height of 10 metres. The map shows that there is some potential for small-scale wind energy generation.

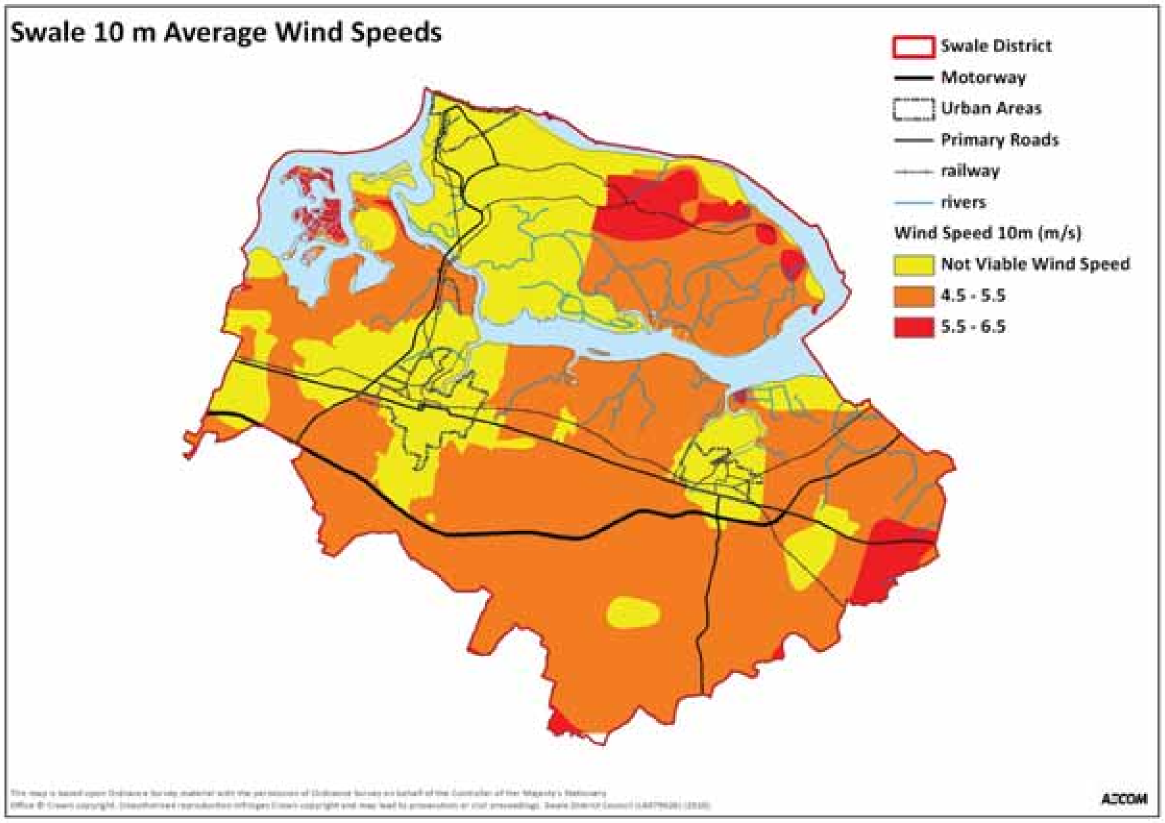

Figure 23: Average wind speed at 10m

The yearly average wind rose for Heathrow, South East England, the closest annual wind rose available from the Met Office to Swale Borough, indicates that as with the rest of the UK the predominant direction of wind is from the southwest, see Figure below. Medium-scale turbines that cannot afford to carry out a year-long monitoring exercise examining wind speed and direction should, therefore, be sited to take maximum advantage of winds originating from this direction.

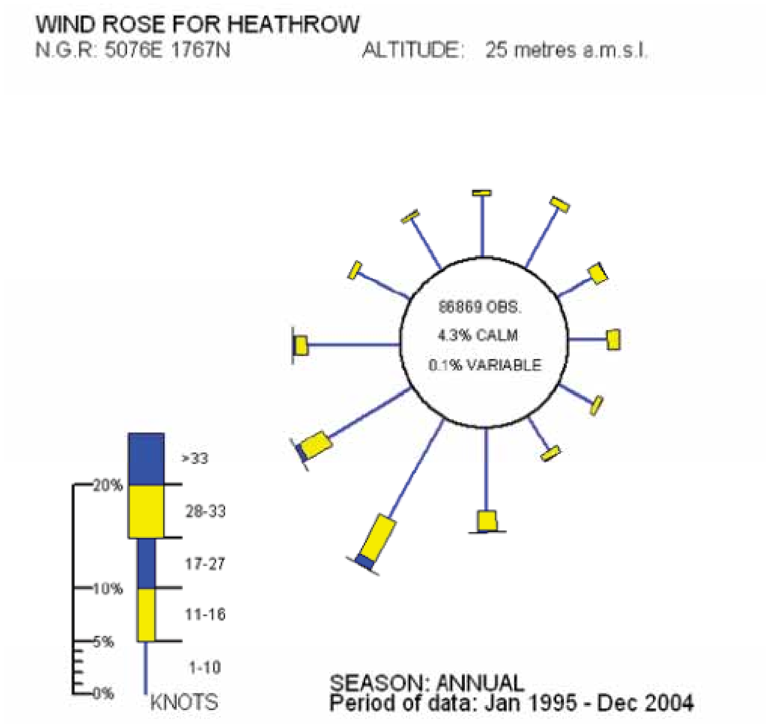

Figure 24: Met office wind rose for the Heathrow, Southern England [21]

Delivery opportunities and constraints

The conversion of potential to delivery requires consideration of a number of factors including:

- Finance - Farming is generally in decline in the UK due to increasingly limited margins and a potential income source from renewable electricity would be welcome. However, it is expected that a significant barrier to investment in small scale renewables will be the upfront investment. As such, some form of fiscal support such as an 'energy loan' is likely to be required to provide funding. There are organisations, such as SALIX[22], that provide funding to public sector projects that reduce CO_2 in a cost effective manner. In addition to funding such a service would need to provide information and advice and expect a return in investment from energy saving and ROCs (Renewable Obligation Certificates) receipts.

- Partnerships with turbine providers and installers can help leverage efficiencies of scale.

- Landscape and visual sensitivity will again be issues in Swale, and is discussed more below.

The SEEPB study[23] suggests that small scale wind in Swale Borough has the potential to deliver 16% of Kent's total wind energy in non-designated areas (which equals 45.1 MW installed capacity , or 63 GWh) and 8.5% in designated areas (5.6 MW installed capacity; 7.84 GWh). As noted earlier, however, Kent Downs is not currently in favour of on-site wind generation. As such, delivery of wind generation in designated areas is only theoretical at this time.

[21] http://www.metoffice.gov.uk/climate/uk/location/southwestengland/wind.html
[22] http://www.salixfinance.co.uk/home.html
[23] South East Partnership Board (2010) Review of Renewable and Decentralised Energy Potential in South East England. Land Use Consultants and TV Energy. Available: http://www.se-partnershipboard.org.uk/page/5/view/175/sub/77/energy

Influence of planning

Natural England notes that caution needs to be applied when considering cumulative small-scale wind developments.

'The scale of development is a key factor when assessing the degree that wind energy can be accommodated within a protected landscape. Small-scale wind energy developments are generally less likely to compromise the objectives of designation, but this is not always the case, especially if there are cumulative impacts caused by several small-scale developments in the same area.'

In 2009, legislation was released for consultation on 'Permitted development rights for small scale renewable and low carbon energy technologies, and electric vehicle charging infrastructure' (consultation closed in February 2010). This would remove the need for planning applications for some small scale turbines up to 15m. Although more restrictive limits are proposed for sensitive areas where the Government considers they would be warranted, these are not extended to Areas of Outstanding Natural Beauty (e.g. Kent Downs) as it is the Government's view that development in these areas would not be dense enough to 'unduly harm their visual character'.

4.5 OFFSHORE WIND POTENTIAL

Physical potential and constraints

The installation of offshore wind energy generation has not been considered as a contributing renewable source within this study as offshore wind resource does not fall within the jurisdiction of Swale Borough Council. However, as offshore wind could be important to the economic base in Swale and the Isle of Sheppey, it is important to understand the scale of potential. The figure below demonstrates the potential for offshore wind in terms of wind speed. Other considerations including grid connections, sea depth and ground conditions also factor in offshore wind turbine siting.

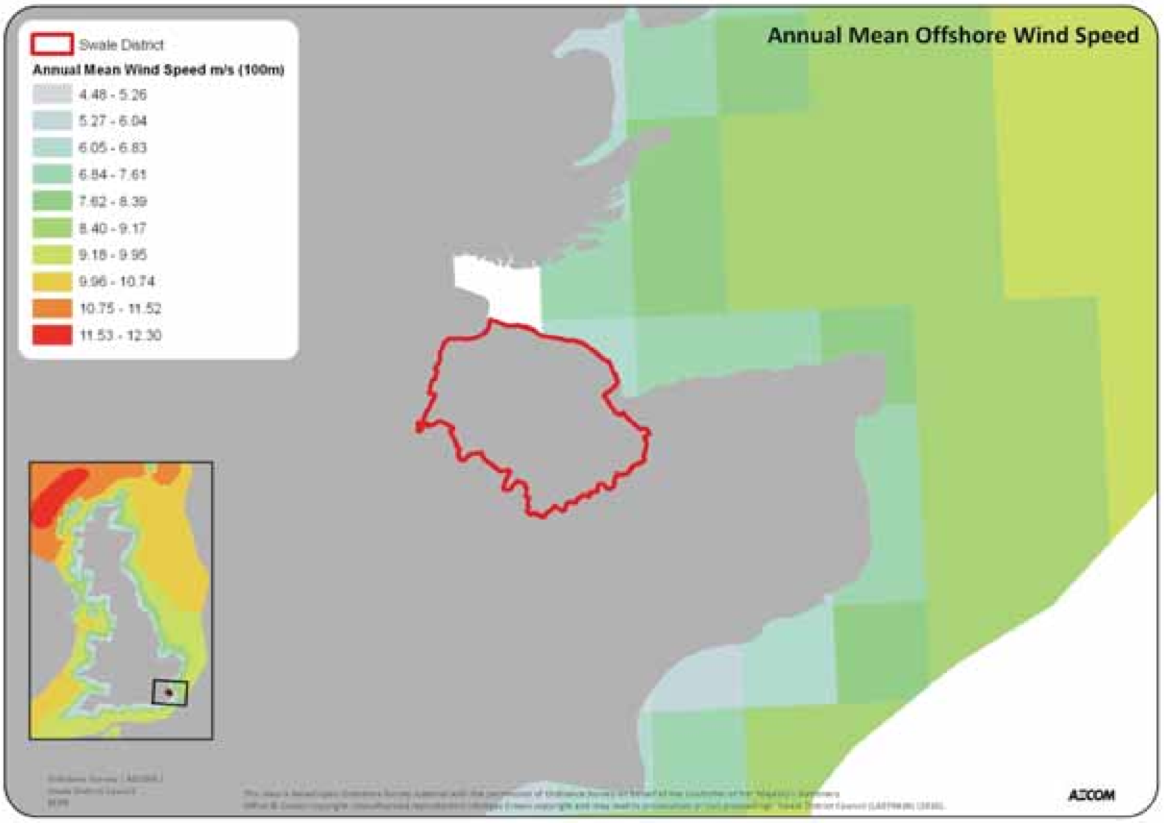

Figure 25: Offshore wind speeds

It is important to note that the London Array, a proposed offshore wind project, is planning to install up to 341 large scale wind turbines over four years more than 20 km off the Swale coast line. While this is an offshore project, benefits could extend onshore to Swale. As Sheerness is one of the larger ports in proximity to the planned London Array, there is potential for it to transform itself into a manufacturing base for wind turbine parts and technology. In addition, the London Array has also planned for a new substation to be constructed in Graveney. This represents an opportunity for other renewable electricity to take advantage of improved infrastructure. There is also an opportunity to showcase Swale as the gateway to The London Array, which may present opportunities for both tourism and renewable energy education.

Influence of planning

Because offshore wind farms are located in national waters, the role of local authorities to influence their implementation is significantly diminished. However, planning can play a meaningful role in realising the onshore benefits associated with offshore development, including the delivery of turbines and supporting industries in Sheerness Port. Policies that support the transformation and regeneration of the region into an alternative energy hub and attract investment and green jobs in the area can help the Isle of Sheppey and Swale Borough as a whole become more economically, socially and environmentally sustainable.

4.6 MARINE ENERGY (WAVE AND TIDAL)

Electricity can be derived from the sea by harnessing the energy from the movement caused by waves or changes in the level of the tide. Although marine energy is expected to play a role in meeting the national renewable energy targets set out by the Renewable Energy Strategy, they are not counted as contributing to local renewable energy targets. This is because marine resources are state controlled rather than under the jurisdiction of the local authority. The marine energy potential on the Swale coast are, in any case, limited as demonstrated below. However, much like offshore wind, the development of tidal energy has the potential to contribute to the development of a renewable energy sector onshore, within Swale.

Physical potential and constraints

The Atlas of UK Marine Energy Sources: A strategic environmental assessment report (2008) illustrates the annual mean wave power in the UK. The figure below shows the south eastern portion of the UK, which captures Swale, has annual mean wave power between 1.01 and 10.0 kW/m. Although no definitive analysis has been undertaken on the capacity limits for the UK wave resource, wave power off the Swale and Isle of Sheppey coast is shown to be at the lower end of the scale and, therefore, among the least likely areas to attract interest from energy developers. Real time wave information can be found at:
http://www.channelcoast.org/data_management/real_time_data/charts/?chart=89.

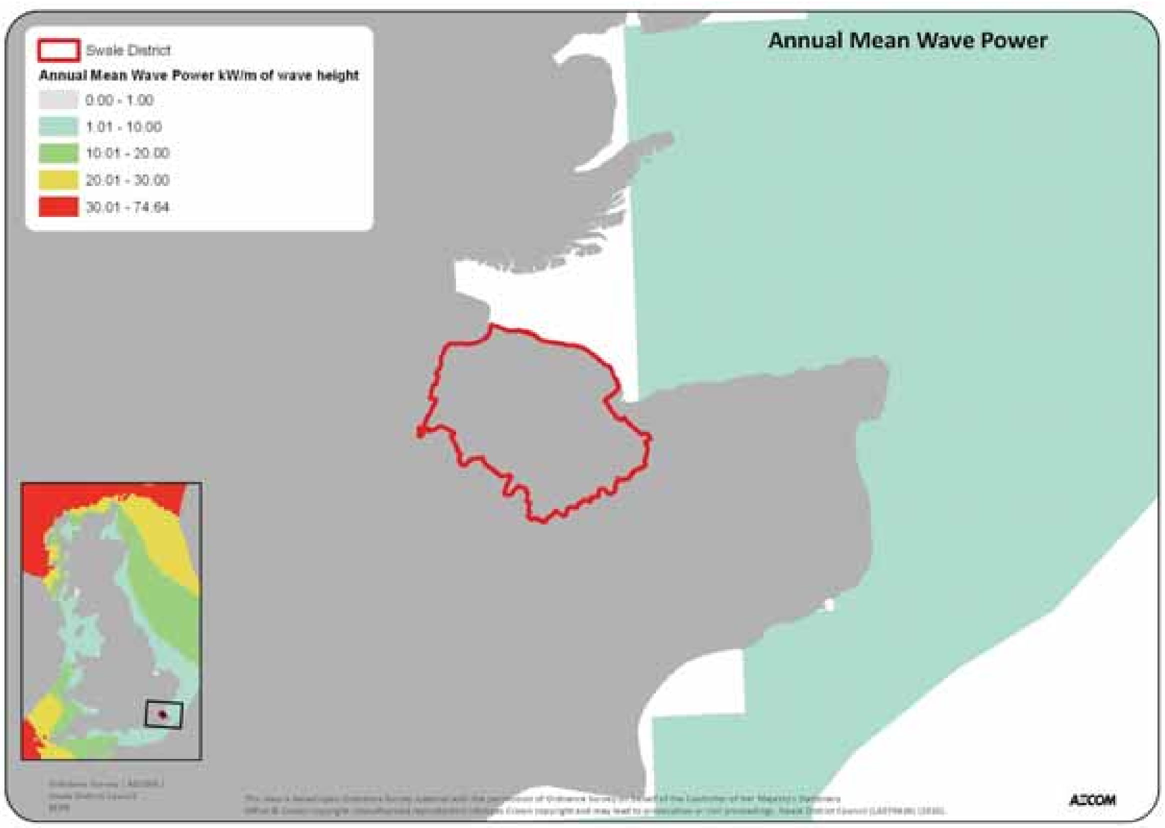

Figure 26: Annual mean wave power in the UK - full wave field

Delivery opportunities and constraints

The scale of potential to exploit marine energy opportunities in Swale is below the necessary threshold to be viable. Other areas of the UK coast present much greater opportunities that should be explored first.

Possible carbon reduction over core strategy period

It is unlikely that marine energy resources will contribute to any carbon reduction in Swale Borough in the core strategy period.

Influence of planning

Given the nature of marine energy and the restricted potential for development, the influence of planning will be limited. Contributions, in the form of allowable solutions or research projects coordinated by local stakeholders, may present viable opportunities to invest in marine energy in the future as the national government has committed to spending £60m on research and development into wave and tidal energy to help improve viability.

4.7 HYDRO ENERGY POTENTIAL

The UK has a long history of generating motive power from water for industrial purposes. Indeed, there are over 20,000 old mill sites across the UK, many of which have potential to generate renewable energy. Using small scale turbines, the energy from rivers can be harnessed with less disruption to water flow than large scale hydro schemes. The introduction of government targets for renewable energy generation, combined with technological development has increased the feasibility of micro hydro generation, both at historic mill sites or in hilly areas with spring-fed streams.

Micro hydro energy generation has a number of advantages. As well as being a renewable source of power, the ecological impacts of small-scale turbines are usually small compared to large scale, dam-based hydro power. Compared to wind power, micro hydro power sources offer more constant generation. In addition, maintenance costs are reasonably low and systems generally have a long lifetime of over 25 years. Moreover, the cost of reactivating historic sites can often be reduced by reusing existing structures such as the weir.

Physical potential and constraints

The SEEPB study[24] highlighted that there are no sites within Swale Borough capable of contributing to Kent County's hydropower. Environment Agency has also investigated the potential for hydro power in Swale and come to a similar conclusion.

The Environment Agency (EA) recently released a report titled *Opportunity and environmental sensitivity mapping for hydropower in England and Wales,* which provides a high level assessment of scale of potential and the sensitivity of micro-hydro schemes. This includes fish passage as well as other ecological and amenity considerations. The Environment Agency study identified a maximum of 4 sites in Swale Borough all with the potential to deliver between 1-10kW (very low potential). The map below shows the relative potential of the micro-hydro sites identified in the Borough.

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[24] South East Partnership Board (2010) Review of Renewable and Decentralised Energy Potential in South East England. Land Use Consultants and TV Energy. Available: http://www.se-partnershipboard.org.uk/page/5/view/175/sub/77/energy

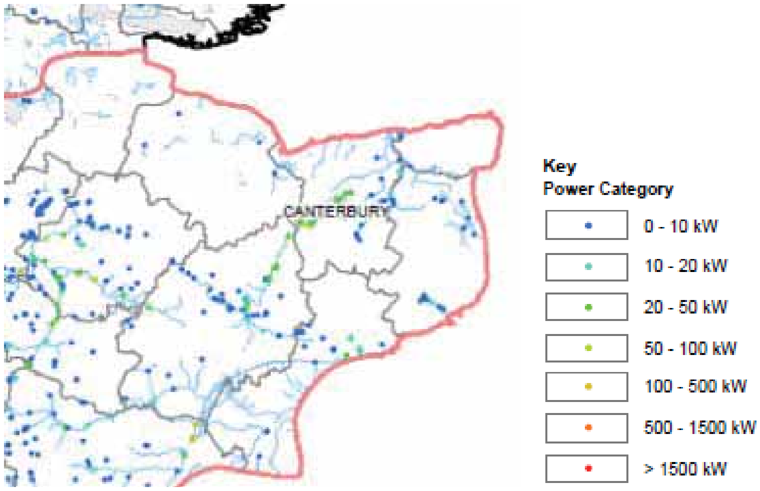

Figure 27: Hydro Power Potential in Swale[25]

Delivery opportunities and constraints

The opportunity to deliver micro hydro power in Swale is negligible. However, should one of the four sites show above prove feasible, a number of other factors will need to be considered, including:

- Land ownership – access in terms of ownership of land can be an issue for site development
- Extraction Licence – required on hydro schemes on rivers via the Environment Agency to ensure the water levels in rivers are not compromised.
- Fish Passage – the Environment Agency requires fish passes to be installed which can increase the construction costs of any future schemes.
- Restoration of historic mills – this is a potential opportunity to both celebrate local heritage and to generate renewable energy.
- Community delivery – micro-hydro projects are an ideal example that can be led and funded by local communities. The case study below demonstrates how community partnerships have delivered a scheme.
- Access – the accessibility of the sites to construction and maintenance vehicles and machinery is varied. Although some sites have good existing access others would require the construction of potentially costly new routes
- Scheme Design – each weir would require a bespoke design which responds to the unique flow characteristics and site constraints.
- Location of new development – the delivery of schemes could be associated with new developments adjacent to potential sites.

[25] Environment Agency *Opportunity and environmental sensitivity mapping for hydropower – Part B South West and South East* (undated)

Possible carbon reduction over core strategy period

Hydro energy turbines range in size and their load capacity (the ratio of average to maximum output) is dependent on the flow of water (the head) through the turbine. As described above, the Environment Agency identified around 4 sites in Swale, most of which have the potential between 1-10kW. For the sake of demonstration, assuming all sites are developed and taking an average capacity as identified by the Environment Agency, and with a load capacity of 52% (industry standard), the total possible renewable electricity generation from micro-hydro for the Borough would be in the region of 91MWh giving a total carbon saving of 52 tonnes per year as shown below.

Table 19: Theoretical Maximal Carbon Savings from Hydro

Hydro turbines	Installed Capacity (kW)	Operational Capacity (kWh/year)	Carbon Saving (tonnes per year)
4 x 5kW	20 kW	91,104kWh	52

However, given the environmental sensitivity of some of these sites, and considerations such as distance to connect to the grid and other delivery constraints it is unlikely that the majority of these sites will be viable. In fact, when taking both the Environment Agency's analysis and the SEEPB study into account, the potential for hydro does appear to be severely limited, if viable at all.

Influence of planning

This study highlights the spatial distribution for potential hydro sites. To be most viable they need to be located within reasonable proximity to a grid connection, and most potential sites are, naturally, predominantly rural. Given the spatial options, major new development is unlikely to be situated in a way to take direct advantage of hydro sites, but might make contributions through allowable solutions to help support schemes.

4.8 BIOMASS POTENTIAL

Biomass is an organically based fuel, which can be utilised to produce low carbon energy. While burning it does produce CO_2 emissions, during the growth and production of organic matter CO_2 is also absorbed from the atmosphere, so over its whole lifecycle it is regarded as a renewable fuel source.

Biomass can contribute to generation of heat through either individual biomass boilers in homes or district heating systems, and it can contribute to the generation of both heat and power through the use of a combined heat and power system (CHP). The use of CHP requires a higher tonnage of biomass fuel to produce the same amount of usable heat, though it also produces electricity. Some types of biomass can also be used to produce biogas through an anaerobic digestion process.

Some biomass products are waste products from other activities including agriculture and forestry, while biomass can also be specifically produced through growth of bio-crops. There is concern in the industry that excessive specification of biomass technologies on a site-by-site basis will lead to either long-distance import of biomass material or the sacrifice of food-producing arable land to grow dedicated biomass crops. There is a need to take a region-wide approach to biomass sourcing and supply to ensure that biomass is both available for energy use, but that its use is managed and sustainable and that waste biomass sources are utilised first.

The South East Regional Renewables Review concluded that there is potentially more biomass potential than was originally estimated as a base for the South East targets, by approximately 50%, and is being delivered at a faster rate than expected in the assessment that underpinned the South East Plan targets.

The following sections consider various types of biomass available:

- Biomass suitable for direct combustion in biomass boilers or biomass CHP
    - Waste wood from domestic, construction and industrial uses
    - Forestry residues
    - Fuel crops including miscanthus and short rotation coppice such as willow
    - Straw

- Organic waste suitable for utilisation in anaerobic digestion processes
    - Pig and poultry farming sectors
    - Meat and Poultry Processors
    - Brewing
    - Water industry

Physical potential and constraints for biomass for direct combustion

Biomass available from woodland management

The South East is one of the most forested areas in England. There are approximately 2,705ha of woodland in Swale, which through effective management could generate 9,469odt (oven dried tonnes) of biomass fuel from trimmings. This accounts for 2.1% of the 446,396odt the Biomass Resources and Concentrators study estimated could be generated across the South East.

The potential for biomass crops is high in Swale. Due to the presence of paper mills, the area is replete with woodland coppice – a sustainable wood fuel crop. With the many paper mills, coppicing has been an ongoing activity in the Borough for many years. For this reason, increasing coppicing represents a natural progression for this industry. Assuming that all the woodland is managed and waste wood was made available for biomass energy through an appropriate supply chain, this could potentially generate 48,723MWh of heat energy. If all the biomass was used in a biomass CHP unit this could generated enough electricity for over 4,300 homes and heat for over 5,700 homes each year. If used directly for heating this would be enough to supply around 12,000 homes with heat each year. The SEEPB study[26] falls in-line with these numbers, as it suggests that Kent could contribute 11% of managed woodlands to the South East's overall total electricity or heating delivery (or some combination thereof).

The figure below shows the location of woodland resource in Swale. Biomass resource should be managed on a County or Regional scale, as management phasing will mean that different areas of forest have waste arising at different times. Biomass supply chain coordination provides an opportunity for the LPA to establish a local supply scheme. The CEN report provides further information on potential suppliers of wood chip and wood pellets in Annex A of their document. Torry Hill Farm, in the Kent Downs AONB just outside Swale, is already processing biomass for fuel purposes, and provides evidence that biomass has real potential in the area.

[26] South East Partnership Board (2010) Review of Renewable and Decentralised Energy Potential in South East England. Land Use Consultants and TV Energy. Available: http://www.se-partnershipboard.org.uk/page/5/view/175/sub/77/energy

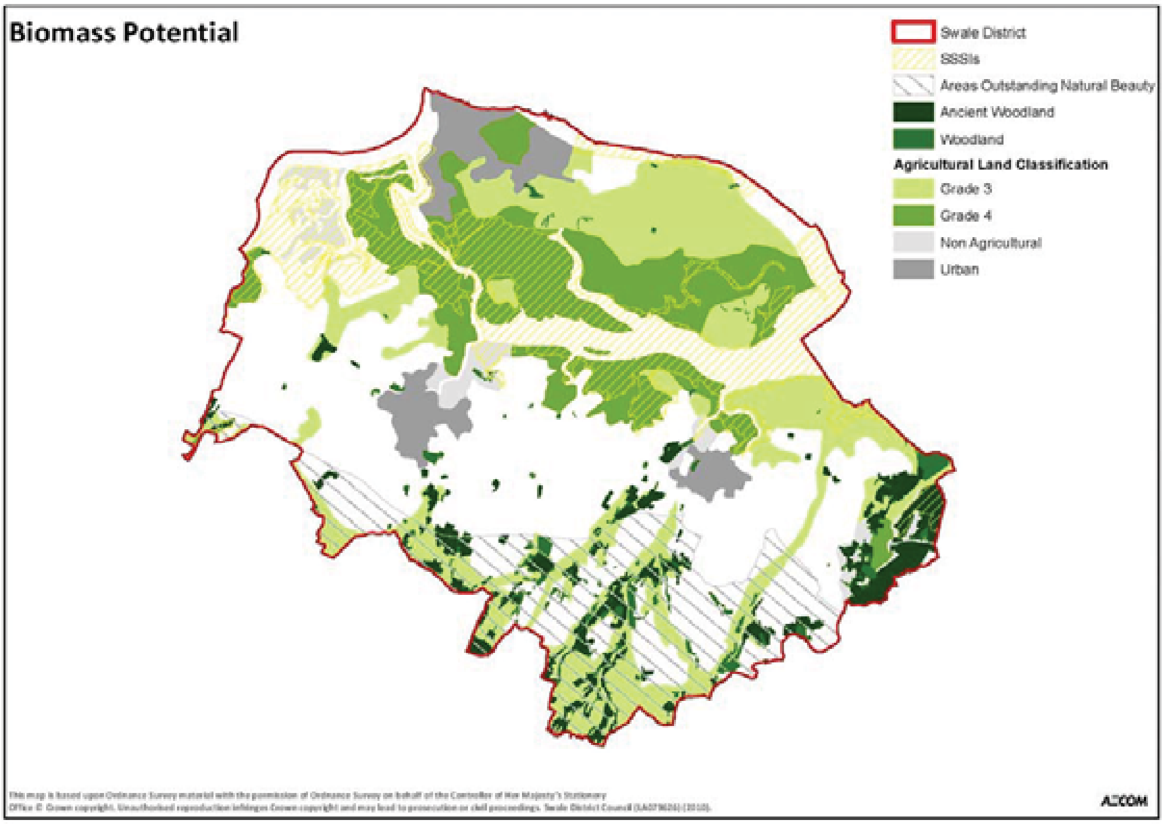

Figure 28: Wood-based Biomass potential

Biomass Potential from Fuel-crops – short rotation coppice (e.g. Miscanthus)

The South East Regional Renewables Review recognises that there is significant potential for renewable energy from dedicated fuel crops. The South East Regional Renewables Review[27] outlined that using 5% of the total agricultural area would generate more primary energy than the existing woodland resource. For the Borough, the study noted that short rotation crops are likely to contribute either 1.12 MW of electricity (8.39GWh) to Kent's potential biomass electricity generation by 2031. Alternatively, this biomass could be used to delivery 14.5MW (25.5GWh) to Kent's heat generation by 2031. In either case, this would make up 7.4% of the electricity or heating for Kent County.

The figure above shows the grades of agricultural land across Swale. The preferred land type for cultivation of bio-crops is grade 3 and 4 (though lower yields are expected on grade 4). Grade 1 and 2 land is unsuitable due to competition with food crops. Within the study area, there is approximately 1,026 a of grade 3 agricultural land, which is considered ideal for fuel crops as it preserves grades 1 and 2, the most productive land, for agricultural crops, but is still of sufficient quality for biomass growth requirements. While grade 4 land is not as ideal as grade 3, the 6,532ha of it in Swale represents the lion share of land available to grow biofuel crops. It should also be noted, however, that SSSI land is unlikely to be used for biomass crops due to its landscape designation and should not be considered as viable for biomass.

[27] South East Partnership Board (2010) Review of Renewable and Decentralised Energy Potential in South East England. Land Use Consultants and TV Energy. Available: http://www.se-partnershipboard.org.uk/page/5/view/175/sub/77/energy

Dedicated fuel crops are a more efficient biomass energy source than forestry arisings, generating between 10 and 12 oven dried tonnes (odt) per hectare rather than around 2-4 odt. If 5% of the Grade 3 and 4 agricultural land was dedicated to growing fuel crops this would generate approximately 3,779odt with the potential to generate 20,469MWh. This would provide electricity for approximately 1,732 homes and heat for 2,280 homes if used in a biomass CHP, or heat to 4,813 homes in a district heating system directly through using biomass boilers.

Diverting significant areas of good quality arable land from food cultivation to industrial growth for fuels could prove counter-productive to wider aims of sustainability and local self sufficiency. Nonetheless, as part of a wider strategy for regional and Borough energy self sufficiency, sourcing a proportion of fuel from woody bio-fuels offers the potential to reduce the CO_2 emissions in Swale. More urban areas, such as Sittingbourne and Faversham represent the necessary demand to make a biomass CHP system viable. Strong local sources of biomass, however, will be essential to facilitating their delivery.

Considering the time required to secure land and cultivate biomass, it is expected that energy crops would require more time than the utilisation of woodland trimmings and waste wood already available in the Borough. The market price for biomass will drive the demand for energy crops. Currently the market price of miscanthus is comparable to that of straw, which is relatively high, so it is not yet considered economically viable in the South East of England. The increased competition for limited fossil fuel resources and a rising cost of carbon will drive an increase in the demand for biofuels. In order to achieve a target of 12% renewable heat, Swale should first seek to harness waste wood and forestry arisings, along with straw before supplementing supply with local bio-crops. Where local supply-chains are not in place, fuel can be imported from elsewhere, but this is not desirable from a carbon perspective.

Biomass Potential from Cereal Crop Residue / Straw

In the SEEPB study[28], it suggests Kent has the potential to contribute 124.8 MW (85.8 GWh) to the region's total agricultural arisings potential. It also outline's Swale's specific potential as 18.6 MW (140.4 GWh) by 2020. This is approximately 15% of the County's total.

Livestock rearing is a significant consumer of locally generated straw and it is not expected that 100% of straw would be available for combustion. Although there may be some straw available to utilise as a biomass resource it is unlikely to be significant. In addition, the use of straw for combustion for the generation of electricity, with or without the use of heat, will be dependent on the cost and availability of straw. The price of straw has been steadily rising over recent years and currently ranges from £38 to £50 per tonne depending on time of year. A high price of straw will limit the viability as a combustion fuel. As such, the scale of straw combustion is not likely to be economically feasible. A small CHP plant might require around 100,000 tonnes of straw per year.

Biomass available from waste wood streams

Municipal and construction waste streams offer potential for source separated fuels (wood fuels) that can be burned, and this can be economically attractive as waste handlers can avoid disposal costs by using waste wood as a heat source. The SEEPB study determined that Kent has the potential to contribute 21% (6.4 MW installed capacity; 47.9GWh) to the South East's total electricity generated from waste wood stream by 2020 – the largest of any county in the South East. Translating resource potential to Swales' waste stream is difficult with limited LPA scale information but based on population of Swale in relation to Kent, approximately 0.1 MW of installed capacity, or 0.79GWh of biomass might be secured and supplied from waste streams within Swale into bio-energy schemes. Alternatively, Kent County could use waste wood for 96.2MW (168.6GWh) of heating (approximately 1.6MW; 2.78GWh specifically in

[28] South East Partnership Board (2010) Review of Renewable and Decentralised Energy Potential in South East England. Land Use Consultants and TV Energy. Available: http://www.se-partnershipboard.org.uk/page/5/view/175/sub/77/energy

Swale). Wood waste, however, is probably more efficiently collected and processed through county-wide coordination.

Currently, in Ridham, Bioflame and Countryside are in the process of developing a biomass plant, which uses waste wood as its energy source. When completed, the plant will be capable of producing 20,000 megawatt-hours of electricity, displacing 30,000 tonnes of waste wood from landfills in the process[29].

Potential and constraints for biomass for anaerobic digestion

There are a variety of waste streams available which could be utilised for energy production using Anaerobic Digestion (AD). AD refers to the decomposition of putrescible waste such as food waste, animal slurries and potentially a proportion of garden waste in anaerobic (oxygenless) conditions. AD produces a biogas made up of around 60 per cent methane and 40 per cent carbon dioxide (CO_2). This can be burned to generate heat or electricity. The biogas produced by the AD process can be used to generate electricity in a gas engine. Note that the AD process itself has an electricity requirement of between 10 - 20% of the power generated.

Anaerobic digesters also produce valuable fertilizer as a by-product which can be recycled back onto the land aiding agricultural productivity. In addition to all of that, biogas is in many ways a good alternative transport fuel – particularly for buses and heavy vehicles - that could provide a measure of resilience against peak oil.

As a transport fuel, the potential of biogas has already been demonstrated in Europe. In the city of Lille[30] in northern France, 120 of the city's 400 buses run on biogas made from locally sourced food waste, with one new gas-power bus commissioned every week. By 2012 all buses will run on a mix of one-third natural gas, two-thirds biogas. The biogas is produced by an anaerobic digester at the bus terminus, which fuels not only the buses but also the lorries that collect the waste. This means there is a high degree of insulation to short term interruptions in the oil supply. In Switzerland there are 3500 vehicles running on biogas, and there are also major programmes in Sweden and Germany.

Some British local authorities (Norfolk, South Staffordshire) have commissioned anaerobic digesters as part of their waste strategy, but none has yet exploited the full transport potential of biogas – which is considerable. According to a report by Environmental Protection (formerly the National Society for Clean Air), Britain produces some 30 million dry tonnes of food waste and agricultural manure per year, and this could produce over 6 million tonnes of oil equivalent in biomethane. That equates to about 16% of total transport fuel demand, while public transport consumes less than 5%. In other words, Britain could fuel a public transport network three times bigger than today's on food and agricultural waste alone.

With Swale's large fruit industry, the potential for energy from fruit waste should be investigated. Germany has a biogas fruit plant, which uses its own production waste for energy as a natural gas substitute. While fruit is not likely a large waste stream, it has the potential to contribute to overall renewable energy supply.

Potential for utilisation of household putrescible waste

The South East Renewables Review suggests that as the 'biomass portion of Municipal Solid Waste' is deemed by the Renewable Obligation Order 2009 to be 50%', 2,260,000t of the 4,520,000 tonnes of MSW produced in the South East would count as biomass resource. The SEEPB study determined that

[29] http://www.renewables-map.co.uk/details.asp?pageid=1920&pagename=Ridham
[30] The Oil Depletion Analysis Centre and the Post Carbon Institute (2009) "Preparing for Peak Oil – Local Authorities and the Energy Crisis" ODAC

Kent could produce 20.5% (499MW; 1,016GWh) of the region's total installed capacity of 2,429 MW (4,948GWh).

Using an understanding of the average household waste per person produced in the Authority, as recorded in the Best Value Performance Indicator[31], along with the population data for 2008, it is possible to estimate the suitable waste arising in the study area.

Table 20: Waste Arisings from Waste Best Value Performance Indicators

	Annual household waste per person (kg)	Total population waste (t)	Biomass available (t)
Swale	420	55,398	27,699

The recycling and composting rate was approximately 15% for Swale in 2005/06 – the worst performing Local Authority Area in the county at that time. Recently, however, the Borough made significant progress, recycling 27.29% of its waste in 2007/08, and achieving its target of 24%[32].

The Shepherd Neame Brewery is a local example of industrial recycling. The company reuses its spent yeast and malt for agricultural feed and has been certified under the Feed Materials Assurance Scheme (FEMAS), which guarantees the quality and traceability of these natural resources for the brewery.

Efforts to reduce waste arising and increase recycling and composting (bearing in mind that composting and AD are not mutually exclusive) can have an impact on the viability of energy from waste installations, as it can reduce the calorific composition of the waste stream. At the county level, Kent hopes to increase its recycling targets to 42%, and reduce overall waste to 704 kg of residual waste per household by 2011[33]. By 2020, Kent hopes to divert 75% of its waste from and recycle or compost at least 50% of its waste[34].

Potential for utilisation of water industry sludge

The water industry produces both wet and dry sludge in large quantities, which can be diverted for energy recovery. Many of biomass electricity projects in the UK are sewage gas projects that are less than 2.2 MW in electrical capacity[35]. The SEEPB study has suggested that Swale has the potential to contribute approximately 51.7 MW (267 GWh), 9.5% to Kent's sewage gas energy resource potential[36]. However, energy from sewage is likely to be delivered at a county level and the LPA should work with the County authority and utility providers to drive renewable energy initiatives for the sewage plants in this area.

[31] Swale Borough Council 'Sustainability Appraisal', March 2009. Available: http://swaleldf.swale.gov.uk/portal/sitt_town_centre/sitsa?pointId=5318#target-d6928769e5357
[32] Kent Waste Management Strategy, 2007
[33] Kent County Council 'Our targets for reducing waste and increasing recycling'. Available: http://www.kent.gov.uk/environment_and_planning/recycling_and_waste/targets_and_statistics.aspx
[34] Swale Borough Council 'Sustainability Appraisal', March 2009. Available: http://swaleldf.swale.gov.uk/portal/sitt_town_centre/sitsa?pointId=5318#target-d6928769e5357
[35] East of England Biomass Foundation Study report, Renewables East, November 2005
[36] Land Use Consultants (2010) *Review of Renewable and Decentralised Energy Potential in South East England*. Available: http://www.se-partnershipboard.org.uk/pdf/nat_res/potential_re_in_se-appendicies.pdf

Delivery opportunities and constraints

The conversion of potential to delivery requires consideration of a number of factors including:

- **Establishment of a supply chain** – While there is already a biomass resource available, there is no supply chain set up to collect, process and distribute that fuel. The LPA should work to enable the set up of a local supply chain. Annex A in the CEN Report is a good place to start.

- **Management of local forests** – Because ownership and status of local forest varies, a management plan coordinating sites and opportunities will need to be established in partnership with the Forestry Commission and key stakeholders. The management plan will need to consider how forest management can be delivered to ensure the biomass yield is available for local use. There is potential for this to be undertaken either in partnership with, or at the county level.

- **Management of environmental effects** - The South East Renewables Review reported that 'most of the wood fuel projects coming forward are of a relatively modest scale and have so far not given rise to severe difficulties through the planning system in the region. Impacts that are of concern relate to: emissions, stack size/ height, extra transport movements, access issues, smell and potential fire hazards from stored fuel'.

- **Management of Kent Downs AONB** – Specifically related to biomass, the Kent Downs AONB guidelines state that for large scale biomass production, "Agricultural crops for biofuels may be grown within the Kent Downs as a commodity but currently it is unlikely that there would be a landscape justification for the development of a biofuel processing plant in the AONB[37]." Policies regarding medium and small scale biomass production are highly supportive. With this knowledge, it can be assumed that the AONB would be a willing partner in growing bio-fuel crops, in appropriate locations, and managing woodland within the park in a sustainable manner.

Possible carbon reduction over core strategy period

Biomass production does produce carbon emissions; however, because during the growth and production of organic matter, CO_2 is also absorbed from the atmosphere, it is considered a low carbon source of energy. From the previous analysis, bio-fuel crops, such as short rotation coppice and miscanthus provide the largest potential for carbon savings. Carbon savings from these sources are detailed in the table below:

Table 21: Carbon Savings Potential from Bio-fuels

Fuel	5% of Grade 3 and 4 land	Carbon savings after one year[38]	Carbon savings over five years
SRC (e.g. miscanthus, willow)	377 ha	140 tonnes carbon equivalents	867 tonnes carbon equivalents

Carbon savings are equivalent to 140 tonnes after one year and 867 over five years, representing an exponential saving over the longer time period. This saving is based on a study by the Institute of Biology, Environment and Rural Sciences at Aberystwyth University completed for the National Assembly

[37] South East Protected Landscapes Project Team (2008) *Identification of key constraints and Opportunities for renewable energy within the Kent Downs AONB*

[38] National Assembly of Wales. Available: http://www.assemblywales.org/bus-home/bus-committees/bus-committees-third1/bus-committees-third-sc-home/bus-committees-third-sc-agendas.htm?act=dis&id=107656&ds=1/2009

of Wales, which determined 370 kg (0.37 tonnes) of carbon saved per hectare of land over one year, and 2,279 kg (2.3 tonnes) per hectare over a five year period.

Influence of planning

The LPA should work to ensure safe and effective biomass growth and development in the Borough. This includes zoning regulations for refinery plants, taking into account surrounding land uses and prevailing winds, minimising impacts on air quality. Other negative impacts from delivery trucks on traffic and air quality should also be considered.

With respect to agricultural land, the LPA needs to protect the agricultural land, focusing the development of bio-fuels in land graded 3 and 4. Grade 1 and 2 lands should be protected and only used for growing food crops.

It is also important to work with Kent Downs AONB to make use of suitable land for growing bio-fuels within their jurisdiction. Kent Downs has noted that it believes it can contribute to wood fuel based renewable energy, and supports its growth on site. As stated, "The near location of two growth areas makes the opportunity for development of a wood fuel industry, which supports sustainable woodland management, more realistic."[39]

The wider council should take a supportive role in establishing biomass supply chains to ensure a local biomass supply is available to new development. This is an opportunity to satisfy Kent Down's goal of supporting renewable energy while simultaneously helping Swale satisfy its renewable energy goals.

Case study

Croydon is a prime example of a successful implementation of a renewable energy from biomass strategy. BioRegional, Croydon Council and City Suburban Tree surgeons have established a TreeStation, which will produce 10,000 tonnes of wood chip fuel per year from tree trimmings. TreeStation is the first biomass plant of its kind in London. Some of its benefits include: sustainable means of disposal for tree waste; stimulate biomass heating market in the region; supports the council's renewable energy policy; and provide new business opportunities. It also acts as an exemplar for the area. The TreeStation project was recognised in 2006 as winner of the Ashden Awards for Sustainable Energy.

More information can be found here:

http://www.bioregional.com/files/publications/CroydonWoodchipCaseStudy.pdf

[39] Kent Downs Area of Outstanding Natural Beauty. 'Kent Downs Area of Outstanding Natural Beauty Renewable Energy Position Statement', September 2008

4.9 COMBINED HEAT AND POWER PHYSICAL POTENTIAL AND CONSTRAINTS

Combined Heat and Power provides a much more efficient way of generating and distributing energy as it makes use of the heat usually wasted in energy production and because it is located close to the development the losses in transmission are reduced. Typically, a standard CHP achieves a 35% reduction in primary energy usage compared with conventional power stations and heat only boilers. However, CHP can also be run using biomass/biogas to provide a low carbon solution, with reductions in emission nearing 100%. The figure below shows the CHP arrangement compared with traditional energy generation.

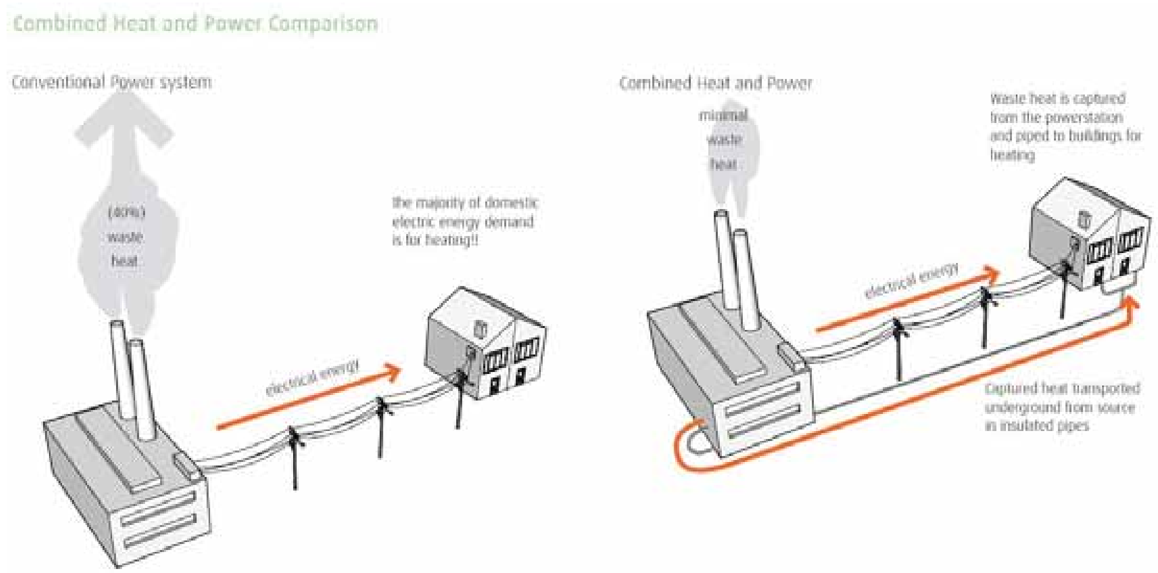

Figure 29: CHP comparison

Scale of potential

A heat network could either be connected to a district heating system or a combined heat and power system (which distributes waste heat from the electricity generation process). These systems could utilise gas or biomass as a supply fuel, and the distribution of heat in such a fashion brings great efficiencies as heat demands are balanced across an area. It should be noted that while the introduction of CHP is strongly encouraged at a European and National level, and local authorities play a key role in delivery, CHP will only count towards renewable energy targets where it is fuelled by a renewable or low carbon source such as biomass or biogas. Technology surrounding biomass powered CHP is still developing in the UK but is expected to be perfected over the coming years. Hence, depending on delivery conditions it may be more suitable to implement gas-fired CHP in the interim and convert the fuel source to biomass or biogas as the technology and supply chain develops. However, the introduction of gas CHP is still beneficial as it contributes directly to CO_2 reduction targets through efficient supply of electricity and heat.

The figure below highlights areas which have a heat demand intensity of greater than 3MW/km^2 (or 26MWh/km^2). These areas are expected to be commercially viable for the installation of a district heating or combined heat and power system based on professional experience. The darker the red areas represent locations where more energy savings can be realised. As can be seen, these areas are focused around urban areas – Faversham, Sittingbourne, Sheerness, and Minster.

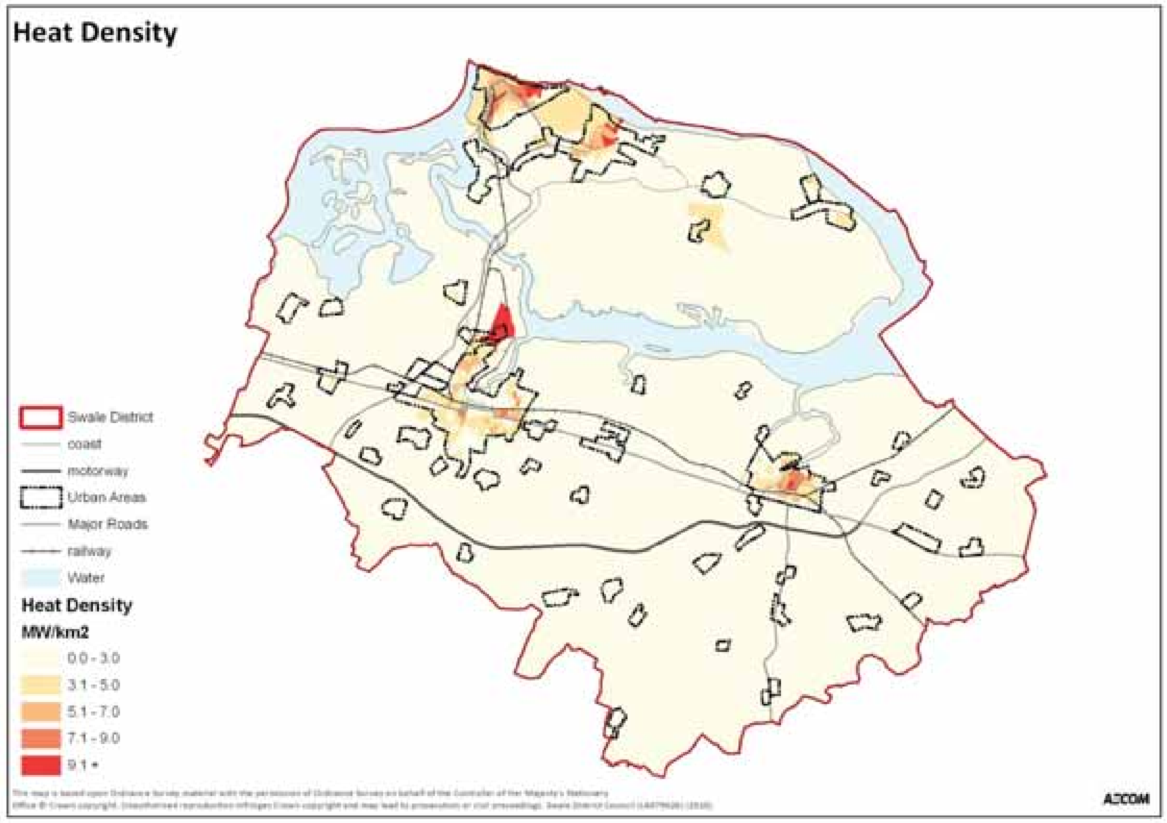

Figure 30: Current distribution of heat density

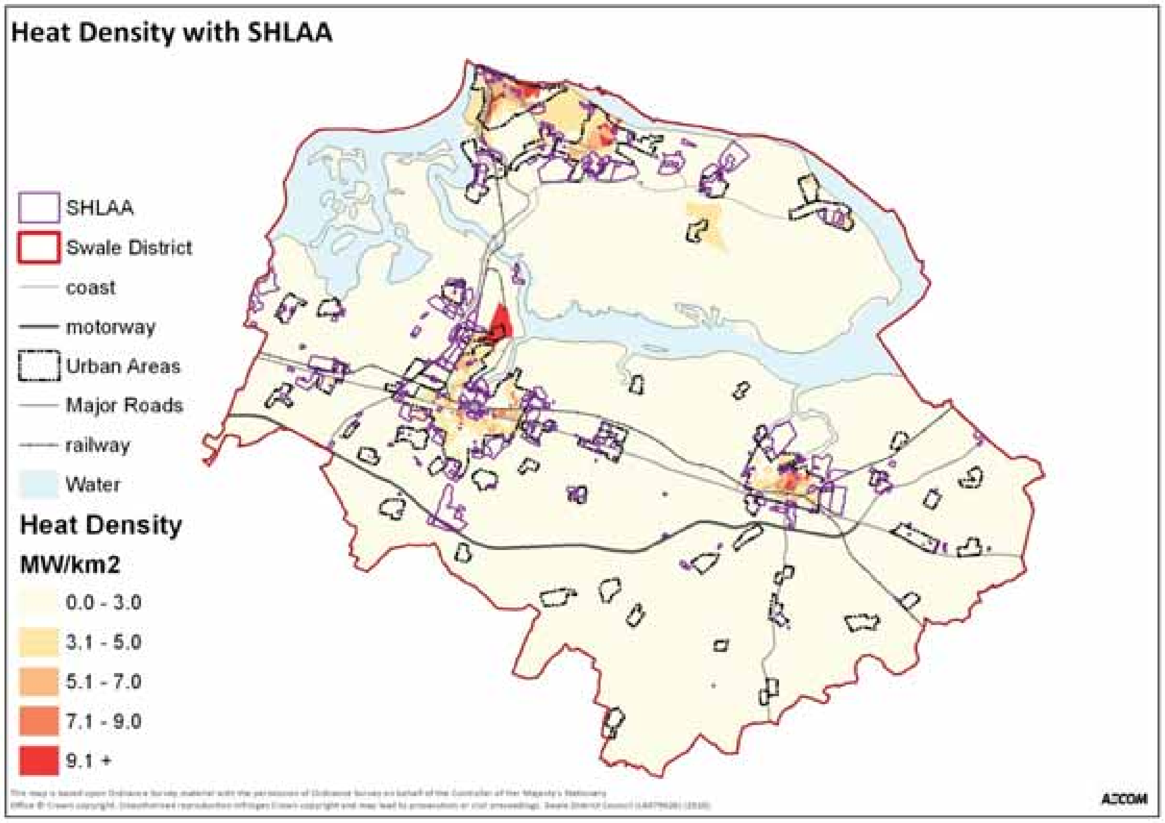

Figure 31: SHLAA in relation to current distribution of heat density

Based on SEEPB's assessment, the South East region has a maximum potential to capture 55TWh per year of waste heat. While it is difficult to accurately predict where the majority of these opportunities lie, Sittingbourne has been listed as a future "demand led opportunity" from predicted future heat users.

CHP linked to a neighbourhood via a district heating arrangement could meet the home's annual heating, hot water and most, if not all, of their electrical requirements. Higher density housing, typically at least 50 dwellings per hectare, tends to be more commercially viable to reduce district heating infrastructure costs. This is because costs are related to the length of the pipe, although CHP is technically viable at most densities. CHP also works best in mixed use developments as they operate most efficiently when they can operate constantly, and so can serve a diverse load. As different users have different energy use patterns (residential more in the morning and evening whilst offices through the middle of the day) mixed use development allows energy requirements to be balanced.

The size of the CHP plant will depend on the size of development, including the number of homes it is to serve and energy demand of any key anchor loads. For a facility to serve 1500 homes, you would likely require a facility of 500m^2 footprint. For biomass power you would need a fuel storage area as well. The majority of the building could be 4m high, but a section rising to 7-9m would also be needed to house the heat store and there would also be a flue which will need to be a few metres higher than surrounding development.

As CHP works best in higher density areas, such as Sittingbourne, Sheerness and Faversham, siting facilities can become a challenge. With sensitive and creative urban design, there is however, limited reason as to why they could not be able to be integrated into a townscape. The regeneration of Sittingbourne Town Centre represents a prime opportunity to include a CHP plant in the design. With this in mind, the figure below highlights some potential options for urban design of CHP.

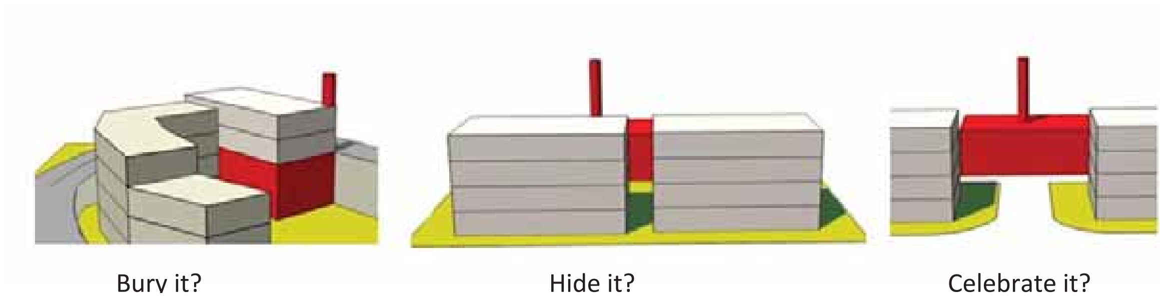

Figure 32: Design options for siting CHP

CHP facilities may be designed to a specification where it is necessary to dispose of waste heat in summer. Suitable locations and methods should be considered in design to ensure this does not have significant environmental effects.

Delivery opportunities and constraints

Successfully delivering CHP requires the consideration of a number of factors including:

- **Anchor loads** – The location of such facilities is key, as district heating schemes often need an 'anchor load' or consistent energy user to operate efficiently. Therefore, areas around these anchor loads are priorities for development. For example, the relatively large manufacturing and distribution sectors in Sittingbourne and on the Isle of Sheppey should produce the high heat loads required to support a CHP network.

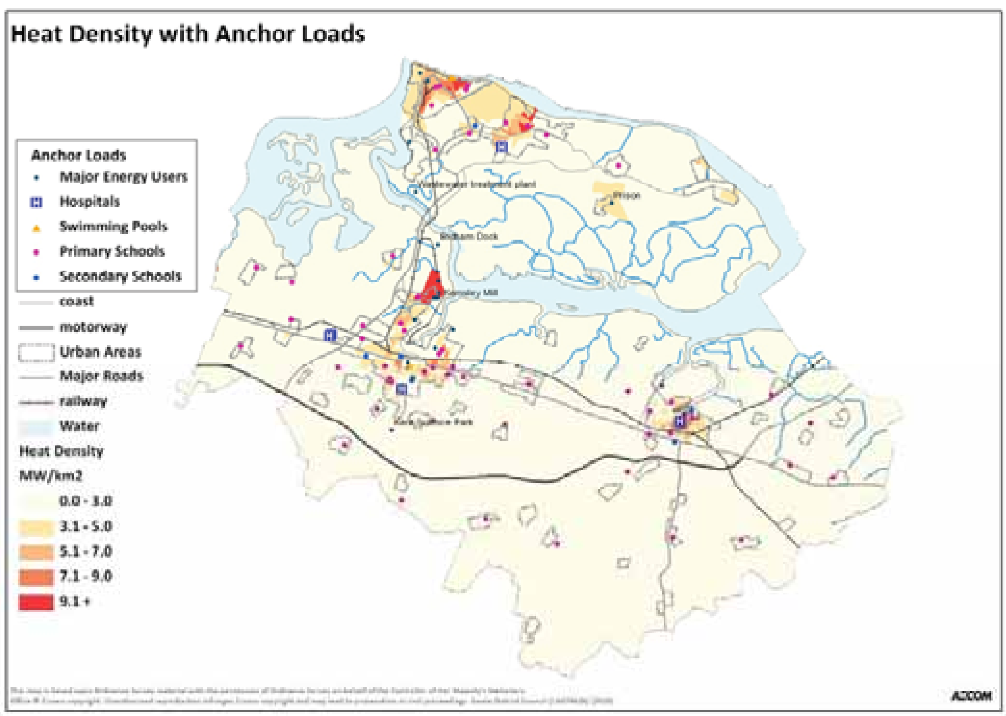

Figure 33: Swale heat density map with key anchor loads

- **Heat Generators** – Swale has a number of heat generating sites with opportunities to contribute to a heat network. The existing steam pipeline corridor in Kemsley could be exploited as the starting point for a heat network. Kent Science Park (KSP) has its own district heating network and is in the process of installing a CHP plant. KSP is enthusiastic about the potential for other organisations and residential developments to connect into their existing heat network. In Faversham, the Sheppard Neame Brewery is a heat generator that might provide an opportunity to link into town. There are numerous other industrial heat generators within Swale, most of which are mapped in the figures below.

- **Council property –** Retrofitting private properties can be a slow and time consuming process before the required critical mass for a district heating network is achieved. Therefore, an opportunity exists for council owned property to retrofit their properties first. In Swale, the lack of council building and land ownership does present a constraint. However, there might be potential for Community Energy Saving Program (CESP) funding to facilitate the development of an effective CHP network, provided the council is able to match CESP funding, as the programme requires.

- **New developments –** New developments of a large scale (300+ homes) or with a substantial mix of uses that will create a strong heat demand density may drive their own site-wide CHP and district heating systems. However, new developments are often built in phases. Each phase on its own is often small and makes district heating on a larger scale difficult. Where possible, new developments should be built in conjunction with large anchor loads, such as hospitals, schools, or community facilities that would make a larger CHP network feasible. In fact, Powergen has proposed a CHP area all around the Thames Estuary in Swale. Queenborough and Rushenden might represent a catalyst in the area as their recent masterplan includes a proposed CHP plant.

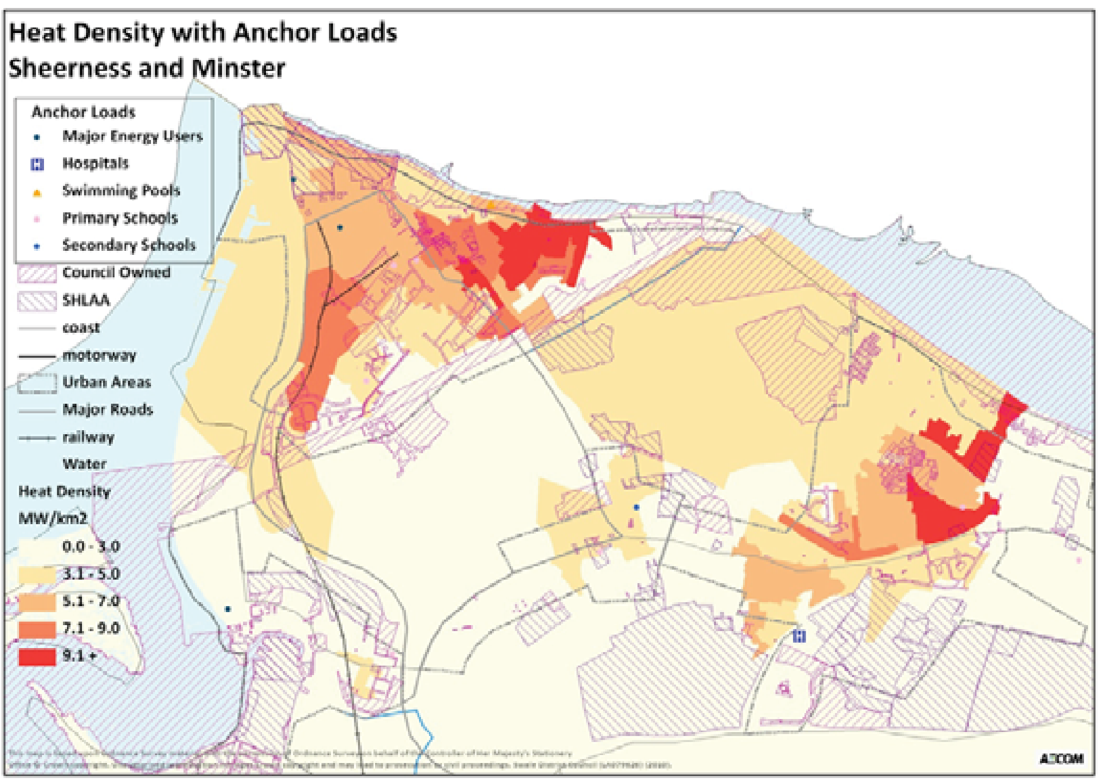

Figure 34: Key anchor loads in Sheerness and Minster in relation to current distribution of heat density

The above figure portrays the heat density in Sheerness and Minster. As can be seen, there is strong potential for a heat network to be established on the eastern shore of Sheerness, and southern portion of Minster. The industrial activities within the port present opportunities to leverage them as key anchor loads to increase the potential for a heat network. The development of the surrounding SHLAA sites would contribute to higher heat densities, while Council could install a district heating network on its owned properties in Sheerness, stimulating renewable heat adoption in the process.

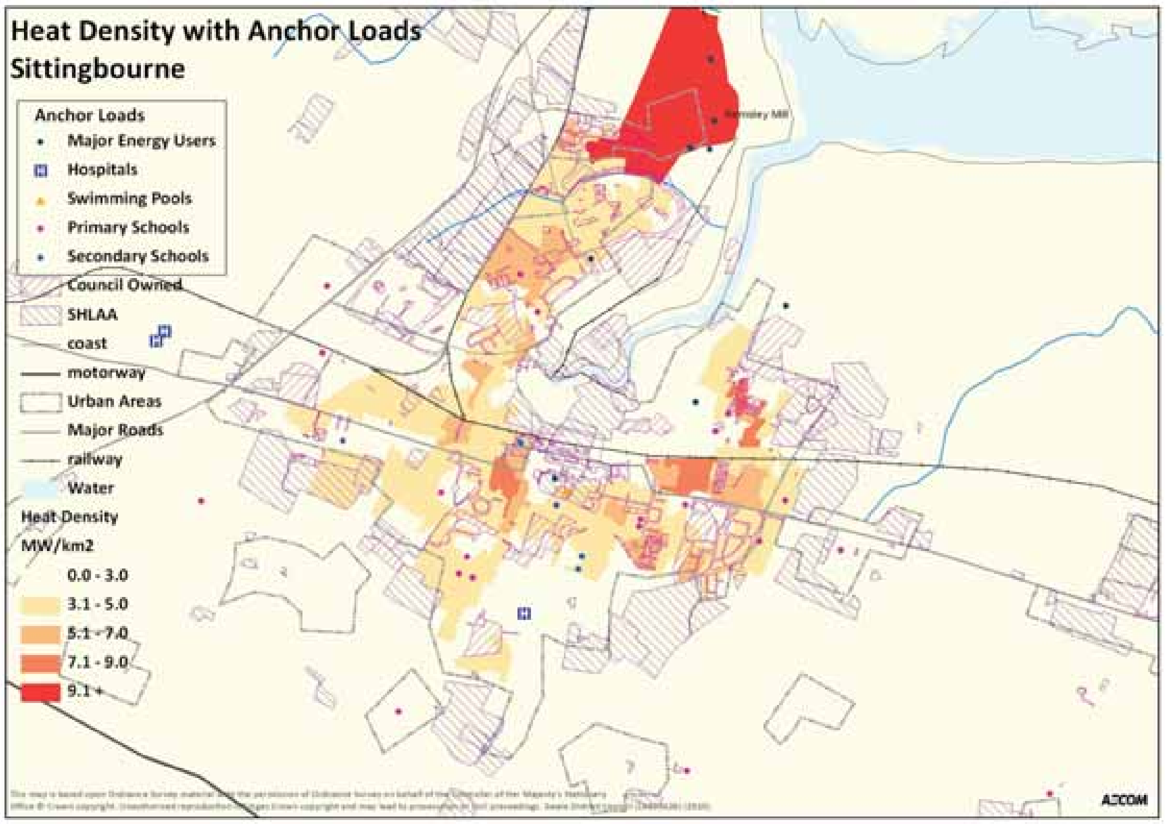

Figure 35: Key anchor loads in Sittingbourne in relation to current distribution of heat density

The figure above shows that that within Sittingbourne, the greatest potential for a district heating network exists to the north around the Kemsley paper mill, which has already built a CHP plant. While the heat density does not appear very "dense", it is above the feasibility threshold and future growth within Sittingbourne will only increase the heat network feasibility. Given that Sittingbourne is also in the process of regeneration, the timing represents an opportunity to include CHP and heat network piping within the site design. Ideally, the network would take a U-shape, as per the diagram; however, it should be noted that designing a heat network to cross railroad tracks can be financially demanding.

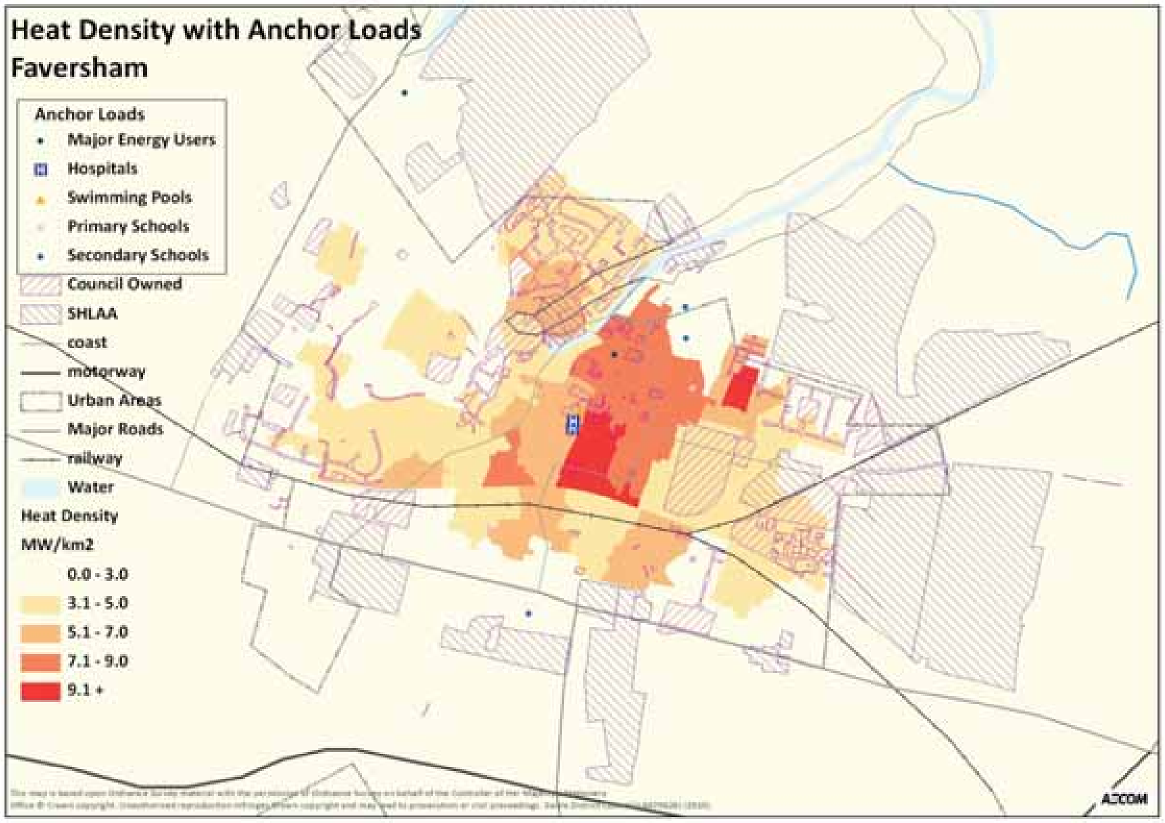

Figure 36: Key anchor loads in Faversham in relation to current distribution of heat density

The figure above shows that Faversham has potential for a heat network, particularly around the hospital. It will be important to determine if the hospital has its own energy supply or if they connect to the main electricity network. Discussing a heat network with the hospital could be the key to unlocking a district heating network in Faversham as it the hospital represents a key anchor load.

Possible carbon reduction over core strategy period

The table below shows the expected energy generation and CO_2 savings associated with installation of gas-fired CHP in 15% of viable areas in Swale (5% uptake each phase, beginning phase 2). The figures of 5% per phase are used as an illustrative example that is also realistic and deliverable. CO_2 reductions could be further increased through a larger take up of heat networks, or through the use of biomass fuel in the place of gas.

Table 22: Effect of introduction of gas CHP into 15% of viable existing areas

LPA Area	2011	2016	2021	2026	2031
Electricity from CHP introduction in existing areas (MWh/year)					
Swale	0	1,189,969	2,379,938	3,569,907	4,759,876
Heat from CHP introduction in existing areas (MWh/year)					
Swale	0	1,802,984	3,605,968	5,408,952	7,211,936
Total CO_2 saving over conventional supply (tonnes/year)					
Swale	0	125,568	257,136	385,704	511,272

Influence of planning

The LPA should look at implementing planning policies that facilitate the development and connection to a heating network. There are a number of strategies planners can employ to influence and encourage its development. Perhaps the most productive strategy would be for the Council to set aside land for CHP Plants and begin retrofitting its own properties, thereby becoming a catalyst in the drive to developing a district heating network for the area. The Woking case study, which follows, is a prime example of a council taking leadership and installing a CHP network throughout its council land, saving over 40% of its energy consumption in the process. This could be buttressed by requiring key opportunity areas to undertake district heating feasibility studies, which can help ensure CHPs are located in the most effective areas to maximise financial and environmental benefits.

Planning can also require new developments in feasible district heating priority areas to install district heating systems (unless proved unviable). Large mixed use strategic sites can often prove financially attractive to independant Energy Services Companies, or ESCos, who will install CHP and a district heating network, serving customers in the development. CHP is often a cost-effective way of reducing carbon emissions to meet emerging Building Regulations or higher Code targets on large sites. Planning can drive delivery of CHP on strategic sites by setting carbon reduction targets or requiring feasibility studies to be undertaken.

Within Swale, there are already a number of key industrial sites that could be catalysts in the delivery of a district heating network. Working with some of the sites identified, or with sites that already have district heat networks and/or CHP plants (i.e., Kemsley Paper Mill and Kent Science Park) would be worthwhile initiatives for the Council to undertake.

Case study

Since 1990, Woking Borough Council has undertaken a series of sustainable energy projects, and become a pioneer in the process. Between 1991 and 2001, the council reduced its energy consumption by 40%. It established the UK's first local sustainable community energy system and the first public/private joint venture Energy Services Company (ESCO). This has resulted in £4.9 million in savings for the council, as well as other savings for local households and businesses. Woking is recognized as the UK's most energy efficient local authority, and is the only local authority to ever be awarded the Queen's Award for Enterprise for its work in sustainable development. In 2002, Woking's energy efficiency policy was replaced with by a more comprehensive Climate Change Strategy for the Borough as a whole, shifting its focus from savings in kWh to savings in tonnes of CO_2.

Category	Savings over 11 years - Woking	Potential savings over 11 years – if applied across the South East
Energy consumption savings	170,170,665 KWh (43.8% saving compared to conventional energy supply))	14,413.5 GWh
Carbon dioxide emissions savings	95,588 tonnes (71.5%)	8,181,000 tonnes
Nitrogen oxides emissions savings	319.1 tonnes (68%)	27,000 tonnes
Sulphur dioxide emissions savings	976.6 tonnes (73.4%)	82,700 tonnes
Water consumption savings	340,011,000 litres (43.8%)	28,799,000,000 litres
Savings in energy and water budgets	£4,889,501 (34.3%)	£414,141,000

Source: http://www.climatespace.org/wp-content/uploads/2007/10/case_study_2-woking.pdf

4.10 MICRO-GENERATION

The term micro-generation is used to describe small scale technologies (typically less than 50 kW electric and 100 kW thermal). These technologies are usually based in a building or on a small site, providing energy to one or more buildings. Micro-generation technologies include:

- Heat pumps
- Wood-burning stoves
- Micro CHP
- Photovoltaics (PV)
- Solar thermal
- Small and micro wind

Physical potential and constraints

Generally, some types of micro-generation technologies are suitable for installation in every type of existing building and the challenges are delivery related, rather than issues of technical feasibility.

Solar energy is a key type of micro-generation. There are two main solar technologies that are generally delivered alongside built development: photovoltaic panels and solar thermal panels. Photovoltaic panels produce renewable electricity and can be mounted on structures or used in stand-alone installations. Solar thermal panels, on the other hand, are commonly used to directly heat water in homes, but can also be used to assist heating. Photovoltaics have a high capital cost in comparison to other renewable energy options, but they are one of the few options available for renewable electricity production and are often one of the only on-site options to assist in CO_2 reduction associated with electricity use. Solar thermal panels are more space and cost effective and are well utilised technology for heating hot water.

Spatially, across the UK the relative benefit of the use of solar technologies varies. Swale's potential for solar energy is relatively high compared to the rest of the UK average. On a global scale, solar technologies do not perform at high efficiencies in the UK as compared to say, Colorado. Nonetheless, parts of England receive as much, or more solar irradiation as Germany, which has a large installed capacity of solar panels. The figure below shows the relative solar exposure of Swale compared with the rest of the UK. Solar technologies are widely available and will have a role to play in renewable energy generation, especially on low density development with a substantial amount of exposed roof space. The flat roofs in the Kent Science Park and large warehouses in Swale provide an opportunity for solar arrays. To ensure that solar technologies are effective, south facing roof space should be favoured in building design and masterplanning (through street orientation). In more open spaces, there are opportunities to generate solar energy via solar farms. In the UK, solar farms would likely take the form of multiple solar panels installed on large pieces of rural land.

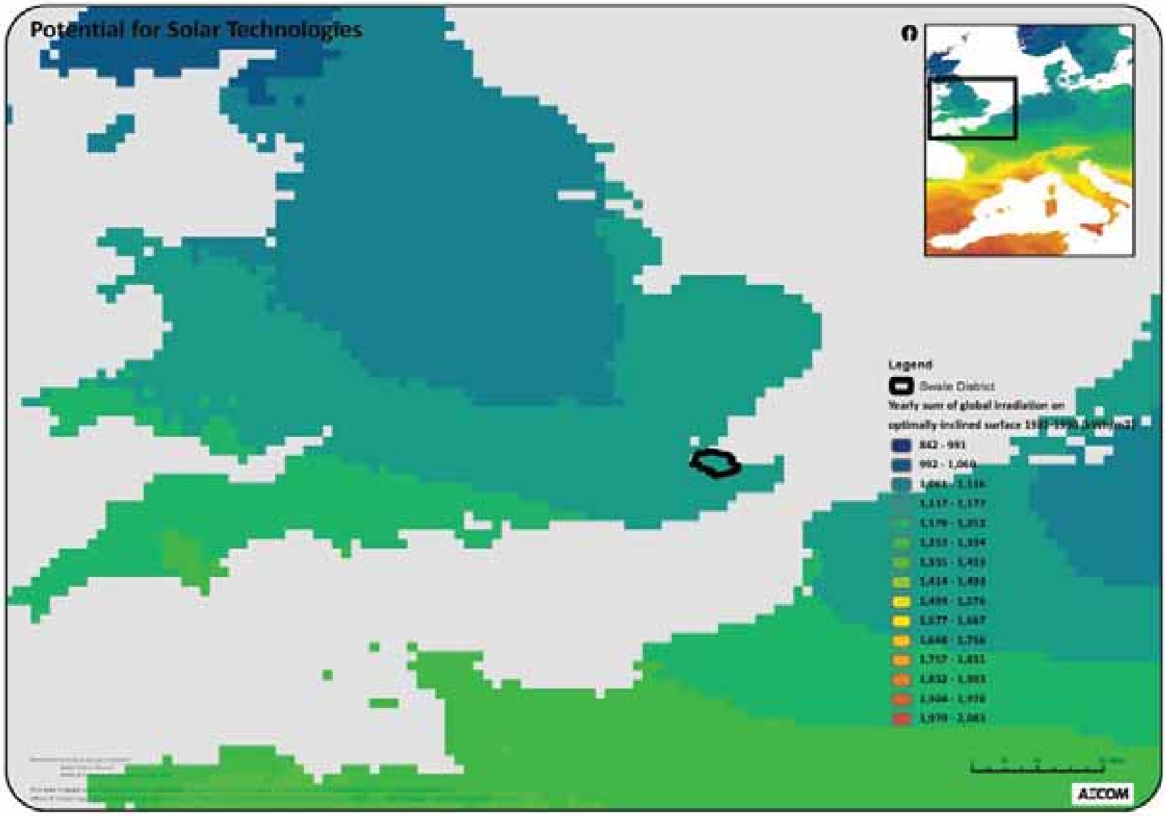

Figure 37: Potential for solar energy in Swale

Other types of micro-generation are generally not geography specific and suitability will depend on building type, operation, layout, and surrounding landscape. Hence the geographic location of the Swale has little effect on the viability of these small-scale technologies.

Delivery opportunities and constraints

Delivery Momentum

Independent uptake of micro-renewable that generate electricity has been stimulated on a national scale through the introduction of the feed-in tariff, which has been in operation since April 2010. The Government has published planned feed in tariffs for the generation and export of renewable electricity for a range of micro generation renewables including, Photovoltaics, as well as anaerobic digestion, biomass, small hydro and wind. It should be noted that while the new government has maintained the feed-in tariff, they have also mentioned that it will come under review in 2013. This provides the impetus for those considering installation of micro-renewables to install them prior to 2013 to ensure they qualify for the feed-in tariff, and guard against potential policy changes in the future. The table below provides an indicative annual income for a range of renewable energy technologies, assumed to have been installed in April 2012, as well as further information on incentive schemes proposed for small scale renewables.

Within the UK, the solar energy industry is starting to make a presence. In Truro, Cornwall, a 5,000 panel, 2.8 hectare solar farm, which will produce enough electricity for 300 homes, has been granted planning permission. Cornwall is currently considering 14 other approvals. Within Swale, the Council has also received a number of inquiries regarding solar farms. There are, however, a number of issues that need to be considered before planning permission can be granted. Some of these issues might include how the solar farms impact the general character of the surrounding area, the agricultural value of the land, and how the installation might impact wildlife habitats and general biodiversity. This is an industry that is in its infancy, and has the potential to become a major energy source in the future.

Table 23: Tariff payments for renewable energy systems installed in 2012

Technology	Applicable tariff system	Generation tariff (p/kWh)	Export tariff(p/kWh)	Value of energy saved (p/kWh)
PV (<4kW new build or retrofit)	FIT	41.3	3.0	12.9
PV (>4-10 kW)	FIT	36.1	3.0	12.9
Hydro (< 15kW)	FIT	19.9	3.0	12.9
MicroCHP (<2kW)	FIT	10.0	3.0	12.9
Wind turbine (<1.5kW)	FIT	34.5	3.0	12.9
Wind turbine (<1.5-15kW)	FIT	26.7	3.0	12.9
Small scale solid biomass (e.g. wood burning stove)	RHI	9.0	n/a	3.7
Small scale bioliquids	RHI	6.5	n/a	3.7
Biogas onsite consumption (e.g. small scale anaerobic digestion)	RHI	5.5	n/a	3.7
Ground source heat pumps	RHI	7.0	n/a	3.7
Air source heat pumps	RHI	7.5	n/a	3.7
Solar thermal/solar water heating	RHI	18.0	n/a	3.7

Feed-in Tariffs (Renewable electricity)

Feed-in Tariffs were introduced in April 2010 to replace the support provided by the Low Carbon Buildings Programme and stimulate increased vigour in the take up of installation of small-medium scale renewable electricity generation.

The scheme will include:

- Fixed payment from the electricity supplier for every kWh generated (the "generation tariff").
- A guaranteed minimum payment additional to the generation tariff for every kWh exported to the wider electricity market (the "export tariff").
- Generators receiving FITs will also benefit from on-site use: where they use the electricity they generate on-site, they will be able to offset this against electricity they would otherwise have had to buy.
- Technologies included: wind, solar PV, hydro, anaerobic digestion and non-renewable micro CHP.
- Tariffs are tax free and will be paid for 25 years for new projects.
- The tariff levels proposed have been calculated to ensure that the total benefits an investor can be expected to achieve (from the generation tariff, the export tariff and/or the offsetting benefit) should compensate the investor for the costs of the installation as well as provide such a rate of return.
- The government intends to set tariffs at a level to encourage investment in small scale low carbon generation. The rate of return will be established between 5% and 8%.
- The proposed tariff levels for new projects will decrease by predetermined rates each year ("degression"). [The tariff rate agreed at the project outset will be maintained for the 20 year period – this therefore incentivises early take-up for maximum revenue return]

Renewable Heat Incentive

In October 2010, the Government confirmed that the Renewable Heat Incentive (RHI) will go ahead in April 2011[37]. Renewable heat producers of all sizes will receive payments for generation of heat. The RHI represents over £850m of government investment. There is no upper limit to the size of heat equipment eligible under the Renewable Heat Incentive and anyone who installs a renewable energy system producing heat after July 15th 2009 is eligible. The following technologies are included in the scheme.

- Technologies included: air and ground source heat pumps, anaerobic digestion to produce biogas for heat production, biomass heat generation and CHP, liquid biofuels (but only when replacing oil-fired heating systems), solar thermal heat and hot water and biogas injection into the grid
- Unlike FITs, tariffs will be paid not on the basis of a metered number of kWh generated, but instead on a "deemed" number of kWh, namely the reasonable heat requirement (or heat load) that the installation is intended to serve.
- Tariff levels will be calculated to bridge the financial gap between the cost of conventional and renewable heat systems at all scales, with additional compensation for certain technologies for an element of the non-financial cost and a rate of return of 12% on the additional cost of renewables, with 6% for solar thermal.

Delivery in Conservation Areas

As of April 6, 2008, changes to permitted development rights for renewable technologies no longer require planning permission for most domestic micro-generation technologies. The General Permitted Development Order (GPDO) permits certain limited forms of development on the home, without the need to apply for planning permission. The scope of the GPDO in England now extends to the following technologies (for domestic properties only):

- Roof-mounted solar PV and solar thermal (permitted unless panels protrude more than 200mm when installed)
- Stand-alone solar PV and solar thermal (permitted unless more than 4 metres in height; installed less than 5 metres away from any boundary; above a maximum area of array of 9m2; situated on a wall within any part of the curtilage of the dwelling house and would be visible from a highway in Conservations Areas and World Heritage Sites.
- Wood burning boilers and stoves, and CHP (permitted unless flue exceeds 1m above the roof height (excluding the chimney); installed on the principal elevation and visible from a road in building in Conversation Areas and World Heritage Sites).
- Ground source heat pumps.
- Air source heat pumps.

Installation of micro and small wind is currently not included as a permitted development due to legal technicalities with the current statutory instrument, though this should soon be resolved as revisions are currently in consultation. Air source heat pumps are in a similar situation to micro-wind, and are expected to become permitted development once legal issues are resolved.

Draft legislation was released for consultation in November 2009 on 'Permitted development rights for small scale renewable and low carbon energy technologies, and electric vehicle charging infrastructure' (consultation closed in February 2010). This document proposed conditions of permitted development for small wind turbines and air source heat pumps. Air source heat pumps are proposed as a permitted activity in a conservation area, while wind-turbines in conservation areas will require planning permission where the wind turbine would be visible from any highway bordering the property.

The consultation document also proposes new policies on permitted development for non-domestic buildings. As proposed, all types of micro-generation except ground and water source heat pumps would require planning permission for inclusion on non-domestic properties in a conservation area.

The consultation document provides an indication of the possible direction of future policy. Regarding the locating of micro-renewables, the document recommends considering the local context, stating:

'The impacts of renewable and low carbon energy technologies will vary on a case by case basis according to the type of the development, its location and setting. Development that is appropriate in one place may not be acceptable somewhere else and permitted development rights need to reflect this. This consultation therefore proposes that limits to what would be permitted would vary according to their site and location.

Further to this, the document states that

More restrictive limits are proposed for sensitive areas where the Government considers they would be warranted:

- *Wind turbines, air source heat pumps and solar panels within World Heritage Sites would not be granted permitted development rights if they are visible from a highway adjoining the site. The same protection would be accorded to conservation areas, although there may be many such areas where they would be acceptable and could contribute to a low carbon footprint. The Government will be interested in views on how far this might be the case.*

In conservation areas, visually obstructive technologies may be unsuitable, but the scale and positioning of renewables should be considered in context to determine feasibility. Roof mounted technologies are likely to be the most concerning from a conservation perspective; however, roof-mounted objects such as TV aerials are allowable in conservation areas. Roof-mounted micro-generation technologies that may be of concern include photovoltaics (PV), solar thermal, flues associated with wood-burning stoves/boilers and CHP and micro-wind turbines. Notably the installation of roof-mounted (but not standalone) PV and solar thermal is currently permitted activity in conservation areas unless specific local guidance or policy is in place.

While Swale contains many conservation areas, there are also many commercial and industrial sites with large, flat roofs that would be ideal for the installation of solar PV. Factories, and large warehouses are ideal locations for Solar PV installations as they are not likely to be located in conservation areas, and have enough roof space to meaningfully contribute to renewable energy and carbon reduction targets for the Borough. Installing solar PV in conservation areas, however, should also be considered. Provided their installation does not negatively impact the visual appearance or overall character of the area, their inclusion should be considered. As an alternative to roof-mounted technologies, solar panels and wind turbines can be installed in private gardens out of view of the public realm.

Similar issues are likely to be encountered in the case of listed buildings, and appropriate design measures will need to be taken to mitigate visual or structural impacts.

Possible carbon reduction over core strategy period

The DECC methodology for renewable capacity assessment sets out a methodology to estimate the potential for solar technologies and ground source heat pumps, which will be estimated for Swale. This, however, will not provide a full overview of all micro-generation technologies, nor will it estimate the scale of potential, which will depend heavily on local desire for their delivery.

A study for BERR[40] (now DECC) modelled the UK market for micro-generation technologies out to 2050, by simulating the UK consumer base and technologies for both the residential and non residential sectors. A number of assumptions are made based on regional surveys of consumer attitudes to technologies and costs, and their likelihood of purchasing a technology depending on their current type of building/dwelling, current energy prices, and their "willingness to pay". Two scenarios are considered in the tables below (using uptakes modelled in the BERR study):

- 'Medium uptake scenario': This scenario entails a substantial change in the uptake of micro-generation. The level of electricity generation shown in the table below is equivalent to every third home in Swale installing 2m^2 of PV panels.
- 'High uptake scenario': This scenario assumes that the feed-in tariff is widely exploited in the Borough, and the current activities are continued along with focussed promotion and support.

Both scenarios are based on installation in domestic properties, assuming there are currently approximately 47,623[41] homes in Swale.

Table 24: Effect of introduction of 'medium level' micro-generation in buildings

	2011	2016	2021	2026	2031
Micro-generation Electricity Production (kWh)	177,269	460,913	1,591,962	4,410,641	7,229,321
Micro-generation Heat Production (kWh)	362,121	893,991	2,999,210	8,681,843	14,364,477
CO_2 Reduction due to Micro-generation (tonnes)	44	110	424	1,384	2,344

Table 25: Effect of introduction of 'high level' micro-generation in buildings

	2006-2011	2011-2016	2016-2021	2021-2026	2026-2031
Micro-generation Electricity Production (kWh)	1,039,880	2,703,761	7,300,899	13,647,034	19,993,169
Micro-generation Heat Production (kWh)	5,599,660	13,824,231	32,825,185	52,933,124	73,041,062
CO_2 Reduction due to Micro-generation (tonnes)	685	1,701	4,325	8,084	11,842

[40] The Growth Potential of Micro-generation in England, Wales, and Scotland. Element Energy 2007. BERR
[41] Swale Borough Council

Influence of planning

As discussed above, delivery of micro-renewables within industrial and commercial sites will be key to increasing the installation of renewable energies in Swale. The table above suggests that there is also much potential for carbon reduction in residential buildings as well, with the potential to prevent nearly 12,000 tonnes of carbon from being emitted by 2031.

To influence uptake of renewable outside residential areas, the Council can seek to encourage and support delivery of micro-generation by providing guidance, and working with communities and local industry. Local industry has already shown they are open to environmental initiatives, and there is potential for Swale Borough Council to incentivise swifter uptake of micro-generation in the Borough through a business information awareness campaign and through working with other partners to identify commercial/industrial businesses with larger areas of south facing roof, or flat roofs, who might either be interested in investing in solar technologies or who would be interested in linking up with an investment partner. Planning can take the opportunity to encourage the installation of micro-generation (along with other energy improvement measures) when a conversion or extension to an existing building is proposed. With the uncertainty around the future of the feed-in tariff, and the higher rates offered in earlier years, speed is important when considering micro-generation installations. Specifically related to solar energy, the council should state their position for the installation of solar photovoltaic panels on building as well as in solar farm developments.

Planning has more control over the introduction of on-site renewables on new development sites, though these are expected to lessen due to the proposals to tighten building regulations. High levels of on-site renewables can be driven through policies across the Borough or for strategic sites where it is considered deliverable.

Case Study: Haringey Guidance on Renewable Energy in Conservation Areas

The London Borough of Haringey has developed guidance on renewable energy installations in conservation areas. The guidance discusses a range of technologies and diagrammatically demonstrates what areas and roof-tops are can support renewable energy installations without impacting on conservation value.

Figure 38: Guidance extract from Haringey Council's guidance on renewables for conservation areas[42]

[42] London Borough of Haringey. Use of Renewable Energy Systems: Historic Buildings and Conservation Areas. Available: http://www.haringey.gov.uk/renewable_energy_systems.pdf

4.11 CONSIDERING BOROUGH-WIDE RENEWABLE ENERGY TARGETS

From the above analysis, it is clear that there are substantial opportunities for renewable and low carbon energy in Swale, though the potential varies across the LPA. The LPA shows significant potential for the delivery of renewable and low carbon heat supply, due to the existence of many opportunities for the integration of district heating networks (in both existing and new development) and the presence of a local biomass supply. Coppiced wood and short rotation crops show the greatest biomass potential in the Borough. CHP plants could also be used either independently, or in conjunction with a district heat network. Solar farms and microgeneration of renewable energy also show signs of increased installation and adoption within the Swale.

The potential to integrate renewable technologies to supply electricity, however, varies for each form of renewable energy.

- **Wind –** Along the southern portion of the Borough, as well as on the Isle of Sheppey, there is potential for wind energy development. The Kent Downs AONB to the south represents the most significant barrier to their wind energy in the Borough, while the Isle of Sheppey is located within internationally recognised wetlands and Southend Airport's 30km buffer. Both of these constraints would need to be negotiated before wind development could be investigated seriously.

- **Biomass –** Biomass suitable for combustion in boilers or CHP represents one of the bigger opportunities for the Borough. With a large portion of grade 3 and 4 land, which is generally unsuitable for agricultural crops, transforming 5% of this land into fuel crops could provide electricity for over 1,700 homes while heating over 2,200 homes. If used as part of a district heating network, it could heat over 4,800 homes. Implementing a regional/sub-regional biomass supply chain could increase the potential for biomass energy in the area.

- **Microgeneration and solar farms –** If many of the commercial/industrial buildings install microgeneration technologies, such as solar photovoltaics, they could play a significant role in Swale's renewable energy mix. They also represent an opportunity to continue building community support for renewables in the area. There is potential for household retrofitting and buy-in to flow from this momentum. Solar farms might play a role into the future, particularly in the less sensitive rural areas of the Borough.

The renewable potential of the Borough is shown visually in the 'Energy Opportunity Map' in the next section.

As Swale has a large capacity to develop renewable heating options, most specifically from biomass energy and micro-generation. Consequently, we recommend the delivery of its proportion of renewable heat based on the national target (around 12% of heat by 2020) should be adhered to. Renewable heat is a similar delivery challenge for most areas across the UK, and hence Swale Borough should be able to meet its proportional contribution. This might be delivered using district heating systems or on a building by building basis.

In terms of electricity generation, targets should be challenging, but deliverable, based on the opportunities and constraints in the Borough. National targets are aiming towards 30% of our electricity on a UK wide basis being supplied by renewables. Some of this target will be met by nationally-driven projects for off-shore wind, wind-farms, and tidal energy. The (now revoked) South East Regional Plan set a target of 10% renewable electricity by 2020 (and 16% by 2026) based on previous estimates of the scale of potential in the South East as a whole. It is, however, recognised that potential was on the whole underestimated, and this has been recently revisited in the SEEPB study[43]. The SEEPB study does not set new regional targets due to the redundancy of the regional framework. This evidence base has shown that Swale has considerable potential for the generation of renewable electricity from wind, biomass CHP and micro-generation, and a renewable electricity target would help to encourage delivery of these opportunities. A target of 30% of electricity from renewable sources by 2020 is therefore recommended to drive delivery of local opportunities.

4.12 ENERGY OPPORTUNITIES MAP

The analysis of renewable and low carbon energy opportunities discussed above, has been compiled to form an 'Energy Opportunities Map' (EOM) for the area (see next page). EOMs can be used as a resource in policy and planning to guide key opportunities for consideration. This spatial map will allow Swale to identify delivery opportunities now, and into the future as new development opportunities come forward.

The map should also be used to inform policy making in the Sustainable Community Strategy and other corporate strategies, and investment decisions taken by the LPA and Local Strategic Partnerships. The EOM could be incorporated into some form of a planning guidance document and/or corporate strategies so that it can be readily updated to reflect new opportunities and changes in feasibility and viability.

The EOM includes the following:

- Spatial distribution of opportunities and constraints relating to renewable resources, including large wind, small wind, biomass from woodland and arable area suitable for biomass.
- Areas where the intensity of heat demand make the introduction of a district heating network a viable option.
- The location of 'anchor loads' or large, consistent energy users which could form an anchor for district heating or CHP schemes.
- The identification of urban areas where improvements to existing buildings should be focussed including energy efficiency measures and the integration of micro-generation technologies.

[43] South East Partnership Board (2010) Review of Renewable and Decentralised Energy Potential in South East England. Land Use Consultants and TV Energy. Available: http://www.se-partnershipboard.org.uk/page/5/view/175/sub/77/energy

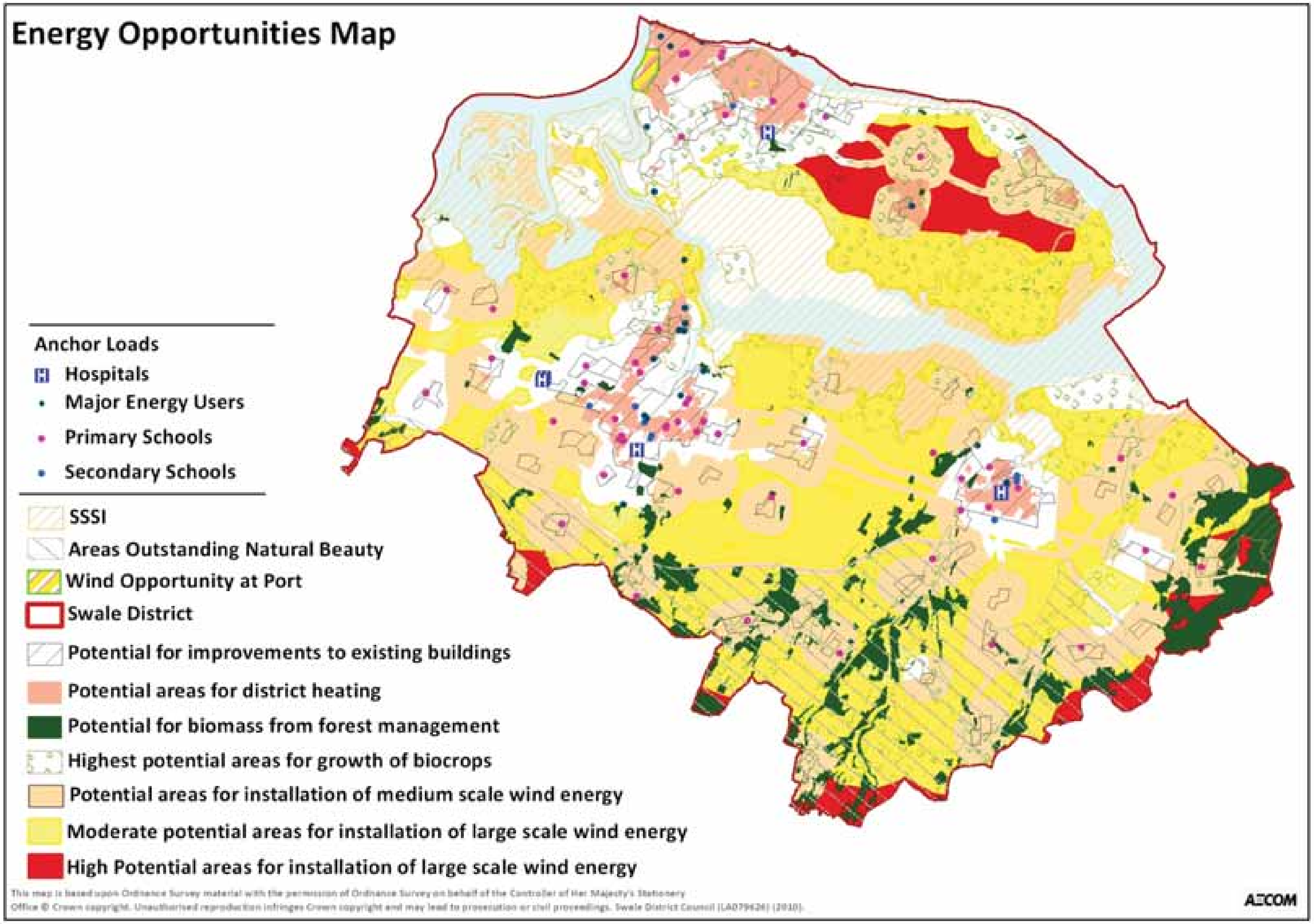

Figure 39: Energy Opportunities Map for Swale

4.13 KEY CONSIDERATIONS EMERGING FROM THIS CHAPTER

The sections above have considered the resource potential of Swale Borough. Key considerations emerging from this chapter are:

- There are considerable renewable and low carbon resource opportunities across the Borough, with high carbon reduction opportunities linked to biomass, wind, CHP and micro-generation;
- Some excellent examples of renewable installations already exist in the Borough and several more are planned;
- The scale of potential and types of technologies that are likely to be viable varies across Swale.
- Faversham, Sittingbourne, Sheerness, and Minster present good opportunities to generate and supply renewable and low carbon heat utilising district heating networks, and these opportunities should be supported through planning;
- Biomass is a strong resource for the area, but a biomass supply chain needs to be strengthened to gather, process and supply biomass locally. This can build on the strong history of wood supply to the area for paper production;
- Areas on the Isle of Sheppey present the best opportunities for wind development, with some relatively uncontained areas available for large scale wind development to the southeast of the Borough;
- The Kent Downs AONB is most technically favourable for the development of large-scale wind, but the impact of turbines on the landscape value would need to be strongly considered;
- All opportunities are delivery dependent – resource potential in itself does not contribute to targets, therefore focus should be on enabling delivery;
- The industrial and commercial sector will represent an important partner in the delivery of micro-renewables, and efforts should be made to cultivate these relationships;
- The extent of potential in Swale provides an evidence base to support the application of targets of 30% electricity and 12% heat from renewables by 2020; and
- An Energy Opportunity Map has been produced as a planning resource which will allow assessment and prioritisation of delivery opportunities.