Tunbridge Wells Borough
Local Development Framework

# Renewable Energy
# Supplementary Planning Document

**Adopted**
**April 2007**

Tunbridge Wells
BOROUGH COUNCIL
www.tunbridgewells.gov.uk

# Preface

**Renewable Energy**

**Supplementary Planning Document**

Prepared by: Creative Environmental Networks

This document can be provided in large copy prints, audio cassette, Braille or languages other than English. If you require the document in one of these formats please contact:

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# Introduction 1

# 1 Introduction

## What is 'Renewable Energy'?

**1.1** Tackling climate change is one of our greatest global challenges. The Borough Council is committed to this, through promotion of sustainable development, conserving natural resources and protection and enhancement of the environment.

**1.2** To develop sustainably, we must take action on a number of fronts, including reducing dependence on fossil fuels and making greater use of energy from renewable sources.

**1.3** Renewable energy can be defined as the energy derived from natural sources that are continuously at work in our environment and are not depleted by being used. Solar radiation is responsible for the majority of renewable energy sources, either in the form of its direct radiation (solar power) or through indirect forms (wind, hydro, geothermal, tidal and wave energy and bio-fuels).


**1.4** This guide deals with small-scale renewable energy technologies that can be integrated into building design. These include:

- Solar thermal (solar water heating)
- Photovoltaics (PV)
- Wind turbines
- Ground source heating/cooling
- Biomass heating

## The Benefits of Renewable Energy

**1.5** A number of benefits come with the integration of renewable energy technologies in building design. These include:

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- Reduced $CO_2$ emissions [1] associated with building operation
- Reduced dependence on fossil fuels
- Reduced fuel bill costs for residents and tenants, protecting them from gas and electricity price increases
- Energy efficiency design, providing greater comfort for users through adequate heating, natural light and ventilation
- Stimulation of the local economy where local installers are used
- Raised awareness of energy matters and the environment within the local community
- Provision of future proofing against new legislation, including the Energy Performance in Buildings Directive (EPBD). [2]
- Gives 'green' credentials and competitive advantage to developers that incorporate the technologies

Beneficiaries include local and global environments, the local economy, tenants and homeowners and developers.

**1.6** In the area of health there are particular benefits, including thermal comfort, addressing fuel poverty. Air pollution aggravates asthma, the number one children's health problem. It can also cause disease and even premature death among vulnerable populations. There are health

1 The UK target to reduce carbon emissions by 20% below 1990 levels by 2010 and 60% [2000 levels] by 2050 (Source: Energy White Paper, 2003) cannot be met through energy efficiency alone. The incorporation of renewable energy technologies is necessary to reach these targets as well as to stimulate growth of the renewables market.

2 The Energy Performance of Buildings Directive will require all new building, public buildings and buildings being let or sold to have an energy rating prominently displayed.

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costs from pollution in the form of treatment costs, higher insurance rates and missed work. The Borough Council's Air Quality Management should achieve and monitor clean air by informing the public and promoting good practice.

**1.7** With greater use and better management of woodlands for wood fuel and woodchip, a resultant benefit would be improved biodiversity.

**1.8** There is a wide range of economic benefits that are particularly associated with renewable energy. Adding an economically stable source of energy provides greater fuel diversity and adds to customer choice. With increased competition it can reduce demand and, therefore, lower prices for fossil fuels and, through economic development, creating jobs in a new industry and expanding work in local support industries. Locally produced renewable energy can avoid costly utility expenditures on the transmission and distribution associated with fossil fuels.

**1.9** Tunbridge Wells Borough Council recognises the benefits of renewable energy technologies and the significant opportunities that exist within new build and refurbishment work programmes to integrate them. Consequently, the Borough Council expects all major development planned within the Borough to incorporate renewable energy technology in line with the guidance set out in this document.

**Major development is defined as:**

**Residential:** ten or more dwellings, or if outline 0.5ha or greater site area
**Other development:** 1,000sqm or more, or if site is 1.0ha or more

## Purpose of the Document

**1.10** The sustainable development agenda is changing rapidly, with new guidance often being revised and changed. Technologies and techniques are also changing, with the overall viability of various solutions increasing. The Borough Council will therefore be addressing this through a suite of documents, produced both by this Council and others, such as the Kent Design Guide.

**1.11** To a large extent, sustainable development is addressed both through the planning development control and building control systems. It is, however, anticipated that there will be continuing changes both to national planning policy statements and guidance and also to the Building Regulations to promote this. The recently issued Code for Sustainable Homes, Building a Greener Future: Towards Zero Carbon Development, and the introduction of Energy Performance Certificates, reflects this. The crossover between planning and building control on these matters is important and may change in the near future.

**1.12** The main purpose of this document is to provide guidance on the technologies available and how developers and householders can integrate renewable energy within new developments and conversions. Energy efficiency and greater use of renewable energy are becoming increasingly important in the design and development of buildings and it is better to consider its incorporation at an early stage of the design rather than retro-fitting. This document is intended principally for applicants and their agents, together with planning officers who will be able to apply it in determining applications.

# Introduction 1

**1.13** This document provides guidance on renewable energy supplements and provides clarity to a number of policies in the Kent & Medway Structure Plan and the draft South East Plan and should be read in conjunction with these Plans. It is therefore a key document in reducing carbon emissions and in the exercise of the Borough Council's role as Planning Authority.

**1.14** This Practice Note constitutes a Supplementary Planning Document (SPD), which indicates the thresholds and the criteria by which planning applications for developments will be judged in accommodating renewable energy.

**1.15** To make this document as accessible as possible, it is purposely brief, focusing on the issues, policy context and introducing the general techniques. It is considered important not to repeat more technical or design considerations.

**1.16** The document therefore attempts, in this regard, to signpost other guidance and sources of help.

**1.17** Although the document concentrates on developments above a particular threshold size, the principles contained in this guidance document promote good practice and should be relevant whether planning permission is required or not, or whether a proposal needs to comply with this policy or not.

**1.18** Development in Tunbridge Wells Borough is varied, comprising sporadic dwellings in the countryside, a number of villages and hamlets, together with larger urban settlements. Building types are also varied. The potential for the use of renewable technologies will therefore be unique in each case, depending on location, building type, orientation etc. This guidance cannot therefore cover every individual situation. It explains the general factors that the Borough Council will take into consideration when determining an application.

**1.19** Advice from a professional designer, who should be able to assist in the examination of options, is strongly recommended. Most professional institutes have a client advisory service. There are also a number of organisations and information sources that can provide advice and help (including public organisations providing grant funding on a case-by-case basis).

See Appendix 1: Further Information and Support

## Status of the Document

**1.20** This Supplementary Planning Document forms part of the Borough Council's Local Development Framework, which is set out in the approved Local Development Scheme. In terms of the consultation process, this document will follow the adopted Statement of Community Involvement and its preparation has been subject to the involvement of key stakeholders as well as a borough-wide consultation. This is set out more fully in Section 4 of this document.

**1.21** Its key objectives will be established and tested through a Sustainability Appraisal/Strategic Environmental Assessment (SA/SEA):

- To encourage sustainable construction practices
- To establish appropriate targets for renewable energy generation to meet established policy and statutory guidance

# 1 Introduction

- To provide information on renewable technologies and guidance on their application
- To encourage design solutions for renewable energy sources which minimise impact on the character and appearance of the local environment, particularly in sensitive areas

**1.22** The Borough Council is required to undertake a Sustainability Appraisal/Strategic Environmental Assessment (SA/SEA) as part of the preparation of a Supplementary Planning Document. This is to ensure conformity with other higher-level strategies and policies, to identify any sustainability issues and to ensure that the Supplementary Planning Document is as sustainable as possible.

**1.23** Consultation with the four key national agencies was undertaken and any comments incorporated in the final SA/SEA. The SA/SEA was also consulted on alongside the SPD. This is set out more fully in 4 'Consultations' of this document.

**1.24** This document has been approved by Tunbridge Wells Borough Council for development control purposes and will help guide the Borough Council when making decisions regarding sustainable development issues and the use of renewable energy.

| **Useful Website Links** | | |
|---|---|---|
| Environment Agency www.environment-agency.gov.uk | English Heritage www.english-heritage.org.uk | English Nature www.english-nature.org.uk |
| Countryside Agency (Natural England) www.naturalengland.org.uk | | |

# Policy Background 2

# 2 Policy Background

## National Policy Guidance

**2.1** The Department for Communities and Local Government (DCLG) views planning policy as an effective means of raising the standard of new and refurbished buildings with regard to energy and other forms of sustainable design and construction. As such, Planning Policy Statements (PPS) 1 and 22 were published during 2005 and 2004.

**Planning Policy Statement 1: Delivering Sustainable Development**

**2.2** Planning Policy Statement 1 (PPS1) sets out the Government's overarching planning policies on the delivery of sustainable development through the planning system and instructs planning authorities to prepare robust policies on design and access. Key objectives include ensuring that developments are sustainable, durable and adaptable (including taking account of natural hazards such as flooding) and making efficient and prudent use of resources.[3]

**2.3** A recent consultation supplement to Planning Policy Statement 1: Planning and Climate Change sets out the Government's proposed further guidance, including:

- the expectation for development to gain a significant proportion from on-site renewables (10% is a standard requirement)
- a balance with their impact on landscape and townscape is of recognised importance

**Planning Policy Statement 22: Renewable Energy**

**2.4** Planning Policy Statement 22 (PPS22) sets out the Government's planning policies on land use and renewable energy. PPS22 states that:

- Regional spatial strategies and local development documents should contain policies designed to promote and encourage, rather than restrict, the development of renewable energy resources
- The wider environmental and economic benefits of all proposals for renewable energy projects, whatever their scale, are material considerations that should be given significant weight in determining whether proposals should be granted planning permission
- Local planning authorities, regional stakeholders and Local Strategic Partnerships should foster community involvement in renewable energy projects

**2.5** Local planning authorities may include policies in local development documents that require a percentage of the energy to be used in new residential, commercial or industrial developments to come from on-site renewable energy developments.

## Regional Spatial Strategy (The South East Plan)

**2.6** The draft South East Plan is a major piece of work being carried out by the South East England Regional Assembly (SEERA). It will set out a vision for the region through to 2026, focusing on improvements that we need to make to ensure the region remains economically successful and an attractive place to live.

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3 Regional planning authorities and local authorities should promote resource and energy efficient buildings; community heating schemes; the use of combined heat and power; small-scale renewable and low carbon energy schemes in developments; the sustainable use of water resources; and the use of sustainable drainage systems in the management of run-off.

# Policy Background 2

**2.7** The principal objective of the Plan is "*to achieve and to maintain sustainable development in the region.*"[4]

**2.8** A number of core policies have been prepared within the draft South East Plan, which promote or expect renewable energy. It should be noted that Policy EN1: Development Design for Energy Efficiency and Renewable Energy states that local authorities may develop policy, which "*encourages developers to submit an assessment of a development's energy demand and provide at least 10% of the development's energy demand from renewable sources*."

**2.9** Other pertinent policies include Policies CC2: Climate Change; CC4: Sustainable Construction; and EN6: Development Criteria.

## Policy EN 1

**Development Design for Energy Efficiency and Renewable Energy**

**Local Development Documents should encourage the incorporation of high standards of energy efficiency in all development. This will be achieved through design, layout and orientation. Local authorities should use design briefs and/or supplementary planning documents to promote development design for energy efficiency and renewable energy. Local authorities should also encourage the use of energy efficient materials and technologies, by using all the tools at their disposal. A proactive approach towards the implementation of this policy may involve:**

**a. Encouragement of developers to submit an assessment of a development's energy demand and provide at least 10% of the development's energy demand from renewable sources for housing schemes of over 10 dwellings and commercial schemes of over 1,000sqm**

**b. Attainment of high efficiency ratings in all new development, where appropriate, through the use of best practice guidance such as Building Research Establishment Environmental Assessment Method (BREEAM) and the National Home Energy Rating (NHER)**

**c. Incorporation of renewable energy sources including, in particular, passive solar design, solar water heating, photovoltaics, ground source heat pumps and, in larger scale development, wind and biomass generated energy**

**d. Active promotion of greater levels of energy efficiency and use of renewable energy sources where opportunities arise by virtue of the scale of new development including the regional Growth Areas**

**2.10** Local authorities and other public bodies, as property owners and managers, should seek to maximise energy efficiency and incorporation of renewable energy technologies, when refurbishing their existing stock.[5]

4 Section D1 (Cross-Cutting Policies)
5 Section D5 (Sustainable Natural Resources Management)

# 2 Policy Background

## County Planning Policy (The Kent and Medway Structure Plan)

**2.11** A number of core policies have been included within the Kent and Medway Structure Plan, which promote the integration of renewable energy technology in new and refurbished development. These are principally Policies NR1 and NR3.

### Policy NR 1

**Development and the Prudent Use of Natural Resources**

**Proposals for development should incorporate sustainable construction techniques and demonstrate that their design and layout contributes to:**

**a. The conservation and prudent use of energy, water and other natural resources, including provision for recycling facilities, water conservation and energy efficiency; and**
**b. A reduction in greenhouse gas emissions through re-use, or the more efficient use of resources** [6]

### Policy NR 3

**Renewable and Sustainable Energy Production**

**Development necessary for the production of energy from renewable sources will be supported where there would be no overriding conflict with environmental interests and Local Development Documents will include criteria for their location. Provision of renewable and sustainable energy production as an integral component of new development and in small-scale and community projects will be supported. Local Development Documents will include renewable energy production targets in support of sub-regional targets for individual energy sources, and will identify sites for renewable and sustainable energy facilities where viable proposals have been put forward.**

## The Kent Design Guide

**2.12** The Kent Design Guide is supplementary to the Kent and Medway Structure Plan and the Local Development Frameworks being prepared by all district and borough councils.

**2.13** Policy QL1: Quality of Development and Design in the South East Plan states that local authorities and others will "*apply the principles of the Kent Design Guide when determining planning applications and preparing site-specific development guidance*."

**2.14** An excerpt from the Kent Design Guide, section 7.3 'Renewable Energy' is provided below:

# Policy Background 2

**Renewable Energy**

7.33 The emission of carbon dioxide and other gases through fossil fuel use is related directly to global warming. A resulting climate change will have adverse consequences for the UK environment and economy. Energy-efficiency measures should reduce energy demand substantially and there will be further benefits if energy can be supplied from renewable sources occurring naturally and repeatedly in the environment.

7.34 Currently only around 3% of UK electricity is generated from renewable sources. Government proposes that this should rise to 10% by 2010 and 20% by 2020. To this end, local authorities are encouraged to promote renewable energy in design briefs and supplementary planning documents.

## Local Planning Policy

**2.15** The Borough Council has a number of strategies, which variously set out the key objective of safeguarding the environment. They include Strategic Objective 2 of the Tunbridge Wells Borough Local Plan 2006: To conserve finite non-renewable resources such as…energy. Within the environment chapter is other guidance.

**2.16** The Sustainable Community Plan has the priority of reducing the local contribution to climate change through the efficient use of resources. The Environment Strategy sets out at Objective 9D: To promote and support the generation and use of energy from renewable sources.

Having regard to the foregoing policy context, the Borough Council will therefore expect all development (either new build or conversion) with ten or more residential units/over 0.5ha site area, or for non-residential developments with a floor space of 1,000sqm or over 1.0ha site area, to incorporate renewable energy technology on-site to reduce predicted $CO_2$ emissions by least 10%.

NB. National targets of energy obtained from renewable sources are to increase to 15% by 2015 and 20% by 2020.

# Procedures 3

# Procedures 3

## Pre-Application

**3.1** In pre-application discussions, development control planning officers will advise developers of the Borough Council's building integrated renewable energy policy. If the proposed development is considered to be 'major', the developer will be expected to incorporate renewable energy technology on site to reduce predicted $CO_2$ emissions by least 10%. Major developments will be classed as development with ten or more residential units, or site area of 0.5ha; for other developments, a floor space of over 1,000sqm or site area of 1.0ha.

## Application

**3.2** The Borough Council has developed a renewable energy information template (see Appendix 4: Renewable Energy Information Template) to ensure that all necessary data is provided to assess compliance. This template should be completed as part of the planning submission and supplied alongside photographs and descriptions of the proposed system design.

**3.3** The details of the renewable energy system should be clearly explained by the developer in order that elected Members and energy experts can assess how the system will work and meet the 10% requirement. It is important that a renewable energy consultant/advisor and the Borough Council be engaged early in the process, so that an outcome that is acceptable to all parties can be developed. This will help to avoid potential delays in the assessment process.

## Energy Efficiency Measures

**3.4** It should also be noted that the Borough Council expects that new developments incorporate energy efficiency measures as a means of $CO_2$ reduction on proposals. Designs may include: compact plan form to reduce external wall surface; careful orientation to harness solar gains; larger windows on south and south-west aspects; reduced glazing on other aspects; high thermal mass. Passive ventilation and cooling can also obviate mechanical energy use. It is therefore in the interests of a developer to design a more energy efficient development, which in turn reduces $CO_2$ through the use of renewables.

**3.5** The thermal efficiency of construction elements, insulation values and heating installations will also need to comply with Part L of the 2006 Building Regulations. Application of the Code for Sustainable Homes, Category 1: Energy/$CO_2$ will bring further efficiencies.

| | |
|---|---|
| The Kent Design Guide<br>www.kent.gov.uk | Building Regulations 2006, Part L<br>www.opsi.gov.uk |
| Codes for Sustainable Homes, Building a Greener Future: Towards Zero Carbon Development<br>www.communities.gov.uk | |

## Design Implications of Renewable Energy Installations

**3.6** The Borough Council requires a high standard of design in all new developments in accordance with Planning Policy Statement 1. There are a wide range of renewable energy technologies with differing design and visual appearances. However, it may be the case that certain technologies and designs will not be acceptable in certain parts of the Borough. In particular, special consideration will need to be given to the visual impact of renewable energy

# 3 Procedures

installations on Listed Buildings and in Conservation Areas and Areas of Outstanding Natural Beauty. There are also other sensitive policy areas, including Arcadian areas and protection of skylines, where care should be exercised.

**3.7** Policy on development in the Green Belt is set out in Planning Policy Guidance Note No. 2: Green Belts. Renewable energy proposals could comprise inappropriate development, depending on the choice of energy source and its siting, which may impact on the openness of the Green Belt. Careful consideration of visual impact and potential harm will therefore be required.

**3.8** As well as the areas of regional importance, there are general visual amenity issues. This is particularly on installations which can be a very visible statement. In the case of wind turbines, extending above the skyline can cause visual intrusion; there is the impact of noise and vibration; and movement and blade flicker. In the case of photovoltaics or solar heat, these are often placed on roof slopes, with a contrasting and shiny surface finish. The problems of glare and reflection need to be appreciated. A carefully integrated design solution would be preferred.

**3.9** Residential amenity must also be considered. Policy EN1 of the Tunbridge Wells Borough Local Plan 2006 makes it clear that the nature of any proposed development should not cause significant harm to the amenity of adjoining occupiers.

**3.10** Aerodrome safeguarding is also a particular issue to be aware of. Siting of taller wind turbine installations on higher ground could have visual and radar implications, in particular for Gatwick Airport. Consult the Civil Aviation Authority publication 'Wind Energy and Aviation Interests: Interim Guidelines'.

**3.11** It may also be necessary to seek advice on the effect of wind turbines on birds and bats in terms of disturbance, severance of foraging or migratory routes, habitat loss or damage, as well as collision.

| | | | | |
|---|---|---|---|---|
| | The Bat Conservation Trust www.bats.org.uk | | The Royal Society for the Protection of Birds www.rspb.org.uk | |

**3.12** In promoting renewable energy, the wider environmental benefits will therefore need to be balanced against any likely local effects on the environment, particularly in sensitive locations. This, and any very special circumstances, should be set out in a design and environmental performance statement.

## Viability and Feasibility

**3.13** The Borough Council recognises that viability is a key issue and that planning should have regard to overall cost, availability of technologies and their viability thresholds.

**3.14** As part of achieving carbon emission reductions, the more cost effective solutions will be to look at energy efficiency measures and reducing energy consumption in the first place.

**3.15** As technologies and economics of scale viability improve, this will bring the price of installations more within reach. Against the backdrop of fluctuating fuel prices and energy security, other government financial incentives are encouraging the market to produce more efficient/cost effective installation, including maintenance costs.

**3.16** If viability/feasibility is considered, the developer/applicant must demonstrate conclusively that a particular development is rendered unviable or unfeasible.

**3.17** Technical, architectural, financial, payback and public acceptance may be considerations. In such circumstances, there may be justification in reducing the percentage target or achieving $CO_2$ reduction in other ways.

## Sources of Help/Expertise

**3.18** Large-scale developments will most likely involve the use of technical services in order to meet existing regulations and requirements. With new emphasis throughout the development industry on energy efficiency and the use of renewable energy technology, more help is available to provide advice on these matters: energy-related skills and expertise are already becoming an extension of many traditional roles within the development and construction arena. Some of the more useful contacts that might be consulted with, and able to provide technical advice on renewable energy include:

- Engineers
- Energy consultants
- Energy organisations
- Trade associations
- Installers/suppliers/manufacturers

| | | | | |
|---|---|---|---|---|
| | Royal Institute of British Architects www.architecture.com | | Royal Town Planning Institute www.rtpi.org.uk | |

**3.19** Creative Environmental Networks (CEN) operates the Kent Energy Centre, which provides impartial advice to developers on how to integrate renewable energy into new developments.

## Planning Approval

**3.20** Planning permission normally will be subject to conditions or a Section 106 Agreement. The Agreement will require the renewable energy to be installed prior to the occupation of the building, or in accordance with the phasing of other schemes, or at such other time as may be agreed.

## Monitoring and Review

**3.21** Monitoring and reviewing the agreed renewable energy process will normally be attached as a condition or a Section 106 legal agreement. In order that systems are achieving their 10% quota, it is necessary to ensure that these systems are monitored. This will mean that the building owner is aware of the overall percentage of energy being delivered from renewable sources (corresponding to a percentage of $CO_2$ emissions) and also allows Council checks to be carried out quickly and efficiently.

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| | | |
|---|---|---|
| | **Local Development Framework Annual Monitoring Report** www.tunbridgewells.gov.uk | |

**3.22** The Borough Council will review the percentage carbon emissions target on a regular basis to take into account changing technology costs and the introduction of new and more efficient renewable energy technologies.

# Consultations 4

# 4 Consultations

## Introduction

**4.1** This document has been prepared in accordance with the guidance set out in Planning Policy Statement 12 (PPS12) regarding preparation and consultation on Supplementary Planning Documents.

**4.2** The most relevant Plan Policies are set out in this document at Section 2. This Supplementary Planning Document is intended to support these policies.

## Consultation Process

**4.3** The initial preparation of the document was through a group consisting of consultants from Creative Environmental Networks and Borough Council officers.

**4.4** Early engagement was undertaken with key interest groups, including parish and town councils, developers and planning agents. The resultant informal initial draft SPD was then subject to scrutiny and input from Members, together with other key Council officers.

| | | |
|---|---|---|
| | **Statement of Community Involvement**<br>www.tunbridgewells.gov.uk | |

**4.5** The draft document was reported to the Borough Council's Local Development Framework Members Working Party on 20 July 2006. Cabinet received the report and approved the draft SPD on 19 October 2006 as the basis for public consultation (Item 061019/CAB002).

**4.6** The document was then subject to public consultation for a period of four weeks between 13 November and 11 December 2006.

**4.7** Documents available comprised: draft Renewable Energy SPD; Executive Summary; Sustainability Appraisal; Statement of SPD Matters; Statement of Consultation. There was also a questionnaire. These were available on the Borough Council's website, at the Council offices and local libraries.

**4.8** Some 783 organisations were notified by letter of the consultation and where the documents could be viewed or obtained.

**4.9** The consultation draft was also made available to all Borough Councillors.

## Response to Consultation

**4.10** The responses to the consultation were reported to the Local Development Framework Members Working Party on 5 December 2006 and to the Cabinet on 8 March 2007 (Item 070308/CAB008), when it was approved and adopted for development control purposes.

**4.11** The report details the responses received and outlines the proposed changes to the document, where appropriate. The report and minutes of the meeting are available from the Council's Committee Section on request, or can be viewed on the Council's website at www.tunbridgewells.gov.uk.

**4.12** The Appraisal was ratified at Full Council on 25 April 2007 and adopted as Supplementary Planning Document.

# Sustainability 5

# 5 Sustainability

**5.1** The Borough Council is required to undertake a Sustainability Appraisal/Strategic Environmental Assessment (SA/SEA) as part of the preparation of a Supplementary Planning Document. This is to ensure conformity with other higher-level strategies and policies, to identify any sustainability issues and to ensure that the Supplementary Planning Document is as sustainable as possible.

**5.2** The Sustainability Appraisal (SA) for the Renewable Energy Supplementary Planning Document has also been undertaken in order to integrate sustainability considerations into the preparation of the SPD. Sustainability encompasses environmental, social and economic components. The report developed the previous work done on the overall Sustainability Appraisal Framework for the LDF.

**5.3** Consultation on the Sustainability Appraisal Scoping Report with the four key national agencies was undertaken and any comments incorporated in the final SA/SEA. The SA/SEA was then also consulted on alongside the SPD.

# Further Information and Support 1

# 1 Further Information and Support

Please contact Tunbridge Wells Borough Council's Planning Services or Creative Environmental Networks (CEN) who operate the Kent Energy Centre, which provides impartial advice to developers on how to integrate renewable energy into new developments.

Contact:

Creative Environmental Networks
Ambassador House
Brigstock Road
Thornton Heath CR7 7JG

Tel: 0845 678 0677

Email: energy@cen.org.uk

For queries on planning matters or general conservation advice you are encouraged to consult the Borough Council's planning officers who will be pleased to assist.

Telephone 01892 526121

Fax 01892 544746

Or write to:

Tunbridge Wells Borough Council
Planning Services
Town Hall
Royal Tunbridge Wells
Kent TN1 1RS

Email: planningcomments@tunbridgewells.gov.uk

# Further Information and Support 1

**Useful web sites:**

| | | |
|---|---|---|
| Tunbridge Wells Borough Council www.tunbridgewells.gov.uk | The Energy Saving Trust www.est.gov.uk | London Renewables Toolkit www.london.gov.uk |
| Department of Trade and Industry www.dti.gov.uk | Renewable Energy Association www.r-p-a.org.uk | Combined Heat and Power Association www.chpa.org.uk |
| National Energy Foundation www.nef.org.uk | British Wind Energy Association www.bwea.com | INREB Faraday Partnership www.inreb.org |
| Routes to Sustainability www.routestosustainability.org.uk | Sustainable Homes www.sustainablehomes.co.uk | South East England Development Agency www.seeda.co.uk |
| The Countryside Agency (Natural England) www.naturalengland.org.uk | The Carbon Trust www.carbontrust.co.uk | Department for Communities and Local Government www.dclg.gov.uk |

# References 2

# References 2

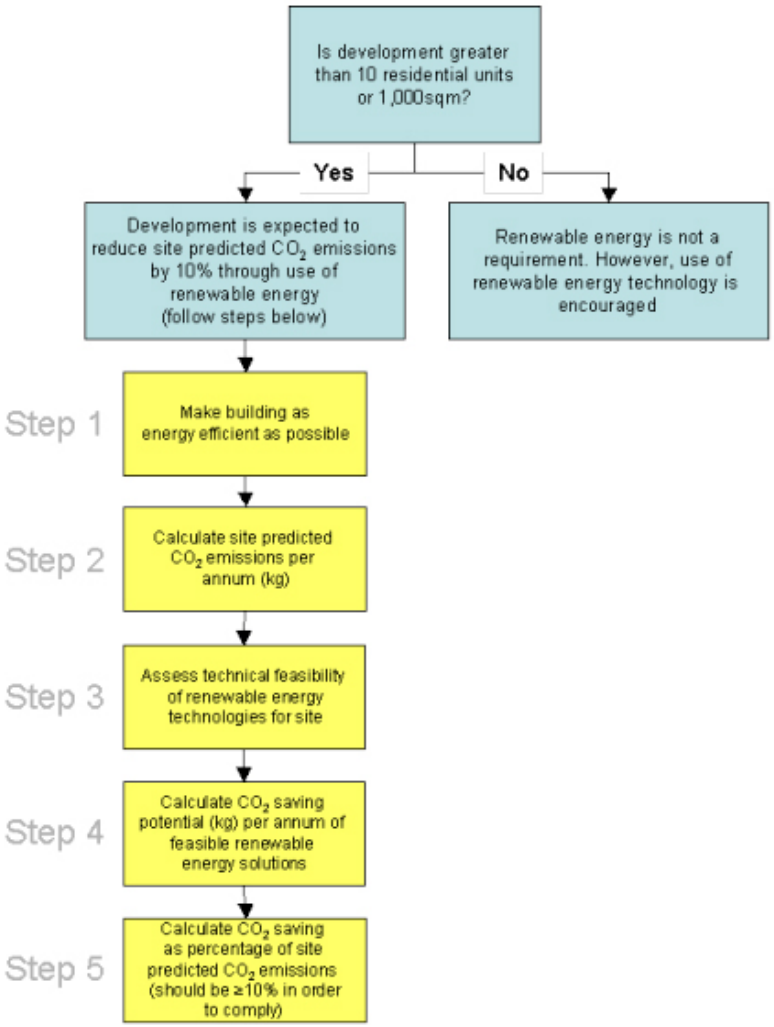

1. Planning Policy Statement (PPS) 1 – Delivering Sustainable Development, ODPM, 2005
2. Planning Policy Statement (PPS) 22 – Renewable Energy, ODPM, 2004
3. Planning for renewable energy – A companion guide to PPS22, ODPM, 2004
4. London Renewables Toolkit for Planners, Developers and their Consultants, London Energy Partnership 2004
5. Draft South East Plan 2006
6. Kent and Medway Structure Plan July 2006
7. Kent Design Guide 2006
8. Tunbridge Wells Local Plan, adopted March 2006
9. SEEDA

# Methodology for Compliance 3

# Methodology for Compliance 3

## Approach

This appendix provides a step-by-step approach to calculate the savings of $CO_2$ emissions offset through the use of renewable energy technologies. The diagram below describes the different steps to follow:




### ***Step 1: Reducing $CO_2$ emissions through energy efficiency***

Before applying renewable energy technologies to new buildings it is also important to consider reducing the total energy requirement (for electricity, space heating and hot water). This can be achieved by incorporating passive solar and low energy design techniques and appropriate energy efficiency measures.

Further guidance on the aspects of design can be found in the Kent Design Guide and any further SPDs. They can include:

# 3 Methodology for Compliance

**Passive solar and low energy design**

- South-easterly orientation of buildings can maximise preheating and reduce summer overheating
- Locate rooms that are most occupied on the south side of a building
- Ensure overshadowing of buildings is avoided
- Conservatories and atria can assist natural ventilation in the summer by drawing warm air upward to roof vents. They can also be used as heat collectors during the spring and autumn.
- Consider use of brise-soleil to prevent overheating on the south facing windows
- Vegetation and landform (earth bunds) can complement passive solar design
- Specify heating and ventilation systems and controls, which respond well to solar gain. Areas subject to high solar gain should have their own zone temperature control
- Use materials such as exposed concrete, ceramic tiles and stone to build in thermal mass. This allows buildings to absorb excess heat during the day and release it slowly during the night when the ambient temperature is cooler

If adequate provision and consideration is not given to passive solar design at the design stage, then the absence of controlled solar gains can give rise to overheating. This does not only cause discomfort to occupiers, but if it occurs regularly can lead to the installation of air conditioning equipment. This in turn will lead to an increased overall energy consumption and a subsequent rise in $CO_2$ emissions.

*For more information on overheating see 'Reducing overheating – a designer's guide' (CE129) available from the Energy Saving Trust (EST).*

**Energy efficiency measures**

- Increase fabric insulation
- Improve air-tightness
- Natural ventilation will reduce dependence on mechanical air handling systems
- Efficient heating and hot water systems (consider use of Combined Heat and Power (CHP) or community heating)
- Specify responsive heating and lighting controls
- Efficient lighting and fittings that do not permit the use of non-efficient lighting
- Efficient electrical appliances
- Implement a Building Management System
- Consider heat recovery

***Step 2: Calculating site predicted $CO_2$ emissions***

Predicted $CO_2$ emissions can be calculated in two ways:

- Using Standard Assessment Procedure (SAP)/ Simplified Building Energy Model (SBEM)[7]$CO_2$ data (preferred method)
- Using benchmark data (e.g. The London Renewables Toolkit)

7 Commissioned by ODPM and developed by BRE, SBEM automates the national calculation methodology for non-domestic buildings. Its use is required by the 2006 Part L building regulations.

# Methodology for Compliance 3

Benchmark data can be out of date, as it is often based on existing buildings built to 2002 Part L (or previous revisions) building regulations. The revised Part L regulations represent a 20% improvement in $CO_2$ emissions over 2002 standards and it may, therefore, be in the interests of the developer to use SAP/SBEM $CO_2$ data in order to predict emissions for this process.

Where SAP/SBEM data is not available and benchmark data is available in energy form only (i.e. kWh electricity or delivered gas), the developer will need to apply $CO_2$ conversion factors. The Carbon Trust publishes an Energy and Carbon Conversions leaflet, which contains up to date information on $CO_2$ conversion factors for a range of fuels. More information is available on www.thecarbontrust.co.uk.

*All figures below are quoted in kg $CO_2$/kWh. If you wish to convert the carbon dioxide factors into carbon equivalents (ie kgC/kWh), multiply the figure by 12 and divide by 44.*

| *Fuel Type* | *Kg$CO_2$/kWh* |
|---|---|
| *Grid Electricity* | 0.43[8] |
| *Natural Gas* | 0.19 |
| *Oil* | 0.26 |
| *Coal* | 0.30 |
| *LPG* | 0.214 |

***Step 3: Assessing technical feasibility of renewable energy technologies***

A number of renewable energy technologies are typically suitable for building integration. These include:

- Wind turbine (stand-alone or roof mounted)
- Photovoltaics (PV)
- Solar thermal (solar water heating)
- Ground source heating/ cooling
- Biomass heating

**Wind turbine**

Key principles

The UK has the largest potential wind resource in northern Europe with approximately 40 per cent of the total supply available. Wind turbines can have outputs ranging from a few watts to several megawatts and produce electricity without emitting carbon dioxide. Energy is extracted from the wind using a rotor generally consisting of two or three blades, which have a profile similar to that of an aeroplane wing.

8 For electricity, the real emissions vary year on year due to the different mix of fuels used in the power stations and are average grid figures. However, the figure quoted for electricity is 0.43kg $CO_2$/kWh which has been held constant since 2000. This value is used by DEFRA to ensure a consistent base on which to measure savings and was calculated on the projected fuel mix for the grid 1998-2000. It is the responsibility of the developer to ensure that the correct $CO_2$ conversion factors are applied.

# 3 Methodology for Compliance

Standalone wind turbines have been available for many years. More recently, a number of roof mounted wind turbines have come onto the market.

Design considerations

- Determine the average wind speed on site as this will have a significant impact on feasibility. (Potential sites generally need average wind speeds of greater than 4.5m/s at hub height to be economically viable in the UK, although small roof mounted wind turbines (typically 1.5kW) can work at wind speeds as low as 3.5m/s)
- Ensure turbine will be free from obstructions and that potential noise will not impact residential areas

**Photovoltaics**

Key principles

Photovoltaic (PV) systems convert energy from the sun into electricity through semi-conductor cells. A cell consists of a junction between two thin layers of dissimilar semi-conducting materials, usually based on silicon.

When light shines on the junction, a difference in energy is created – otherwise known as 'voltage' or 'potential difference'. This voltage is used to produce an electrical current or direct current (DC), which can be used directly or converted into alternating current (AC) depending upon the application.

PV comes in a range of different applications, ranging from modules/ panels to PV tiles, cladding and atria glass.

Design considerations

- For optimum results, PV arrays should face between south-east and south-west and at an elevation of between 30-40°

- Systems should only be situated where they are completely unshaded. Panel performance can be significantly affected even if only partially shaded
- PV arrays need to be adequately ventilated to prevent overheating and a subsequent drop in panel efficiency
- A key advantage of PV in high-density urban environments is their potential to be integrated as part of the materials of the building

**Solar thermal**

Key principles

Solar thermal or solar hot water systems use a heat collector, which is generally mounted on a roof, and contains a fluid (usually water with antifreeze), which is heated up by the sun. The heated liquid is then passed through a coil in a hot water storage cylinder. The water in the cylinder may then be supplied directly, or raised to a higher temperature (if required) by a boiler or electric immersion heater.

Design considerations

- The building should have a year round hot water demand
- For optimum results, collectors should face between south-east and south-west and at an elevation of between 10-60°
- Larger hot water storage cylinders than would normally be installed for gas or oil-fired systems are usually required. (For dwellings, airing cupboards will need to be designed to allow for this. For non residential development with centralised systems, adequate space provision will need to be made in the plant room)
- Ensure that the intended location for the collector will not be shaded by obstructions, such as trees and other buildings

**Ground source heating/ cooling**

Key principles

A heat pump extracts heat from the ground, air or water and transfers it to a heating distribution system, such as under-floor heating, using an electric pump. Ground source heat pumps are currently the most common type of heat pump used for domestic space heating in the UK, and use technology which is essentially the same as that in a domestic refrigerator.

A typical ground source heat pump system will comprise a ground heat exchanger (for extracting heat from the ground), the heat pump itself, and a heat distribution system. Systems can be designed for reverse cycle, i.e. cooling.

# 3 Methodology for Compliance

Design considerations

- Ground source heat pumps require a large outdoor space for the burial of coils/ pipes. Where there is insufficient space available, a vertical borehole system can be explored
- A license may be required to drill vertical systems in most locations
- Ground source heat pump systems will be at their most cost-effective in locations where mains gas is not available, and high levels of energy efficiency have already been integrated into the dwellings/ building

**Biomass heating**

Key principles

Biomass is a term used to define all plant and animal material and has been used as an energy source for centuries. Wood is an extremely versatile source of energy and can be burned in a number of different forms and appliances. It is a plentiful resource in the south-east.

Biomass or wood burning systems differ from other renewable energy sources in that carbon dioxide is emitted when the fuel is burned to produce heat. However the amount of $CO_2$ released is only the same as the amount of $CO_2$ absorbed by the tree whilst it was growing.

Using biomass as a fuel is essentially a carbon neutral approach, however the fuel can only be called a renewable energy source if it has come from a sustainable source (i.e. it is processed and replenished). It should also be used close to where it was originally grown to reduce secondary carbon dioxide emissions incurred through transportation.

Design considerations

- Local and reliable fuel supply is critical

# Methodology for Compliance 3

- Fuel delivery (e.g. turning circle for lorry), fuel handling and storage space should be 'designed in' at the earliest stages
- Biomass boilers are likely to require more frequent cleaning and maintenance than gas or oil boilers and provision needs to be made for auxiliary heating when maintenance is required
- Where individual wood stoves/ boilers are proposed, the system will need to be managed by the occupants. This arrangement may not be suitable if the development is intended for the elderly unless maintenance contracts are entered into
- Where a centralised biomass heating system is proposed, the developer will need to consider system management and maintenance and heat metering where more than one building is served

This decision tree allows developers to assess at a high level the technical feasibility of a range of renewable energy technologies.

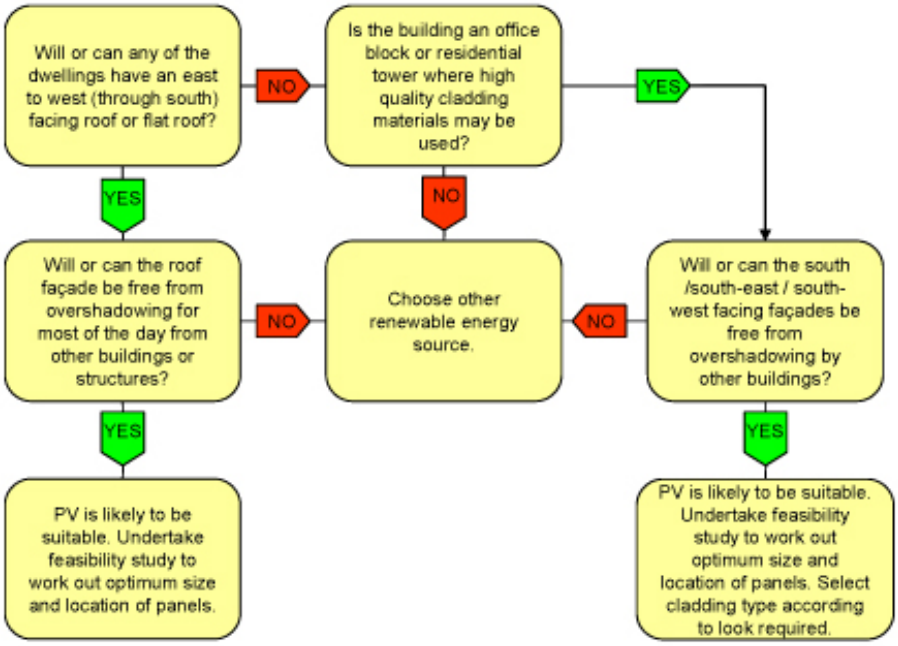



**Figure 3.3: Guidelines for suitable locations for Photovoltaics (PV)**

## ***Step 4: Calculating $CO_2$ saving contribution of renewable energy solutions***

Once a renewable energy system has been sized and designed by a qualified expert, heat or electricity output data will be available. Converting this output into $CO_2$ savings is relatively straightforward and involves multiplying the kWh output by the relevant $CO_2$ conversion factor for either electricity or delivered gas. In the case of renewable energy systems that provide heat, the efficiency of the primary (or originally proposed) heating system will also need to be taken into account. Furthermore, for ground source heating and cooling the $CO_2$ emissions associated with the electricity required to run the pump must be deducted.

# 3 Methodology for Compliance

Example conversion calculations are provided in the table below. It is assumed that mains gas was originally proposed for space and water heating. Savings will be higher when offsetting electricity, oil or solid fuels.

Electricity and heat generated by renewable energy technology is greatly affected by site conditions. For example, site wind speed will affect the amount of electricity generated by a wind turbine; pitch and orientation of a PV array and solar thermal collectors will affect electricity and heat generated respectively. The table below provides example system output data only and should not be used to size systems. Designing and sizing renewable energy systems is a complex process and should be undertaken by a qualified professional.

| Example Renewable Energy Solution | Description of System Output (sourced from designer/ installer) | Annual $CO_2$ Saving Calculation | |
|---|---|---|---|
| **6kW Standalone Wind Turbine** | 6kW rated standalone wind turbine operating at an average wind speed of 6m/s. Estimated yearly output is 16,900 (based on manufacturer's power curve). | Annual $CO_2$ Saving (kg) | = System Output x Grid Electricity Conversion Factor = 16,900 x 0.43 **= 7,267 kg** |
| **4 x 1.5kW Roof Mounted Wind Turbine** | 4 x 1.5kW rated roof mounted wind turbine operating at an average wind speed of 5m/s. Estimated yearly output is 2,000kWh (based on manufacturer's power curve). | Annual $CO_2$ Saving (kg) | = System Output x Grid Electricity Conversion Factor = 8,000 x 0.43 **= 3,440 kg** |
| **10kWp Photovoltaics Array** | 10kWp mono-crystalline silicon PV array with estimated output of 7,500kWh per annum. | Annual $CO_2$ Saving (kg) | = System Output x Grid Electricity Conversion Factor = 7,500 x 0.43 **= 3,225 kg** |
| **70sqm Solar Thermal System** | 70sqm collector flat plate solar thermal system with centralised hot water storage cylinders. Solar contribution to annual domestic hot water is approximately 50% or 30,000kWh. | Annual $CO_2$ Saving (kg) | = (System Output/ Primary Heating Boiler Efficiency[9]) x Delivered Gas Conversion Factor= (30,000/ 0.87) x 0.19 **= 6,552 kg** |
| **85kW Ground Source Heating System** | 85kW heat pump. Vertical borehole system. 150,000kWh heat generated per annum (sized to meet 100% space and water heating needs). CoP is | Annual $CO_2$ Saving (kg) | = ((System Output/ Original Proposed Boiler Efficiency10) x Delivered Gas Conversion Factor)) – (Electricity Required to Operate System x Grid |

9 For this example, the efficiency of the primary or originally proposed heating system is 87%. This figure will differ from development to development.

| Example Renewable Energy Solution | Description of System Output (sourced from designer/ installer) | Annual $CO_2$ Saving Calculation | |
|---|---|---|---|
| | 3.5.Site does not have cooling requirement. | | Electricity Conversion Factor)= ((150,000/ 0.87) x 0.19) – (42,857 x 0.43)= 32,759 - 18,429 **= 14,330 kg** |
| **100kW Biomass Heating System** | 100kW biomass boiler sized to meet 75% of site space and water heating needs. Output is 115,000kWh per annum. | Annual $CO_2$ Saving (kg) | = (System Output/ Original Proposed Boiler Efficiency[10]) x Delivered Gas Conversion Factor= (115,000/ 0.87) x 0.19 **= 25,115 kg** |

**Table 2.1 Example conversion calculations – kWh to $CO_2$**

***Step 5: Calculating percentage of site $CO_2$ savings delivered by renewable energy***

As a final step, the percentage of site $CO_2$ savings delivered by renewable energy is calculated as per the formula below:

**Formula for calculating percentage of site $CO_2$ emissions offset through use of renewable energy**
Site $CO_2$ Savings Offset (%) = ($CO_2$ Savings Delivered by Renewable Energy System(s)/ Predicted Site $CO_2$ Emissions) x 100

**Worked example**

A worked example is provided below to illustrate the key steps to complying with the building integrated renewable energy policy. The data provided is specific to the example and should not be used in order to size or cost renewable energy systems. Designing and sizing renewable energy systems is a complex process and should be undertaken by a qualified professional.

**About the site and the development**

The development is residential and comprises 10 detached dwellings in a semi-rural environment. All properties have a south-facing roof and front and rear gardens.

The site wind resource at the site is 4.5m/s. There is no established wood fuel supply chain in the area, however, this could be established where sufficient demand was stimulated.

10 Electricity required to operate the ground source heating system is calculated by dividing the heat output by the system's CoP, i.e. 150,000/3.5.

# 3 Methodology for Compliance

***Step 1: Reducing $CO_2$ emissions through energy efficiency***

The developer has achieved an improvement on building regulations ADL1A by adhering to standards within the EST Energy Efficiency Best Practice in Housing guides[11]

***Step 2: Calculating site predicted $CO_2$ emissions***

Total $CO_2$ emissions for the site have been calculated using SAP 2005 and are as per the table below.

| Dwelling Type | No of Units | Total Carbon Dioxide Emissions $kgCO_2/yr$) |
|---|---|---|
| Detached | 10 | 28,000 |
| **10% target 2,800: $kgCO_2/yr$** | | |

***Step 3: Assessing technical feasibility of renewable energy technologies***

The following observations have been made with regard to technical feasibility of the renewable energy technologies:

| Technology | Feasible? | Reason |
|---|---|---|
| **Standalone Wind Turbine** | No | There is insufficient open plan space around the development to install a standalone wind turbine. The wind speed is relatively low at 4.5m/s. |
| **Roof Mounted Wind Turbine** | Yes | At 4.5m/s the wind speed is adequate for the operation of a roof mounted wind turbine. Providing walls can bear wind turbine loads, an installation is possible. |
| **Photovoltaics (PV)** | Yes | Each property has sufficient south-facing roof space for a 1kWp system. |
| **Solar Thermal** | Yes | Each property has sufficient south-facing roof space for 4sqm of solar collectors and there is a year round hot water demand. |
| **Ground Source Heating** | Yes | There is sufficient space in the rear gardens for the burial of horizontal coils. |
| **Ground Source Cooling** | No | Residential development does not have a cooling demand. |
| **Biomass Heating** | Yes | Individual pellet systems are possible, however, local and reliable fuel supply would need to be established. Site is not of sufficient |

11 The Energy Saving Trust produces guidance for going beyond building regulations for energy efficiency in housing. For further information, visit http://www.est.org.uk/housingbuildings/professionals

# Methodology for Compliance 3

| Technology | Feasible? | Reason |
|---|---|---|
| | | density to warrant a centralised system operated by an Energy Services Company (ESCO). |

***Step 4: Calculating $CO_2$ saving contribution of renewable energy solutions***

The developer chooses to take the following technologies forwards for sizing and calculation of $CO_2$ savings:

- Roof mounted wind turbine
- Photovoltaics
- Solar thermal
- Ground source heating

| Technology | System Description | Estimated $CO_2$ saving ($kg/CO_2/yr$) |
|---|---|---|
| Roof mounted wind turbine | 1.5kW rated roof mounted wind turbine | 700 |
| Photovoltaics | 1kWp mono-crystalline silicon PV array | 320 |
| Solar thermal | 2.75sqm solar thermal flat plate system | 310 |
| Ground source heating | 8kW heat pump, providing space and water heating | 600 |

***Step 5: Calculating percentage of site $CO_2$ savings delivered by renewable energy***

The following renewable energy solutions are identified for the site. The percentage of $CO_2$ offset and the cost of each solution are detailed in the table.

| Solution # | Renewable energy solution | Esimated $CO_2$ saving ($kg/CO_2/yr$) | Indicative Cost | Percentage $CO_2$ saved (%) |
|---|---|---|---|---|
| **Solution 1** | 4 x roof mounted wind turbines | 2,800 | 24,000 | 10 |
| **Solution 2** | 9 x PV systems | 2,880 | 90,000[12] | 10 |
| **Solution 3** | 10 x solar thermal systems | 3,100 | 26,000 | 11 |
| **Solution 4** | 5 x ground source heating systems | 3,000 | 22,500 | 11 |

12 It is assumed that PV tiles will be installed as opposed to modules.

# 3 Methodology for Compliance

The solutions in the table above are not hybrid, i.e. they are single technology solutions. However, the developer can explore a combination of technologies for the site. For example, while roof mounted wind turbines are a cost effective means of complying with the policy, the developer may prefer to reduce the number of turbines for aesthetic reasons and install 7 x solar thermal systems and 1 x roof mounted wind turbine.

**Key considerations for the developer**

The developer is presented with a number of options to meet the building integrated renewable energy policy. As a next step, the 'best value' solution needs to be chosen. In order to make this decision, the developer should consider the following:

- **Cost** – certain solutions are more cost effective than others in terms of kg $CO_2$ saved per pound sterling spent
- **Technological risk** – while some systems will need to be designed carefully to fit in with the requirements of the specific site, others such as Photovoltaics, are essentially 'off the shelf' items, which can be more easily integrated into a dwelling or development
- **Visual impact/promotional value** – technologies such as Photovoltaics, wind turbines and solar thermal can influence the visual impact of a dwelling or development. In some cases this can lead to problems with obtaining planning consent because of opposition from local residents. However, there can also be a positive effect in that it can increase the 'saleability' of an individual dwelling or development as a whole.
- **Maintenance** – maintenance requirements for the various technologies should be taken into account, including component replacement costs over the system lifetime.
- **Management** – where a centralised heating system is proposed, for example biomass heating, careful consideration should be given to system management, including heat metering where more than one building is served.

# Renewable Energy Information Template 4

# 4 Renewable Energy Information Template

**80** Look at page 170 of the Kent Design Guide. This should be included as part of the Design/Sustainability Statement.

| Development Details | |
|---|---|
| Development name/reference | |
| Development description (e.g. number and type of residential units) | |
| sqm Gross Internal Floor Area (GIFA) | |
| Site electricity demand per annum (kWh) | |
| Site delivered gas demand per annum (kWh) | |
| Predicted site $CO_2$ emissions per annum (kg) | |
| Source of kWh/$CO_2$ emission data (e.g. SAP 2005) | |

| Proposed Renewable Energy Solution | |
|---|---|
| **Standalone Wind Turbine** | |
| Numbers to be installed | |
| System rating (kW) | |
| Manufacturer | |
| Site wind speed | |
| Installer contact details | |
| Energy generated per annum (kWh) | |
| $CO_2$ savings per annum (kg) | |
| **Roof Mounted Wind Turbine** | |
| Numbers to be installed | |
| System rating (kW) | |
| Manufacturer | |
| Site wind speed | |
| Installer contact details | |
| Energy generated per annum (kWh) | |
| $CO_2$ savings per annum (kg) | |
| **Photovoltaics** | |
| Numbers to be installed | |

# Renewable Energy Information Template 4

| Proposed Renewable Energy Solution | |
|---|---|
| System rating (kWp) | |
| Array area (sqm) | |
| Array orientation (e.g. south east) | |
| System type (e.g. bolt on modules, tiles, cladding) | |
| Installer contact details | |
| Energy generated per annum (kWh) | |
| $CO_2$ savings per annum (kg) | |
| **Solar Thermal** | |
| Numbers to be installed | |
| System size (sqm) | |
| Array orientation (e.g. south east) | |
| System type (e.g. flat plate, evacuated tube) | |
| Installer contact details | |
| Energy generated per annum (kWh) | |
| $CO_2$ savings per annum (kg) | |
| **Ground Source Heating & Cooling** | |
| Numbers to be installed | |
| System rating (kW) | |
| Ground loop type (e.g. closed/open loop, horizontal/vertical) | |
| Ground loop/borehole length (m) | |
| System CoP | |
| Cooling provided? | |
| Installer contact details | |
| Energy generated per annum (kWh) | |
| $CO_2$ savings per annum (kg) | |
| **Biomass Heating** | |
| Numbers to be installed | |
| System rating (kW) | |

# 4 Renewable Energy Information Template

| Proposed Renewable Energy Solution | |
|---|---|
| Fuel store details (size, location) | |
| Anticipated frequency of fuel deliveries | |
| Installer contact details | |
| Energy generated per annum (kWh) | |
| $CO_2$ savings per annum (kg) | |
| **$CO_2$ savings through use of renewable energy** | |
| Total electricity offset per annum (kWh) | |
| Total delivered gas offset per annum (kWh) | |
| Total $CO_2$ offset per annum (kg) | |
| Total annual $CO_2$ savings delivered (%) | |