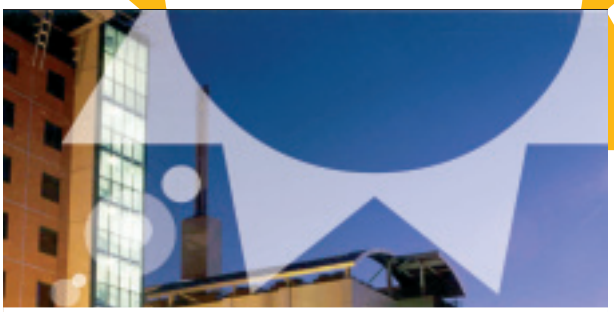
Energy



Good Practice

- The energy consumed by new development should meet the target of reducing green house gas emissions to a level equivalent to 80% of CO_2 emissions (compared to the previous use of the land in 1990)
- Resilience to climate change should be designed into new developments by making them less dependent on grid distributed energy and fossil carbon fuels
- The energy requirements of new development should be met through sustainable energy and renewable energy generation

Background - Climate Change and Energy

The ways we generate and consume energy impact on the causes of climate change:

- Buildings account for most of the UK's CO_2 emissions. For example, dwellings alone account for 30% of UK energy consumption and 28% of the resulting CO_2 emissions. However, most of the CO_2 emissions are produced by the power stations serving dwellings. Wasted energy from power stations and the national grid in the UK is approximately double the energy consumed by transport.
- Much of the energy produced by UK centralised power generation is heat which is wasted by being evaporated into the atmosphere through large cooling towers. This, together with transmission and distribution losses and the use of individual boilers to provide heat, wastes enough energy to heat every home in the UK. It is estimated that nearly $1billion worth of electricity is lost each year in the UK distribution networks alone.

Developing Sustainable Energy: Combined Heat and Power

The primary source of sustainable energy available to developments is combined heat and power (CHP). This recovers the heat that is a by-product of electricity generation and distributes it alongside electricity in the form of hot water for space heating. CHP offers a number of benefits:

- The energy generated is up to 90% efficient (compared with centralised power generation distributed through the national grid which can be as little as 22% efficient at the point of use). CHP will typically reduce CO_2 emissions by 60%. When combined with thermal storage and heat fired absorption cooling it can achieve reductions in equivalent CO_2 emissions of up to 80%.
- CHP plants can be adaptable to different fuels. Conventionally, natural gas is used which is a low carbon fuel. A renewable fuel such as biogas, biomass or even hydrogen can replace this when fossil fuels become scarce or non-existent.
- Greater resilience to supply disruption is provided by meeting local energy needs through locally generated CHP.
- 70% of the UK's non-transport energy needs are thermal and cannot be met by many renewable energy technologies which are electricity generation only.

Absorption Cooling

This process can be used for both air conditioning and refrigeration. Chilled water is generated by hot water through a process of absorption at very low pressure which causes the water to boil at typically 2ºC. The benefits are:

- Heat is provided by CHP which displaces electricity that would otherwise be consumed by conventional cooling systems and generates more 'green electricity' from the heat-to-cool process.
- Heat fired absorption cooling does not use refrigerants such as CFC's, HCFC's or HFC's. It therefore displaces further CO_2 equivalent emissions as the technology has both zero Ozone Depletion Potential and zero Global Warming Potential

1 tonne of HFC-134a used in modern electric air conditioning systems when released into the atmosphere is equivalent to 3,400 tonnes of CO_2, in terms of global warming, whereas heat fired absorption cooling has zero equivalent CO_2 emissions.

Developing Renewable Energy

Renewable energy is defined as sources of energy other than fossil fuel or nuclear fuel which are continuously available such as solar, wind, hydro, geothermal, biomass or waste derived fuels. Renewable energy offers the potential to generate heat and power without any emissions or depletion of natural resources.

Under the Climate Change Strategy for Woking, the Council has adopted a target of purchasing 20% of the Council's electrical energy requirements from renewable sources by 2011. Woking currently has the largest concentration of solar energy photovoltaics in the UK.

Below
Photovoltaics can provide attractive solar shading (spectators' gallery at the Pool in the Park, Woking).
Below Left
In many developments, there is sufficient suitable roof area for photovoltaic (p.v.) generated energy to exceed the annual electricity consumed by the building. The p.v. cells at The Vyne Community Centre and Knaphill surgery provide almost 1 1/2 times the amount of electricity consumed.

The effects of climate change will affect energy consumption:

- Whilst Climate Change is predicted to result in milder winters (thereby reducing the need for space heating), the corresponding predicted increase in summer temperatures will lead to an increase in demand for air conditioning. This may be particularly so at the luxury end of the housing market and in town centre apartments where other factors such as noise, security and internal layout reduce the use of natural ventilation. Generating and distributing the energy required to power air conditioning contributes to CO_2 emissions, and the refrigerants used for cooling can also act as greenhouse gases.
- Climate Change is also expected to lead to increased severe weather incidents. These will result in greater risk of damage and disruption to grid energy supplies. In addition, as the UK's fossil carbon fuel reserves decline over the next half century there will be a reduced security of energy supply.

CO_2 emissions Source *DoE/Energy Efficiency Office Good Practice Guide 116.*
Energy costs Source *Datamonitor Domestic Energy Pricing (April 2004 - All figures based on payment by Direct Debit).*

Apartments

Comparison of energy costs for a two bedroom apartment (10,000 kWh gas and 2,000 kWh electricity per annum)

	Gas £	Electricity £	Total £
SEEBOARD (EDF Energy Ltd)	179.21	147.34	326.55
Thameswey Energy Ltd	161.98	132.49	294.47

CO_2 emissions comparison between grid supplied gas heating and electricity and CHP for 54 town centre apartments

Grid supplied (Tonnes CO_2 per annum)	675
CHP (Tonnes CO_2 per annum)	278
Reduction (Tonnes CO_2 per annum)	**397**

Medium Sized Homes

Comparison of energy costs for medium sized domestic cutomers (21,000 kWh gas and 3,300 kWh electricity per annum)

	Gas £	Electricity £	Total £
SEEBOARD (EDF Energy Ltd)	346.30	240.42	586.72
Thameswey Energy Ltd	316.53	218.55	535.08

CO_2 emissions comparison between grid supplied gas heating and electricity and CHP for 13 family/medium sized homes

Grid supplied (Tonnes CO_2 per annum)	113
CHP (Tonnes CO_2 per annum)	69
Reduction (Tonnes CO_2 per annum)	**44**

Large Homes

Comparison of energy costs for large sized domestic properties (40,000 kWh gas and 6,000 kWh electricity per annum)

	Gas £	Electricity £	Total £
SEEBOARD (EDF Energy Ltd)	634.91	433.74	1068.65
Thameswey Energy Ltd	583.49	397.29	980.78

CO_2 emissions comparison between grid supplied gas heating and electricity and CHP for 3 five bedroom 'executive' homes

Grid supplied (Tonnes CO_2 per annum)	212
CHP (Tonnes CO_2 per annum)	55
Reduction (Tonnes CO_2 per annum)	**157**

Below
By using integrated p.v. products which are built into the fabric of the building, the comparatively high cost of p.v. can be offset against the cost of the conventional building materials they displace. Products available include solar cells laminated into double glazed units, curtain walling, solar shading louvres and rainscreens. P.v. integrated roof tiles are also available. (Photo: SolarTile™ courtesy Marley Roofing).

Designing Solutions

Climate Neutral developments need to combine passive solar design, energy efficiency and local distributed generation from CHP and/or renewable energy. Other energy efficiency measures such as advanced thermostatic/ timer controls, building energy management systems, energy efficient lighting and pump/fan variable speed drives will reduce energy consumption and CO_2 emissions beyond current Building Regulations requirements.

The best solution for energy source depends on the nature of a development. In small-scale developments of individual houses, domestic or micro CHP for individual dwellings will achieve significantly greater reductions in CO_2 emissions than condensing boilers (but significantly less reductions in CO_2 emissions than community energy CHP). Domestic or micro CHP can be considered for small housing developments of less than 5 dwellings or domestic sized small commercial buildings. Stirling engine and fuel cell domestic or micro CHP are quiet enough to be located inside buildings and dwellings. Stirling engine CHP are as quiet as conventional domestic boilers and fuel cell CHP are as quiet as domestic refrigerators or fridge/freezers. In larger scale developments, larger scale community energy CHP is more appropriate.

Renewable energy can be generated from photovoltaic (pv) cells (which generate electricity from sunlight), or wind energy. In Woking, typical sunlight levels and wind speeds are sufficient to power pv and generate wind energy year round, and the predicted changes in climate favour both sources of renewable energy.

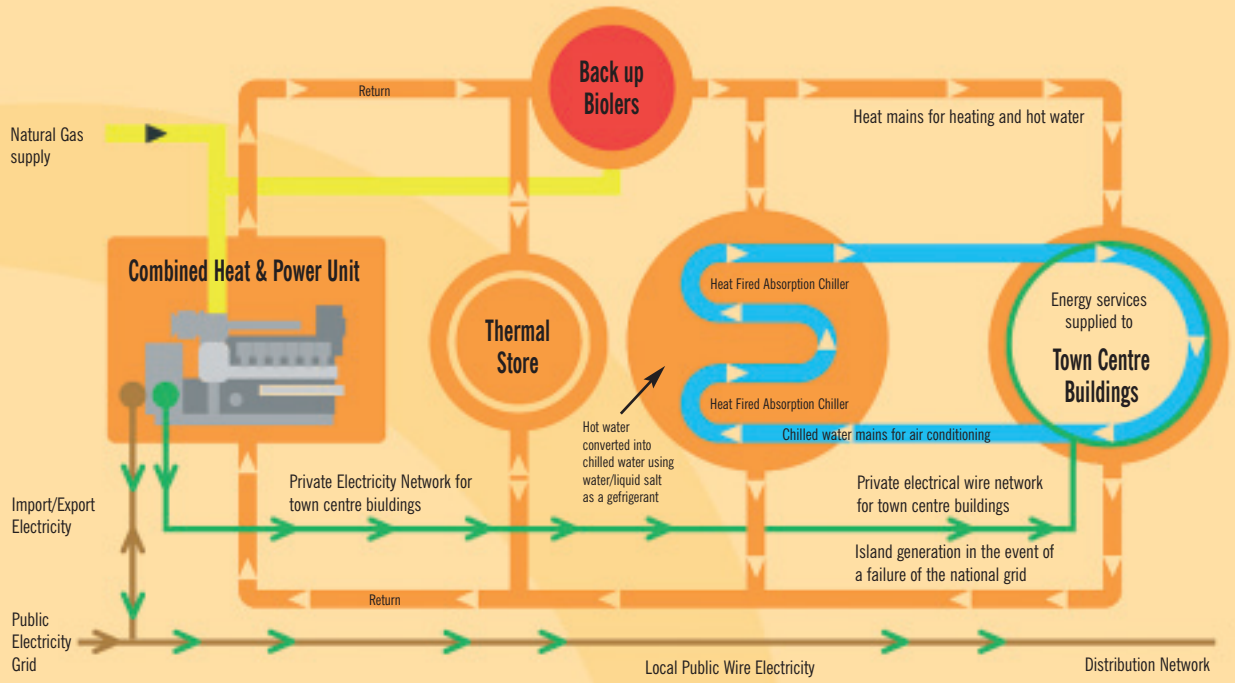
Medium-sized wind energy installations can generate up to 1 mega Watt at wind speeds of as little as 3.5 metres/second. Mean wind speeds in Woking are typically 6m/sec.

Delivering and Managing Sustainable Energy Solutions

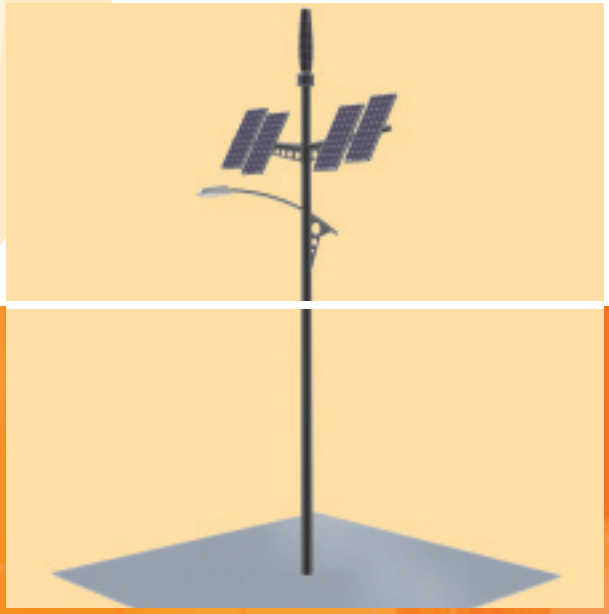
For small scale developments where micro sustainable energy technologies are used on individual buildings or dwellings, such as domestic CHP or small scale photovoltaics, these would normally be owned by the owner/occupier who would be responsible for its operation and maintenance similar to individual boiler systems.

For larger developments where the development is to be served by a local community energy system, the developer would need to arrange for an Energy Services Company (ESCO) to design, finance, build and operate the system on a long term contractual basis. The responsibility for delivering energy services from the primary energy plant and infrastructure is invested in the ESCO once the developer has sold the properties and moved off site. The owners/occupiers of the properties would become customers of the ESCO who would meter, bill and collect revenue from the customers. An example of an ESCO is Thameswey Energy Ltd., a public/private joint venture Energy Services Company. Thameswey designs, finances, builds and operates local community energy systems for both new and existing developments. Thameswey already owns and operates a number of local community energy systems on private wire district or distributed energy networks in Woking. These include the Woking Town Centre and Woking Park district energy systems as well as a number of residential local community energy systems around the Borough based on CHP, fuel cell, photovoltaic, thermal storage and heat fired absorption cooling technologies.

Woking District Energy System



The Council has taken a lead by reducing its own energy consumption by 44% and its CO_2 emissions by 72% between 1990 and 2002. It has improved the energy efficiency of its housing stock in the Borough by 19% between 1996 and 2001 and is working towards a target of 30% improvements in energy efficiency by 2006.



Right
Lighting columns can generate renewable electricity from combined solar energy photovoltaic and vertical wind turbine systems.

Energy Regulation

The Utilities Act 2000 enables electricity to be generated, distributed or supplied by persons authorised to do so by a licence or exemption. The licensed electricity market is the conventional, large scale, centralised power generation market, whereas the exemption electricity market is the local distributed generation market using CHP and/or renewable energy, including private wire networks. ESCO's such as Thameswey are authorised to generate, distribute and supply electricity under The Electricity (Class Exemptions from the Requirement for a Licence) Order 2001. Heat is an unregulated market.

Commercial/Financial Considerations for ESCO Developments

Implications for the Developer:

The ESCO should be able to finance most of the sustainable energy development with financial contributions from the developer/sub developers and/or owners/occupiers that they would have otherwise spent on conventional brown energy electricity and gas grids, connections, boilers and other primary energy plant, metering, etc. Although it is possible, depending on the development, for the ESCO to finance the sustainable energy development with the avoided cost contributions from the developer, it would be prudent for the developer to budget for any capital shortfall between the ESCO's economic investment and the actual cost of the sustainable energy development. A detailed feasibility study should determine these costs and investments.

Implications for the Owner/Occupier:

For non residential customers, the energy services contract with the ESCO is individual and bespoke similar to the deregulated energy market, except that other issues are taken into account such as avoided cost of primary energy plant, operation, maintenance and other avoided costs that are taken into account with an energy services contract.

For residential customers the energy services contract with the ESCO is different in that a common domestic tariff is normally used to demonstrate that the electricity and heat prices are more competitive than the local regional electricity and gas supply tariff prices. Maintenance of the primary energy plant undertaken by the ESCO is also more competitive than boiler maintenance contracts. An energy services or ESCO contract is normally index linked, so that the benefit that the customer starts out with is maintained throughout the length of the energy services contract (typically 20 to 25 years). The cost differential between ESCO and grid energy supplies should be maintained whatever happens to electricity and gas prices.

Further information and advice

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Email: allan.jones@woking.gov.uk

Information and advice on energy efficiency in housing is available from the Energy Saving Trust
Tel: 020 7222 0101 Fax: 020 7654 2444
Email: info@est.co.uk www.est.co.uk

The Carbon Trust offers advice to businesses to help them move to low carbon futures
Tel: 020 7170 7000 Fax: 020 7170 7020
Email: info@thecarbontrust.co.uk www.thecarbontrust.co.uk

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South East Climate Change Partnership
A partnership of the public, private and voluntary sectors
President: John Craven OBE

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UK Climate Impacts Programme