CHAPTER 14

SUSTAINABILITY, ENERGY EFFICIENCY AND LISTED BUILDINGS

(Refer to English Heritage's Guidance - Micro generation in the Historic Environment)

GENERAL SUSTAINABILITY

14.1 Approximately one in four homes in Great Britain were built 90 years or more ago, long before Carbon Emissions Reduction Targets, Building Regulations and Energy Performance Certificates. England has more than 370,000 Listed Buildings, often constructed to environmental standards that would not be approved today. A further one million unlisted buildings are situated within England's 9,734 Conservation Areas. The 2000 Building Regulations specify (in Regulation 9) that buildings of special architectural or historic interest and those in Conservation Areas are not required to comply with the energy efficiency requirements set out in Part L where this would unacceptably alter their character or appearance. (Source: House of Commons, Existing Housing and Climate Change, 17 March 2008).

14.2 Research suggests that old buildings can perform well in energy terms as the thick walls and small windows provide a high thermal mass compared with many modern construction methods. Old buildings have embodied energy including an existing investment in materials and have been proven to be robust. Natural ventilation supports the building's breathability and enables moisture management.

14.3 Sustainability is not just about reducing heating costs, and calculations can often be misleading. It is important to look at the building holistically in order to determine the best solution for the particular construction, age and material. The latest government regulations and requirements to make all buildings energy efficient are primarily focused on new buildings and the existing modern building stock - not traditional or Listed Buildings.

14.4 Planning Policy Statement 1 (Delivering Sustainable Development) and PPS22 (Renewable Energy) indicate that the local planning authority should ensure that any development plans contribute to the sustainability of the planet as well as seeking to cut carbon emissions. PPS22 also discusses the potential impact on the visual appearance of the wider landscape from renewable energies. South Cambridgeshire District Council supports and encourages proposals for the use of renewable energy, energy efficiency and energy conservation providing they meet current Local Development Framework policies and comply with National legislation.

14.5 A balance must be struck between managing change and the environment and the needs of a Listed Building. The fundamental difference between modern and traditional construction is that modern buildings use impervious materials such as cement and plastic cladding to keep moisture out, whilst traditional buildings were

built using thick permeable materials such as solid brick and stone masonry, timber and lime plasters, which can absorb excess moisture and release it slowly by evaporation.

14.6 The main risks to traditional and historic buildings are trapping moisture within the building materials, condensation within unheated areas of the building and ventilation and heating that are insufficient for removing moisture.

14.7 In principle, sustainable technology may be supported providing it meets the following criteria, but will always require Listed Building Consent:

- The change will not result in the loss of historic fabric or affect the building's special architectural interest
- The justification demonstrates that other energy saving measures have been addressed or other locations have been explored, such as freestanding equipment
- Visual impact is minimal
- The cabling, wiring, pipe work and all other associated equipment can be accommodated without loss or damage to historic fabric
- The units are removed upon such time as technology improves or they become redundant at which time the historic fabric is made good
- The work is considered reversible

ENERGY EFFICIENCY

14.8 The government's focus on improving the energy efficiency of buildings is targeted at *new construction*. As the percentage of Listed Buildings in England is approximately between 5 - 8%, the government expect the other 92 - 95% of buildings will be made energy efficient first. However, in practice, owners are interested in contributing to the decreased use of the planet's finite fossil fuels and reducing their energy bills, which should not be at the sake of a finite resource of Listed Buildings.

14.9 Each proposal will be reviewed on its merits. Locations, for solar panels, wind turbines and other plant that are freestanding in the garden, or located on a modern building within the curtilage of the Listed Building, may be viewed more favourably. Listed Building Consent may not be required in these instances. However, the works are likely to require Planning permission and the conservation officer will be consulted to assess any impact of the scheme on the setting of the Listed Building.

14.10 There are many ways to improve the energy efficiency of a Listed Building:

- Secondary glazing
- Insulated curtains
- Reinstating shutters, if historically appropriate to the building
- Improved loft insulation
- Fuel efficient boilers and thermostatically controlled radiators
- Energy efficient lighting
- Hot water tank jackets
- Insulation of pipe work

INSULATION

14.11 Insulation for traditional buildings should be carefully considered, as modern materials, such as fibreglass or mineral wool, tend to hold moisture. Natural materials such as sheep wool or hemp fibre are more appropriate as they have good thermal qualities and do not prevent the movement of moisture.

DRAUGHT PROOFING

14.12 Draught proofing is one of the best and least intrusive methods of improving comfort and reducing heat loss to any opening in a building.

14.13 Windows and doors are a major source of air gaps, noise and dust ingress. Provided sufficient ventilation remains for the health of the building, its occupants and any appliances such as boilers or other combustion appliances, the introduction of draught proofing can improve the situation.

14.14 All openings, including cat flaps, letter boxes and loft hatches should also be included.

14.15 There is a limit to how draught-proof a building should be, especially in rooms which produce large quantities of moisture- such as kitchens, bathrooms, and utility rooms. Additional extraction systems may be required to ensure the levels of moisture are properly managed.

14.16 Unheated spaces, such as roof and floor voids, are meant to retain cross-ventilation and should not be draught-proofed.

THERMAL PERFORMANCE OF HISTORIC WINDOWS

14.17 Original historic windows are disappearing despite being an important part of the character and history of any building. Those concerned about thermal performance are increasingly targeting windows, however, there are several tests that can be conducted to reveal air gaps and draughts in order to develop an informed decision and provide the most benefit to the building's energy efficiency.

14.18 Studies have revealed that a typical single glazed window on its own will fall short of performance against a double glazed window. However, small and simple improvements can increase the performance despite the window being single glazed. For example, providing secondary glazing significantly improves both the thermal performance and noise reduction of a single glazed window. The addition of heavy curtains, draught proofing and retaining, if they exist, shutters all will raise the U-value of the single glazing.

14.19 The improvements mentioned above should be discussed with the Council prior to considering altering any existing single glazed window. The majority of these improvements will not require Listed Building Consent.

RENEWABLE ENERGY

14.20 Energy efficiency is not the same thing as renewable energy. Renewable energy is the supply of energy to buildings in the form of heat or electricity from sources which are not depleting the earth's limited resources. For example, energy can come from the sun, wind, and water or from organic material.

14.21 There is an ongoing debate about the cost effectiveness of renewables. Much depends on the location of the building, and which form of energy is being used. It is not just the number of years of payback that should be considered, but also the carbon emissions. For instance, a biomass boiler is thought to have no carbon emissions whilst a ground source heat pump creates over 28,000 kg of carbon dioxide. It is therefore important to research which system is appropriate not only for the location, but based on the needs and functions of the Listed Building and its occupants.

- Solar powered systems are not always the most cost effective
- Biomass systems can provide an economic solution if space is available and if there is a sustainable fuel source
- Ground source heat pumps can be an alternative, but are not carbon efficient in all situations
- Wind turbines and micro hydro systems should only be considered where conditions are suitable and if they will not adversely impact on the appearance and setting of the Listed Building

14.22 Considerations associated with thermal upgrading:

- That the insulation of the structure is even and avoids thermal bridging - problems often arise at the junctions
- Providing a well-controlled heating system, with heat emitters in rooms where heat will not be gained from heated spaces elsewhere - this helps reduce moisture levels and avoids condensation. However, if only parts of the Listed Building are upgraded, other areas may suffer and condensation could be the result
- Preventing the distribution of moisture throughout the building, particularly in unheated spaces - some areas are not capable of being heated due to their location, the historic fabric, etc. However, it is important to control moisture levels.
- Trapped moisture within the construction can lead to problems
- Condensation within the construction or at thermal bridges or within unheated areas can lead to problems
- Insufficient ventilation and heating to remove moisture can lead to condensation and damp problems

14.23 Before undertaking any proposal for renewable energy on a Listed Building, sufficient research should be carried out to determine which source is the best for the particular building taking into account of its location, the potential impact on the historic fabric and character, as well as the potential for removal should the proposal not be viable. In addition to the impact on the Listed Building, there is a potential impact on wildlife such as bats and birds if proposals involve works to loft or attic spaces within roofs. Many systems allow for a freestanding unit to be erected within the grounds of the Listed Building. This may be more satisfactory than implementing works on the historic building. However, it is important to consider the impact of the proposal on the Listed Building and its setting. Careful consideration should be made before undertaking any proposal.

14.24 Visit the Energy Saving Trust's website for further advice and guidance at www.energysavingtrust.org.uk.

SOLAR PANELS

14.25 There are two main types of solar panels, both of which generate power:

Solar water heating – solar panels - These have the appearance of large raised rooflights and have two main components- the collector and the thermal store. The collector uses the sun's radiant energy to heat the water. There are alternative designs incorporating flat panels or tubes. These should only be used

on modern or unobtrusive roof pitches. Consider impact internally- including pipe work, cutting of any of the roof structure, affect on historic fabric, etc.

Solar electricity – photovoltaic (or PV) - These can have the appearance of roof tiles. They convert sunlight into electrical energy: the greater the intensity of light, the greater the flow of electricity. PV's only produce electricity when there is light, which means the energy must either be consumed as it is being generated or stored for later use or supplied to the National Grid. These PV tiles have a shinier appearance than natural tiles making them inappropriate in most locations.

Example of freestanding solar panels installed in the garden of a Listed Building

WIND TURBINES

14.26 Small wind turbines are now available for individual power generation. Advice from a structural engineer may be necessary, as wind loading and vibration from units can have a damaging effect on the building.

14.27 Electricity generated by a wind turbine is highly dependent on the speed and direction of the wind. The wind speed itself is dependent on a number of factors, such as location within the country, height of the turbine above ground level and nearby obstructions. To ensure that a scheme is viable, a professional assessment should be undertaken of the local wind speed for a full year at the exact location where the turbine is to be located before proceeding. Listed Building Consent will be required for any wind turbine attached to a Listed Building or Curtilage Listed Building, and is more likely to gain officer support if it is not located on the building itself.

BIOMASS

14.28 Biomass is produced from organic materials, either directly from plants or indirectly from industrial, commercial, domestic or agricultural products. It is often called 'bio energy' or 'bio fuels'. It doesn't include fossil fuels, which have taken millions of years to be created.

Bio-mass boiler set up in a converted Listed building

14.29 Biomass falls into two main categories:

- Woody biomass includes forest products, untreated wood products, energy crops and short rotation coppice (SRC), which are quick-growing trees like willow.

- Non-woody biomass includes animal waste, industrial and biodegradable municipal products from food processing and high-energy crops. Examples of the latter are rape, sugar cane, and maize.

14.30 For small-scale domestic applications using biomass the fuel usually takes the form of processed wood pellets, wood chips or wood logs.

14.31 The following are considerations that should be taken into account prior to proceeding with the installation of any Biomass system:

- **Fuel:** it is important to have storage space for the fuel, appropriate access to the boiler for loading and a local fuel supplier.

- **Flue:** The vent material must be specifically designed for wood fuel appliances and there must be sufficient air movement for proper operation of the stove. Chimneys can be fitted with a lined flue, but Listed Building Consent may be required.

- **Regulations:** Installation must comply with all safety and Building Regulations.

- **Smokeless zones:** Wood can only be burnt in exempted appliances, under the Clean Air Act

UNDERGROUND HEAT PUMP

14.32 Ground Source Heat Pump (GSHP) systems are heating systems that exchange heat from an underground source in either a heating or a cooling system. Ground source heat pumps require excavation and a substantial amount of land. There is

the potential for any installation to undermine the historic foundations of the Listed Building and advice should be sought in advance of any proposal. In addition, there may be archaeological implications.

14.33 An accredited installer will be able to provide detailed advice, but these systems can be classified generally as open or closed systems:

• **Open systems:** Groundwater is used as a heat carrier, and is brought directly to the heat pump

• **Closed systems:** Heat exchangers are located in the underground (either in a horizontal, vertical or oblique fashion), and a heat carrier medium is circulated within the heat exchangers, transporting heat from the ground to the heat pump (or vice versa)

14.34 The following are considerations that should be taken into account prior to proceeding with the installation of any Ground Source heating system:

- You will need space outside your house for the ground loop.
- The ground will need to be suitable for digging a trench or borehole.
- For electricity, oil, LPG or coal the payback may be more favourable. Heat pumps are a good option where gas is unavailable.
- The type of heat distribution system. Ground source heat pumps can be combined with radiators but these will normally be larger than with standard boiler systems. Under floor heating is preferable as it works at a lower temperature.
- Wall, floor and loft insulation will lower your heat demand and make the system more effective.

AIR AND WATER SOURCE HEAT PUMPS

14.35 Air and water source heat pumps use air or water respectively. They do not rely on a collection system and simply extract the heat from the source at the point of use. Air source heat pumps can be fitted outside a house or in the roof space and generally perform better at slightly warmer air temperatures. Water source heat pumps can be used to provide heating in homes near to rivers, streams and lakes.

14.36 The benefits of air source heat pumps are similar to ground-source heat systems. Firstly, neither type of system requires the use or storage of oil / solid fuel. The systems instead run on electricity. Air source heat pumps present an advantage over ground source heat pumps because they require less space for installation and are therefore more suited for an urban home.

14.37 They require ducting to each room and therefore are unsuitable for historic buildings that have exposed historic structure and where the ducts cannot be concealed. Consideration should be taken in regards to impact to any historic fabric. Planning permission may be required as well.