PROMOTION OF RENEWABLE ENERGY TECHNOLOGIES

172. **Solar Technologies:** Panel orientation is important and when including building or roof mounted systems the overall block and plot layout of a proposal will take this into consideration early in the design process. There are also considerations relating to visual amenity and impacts. The positioning, structure and colour of panel mounting fixtures and frames should be given consideration, darker more recessive fixings being the least obtrusive. Panels should not result in excessive glint or glare, they are engineered to absorb light rather than reflect it. Solar slates/tiles may be less conspicuous but are more costly, they may however be considered where affecting the fabric or setting of listed building, in Conservation Areas, the Peak District National Park or Derwent Valley World Heritage Site and buffer zone.

Over Haddon Village Hall, Derbyshire: Solar PV and air source heat pumps, within the Peak District National Park and on the edge of the Over Haddon Conservation Area. Image with permission of Over Haddon Village Hall.

173. **Photovoltaic:** PV panels need to be facing south or within 30º of south to deliver the required efficiency whether roof, wall or ground mounted. PV can be mounted on domestic or commercial buildings. To get close to achieving the CO_2 reductions necessary, all new buildings should include as much renewable energy generation capacity as possible. Solar PV should be maximised on roof spaces. If PV is not to be installed, then the roof structure should be designed and specified to enable the later installation of PV panels capable of a significant contribution to the energy demand of the building. Ideally, building integrated PV will form part of the initial design brief. Where PV and heat pumps are installed together, the PV can contribute to the running of the heat pump, particularly if coupled to a battery system.

174. Ground mounted PV has an important role to play in the future provision of low carbon energy. There are significant location and design considerations in site selection including but not limited to, the impacts of glint and glare on road users and air traffic, food production security, agricultural land quality, the loss of best and most versatile agricultural land and, the ability of a landscape to accommodate large scale ground mounted PV arrays while minimising the impact on landscape character, areas of multiple environmental sensitivity, and ecological and cultural assets.

175. As with roof mounted and BIPV, arrays must be close to south facing and not overshadowed. Topography will therefore be a locational consideration determining whether or not a site is suitable for ground mounted PV. On a practical level, the availability of a suitable electricity grid connection may prove to be the deciding factor in an applicants' final site selection for large scale solar parks.

176. Although the PV panels themselves are effectively passive, simply absorbing energy from the sun and converting it silently to electricity, the associated inverter, substation and electricity transmission infrastructure required for large scale commercial solar parks does have the potential to generate a low hum often associated with electrical infrastructure. Such infrastructure is therefore best located away from sensitive receptors such as dwellings.

177. **Battery storage:** Large-scale battery storage facilities are not in themselves necessarily a source of renewable energy, they are however often associated with renewable resources as a means of evening out the delivery of electricity to the grid. Batteries can be used to store renewables generated at times of low demand, to be released to the grid at times of high demand and low generation. Battery systems and their associated transformers and inverters can be a source of low frequency noise and should therefore be located away from sensitive receptors or suitable acoustically screened.

178. **Solar thermal:** Potential for inclusion in any development where there is demand for hot water, domestic or commercial. Solar water heating requires a similar orientation to PV, within 30° of south. Solar thermal and PV may be combined and an assessment as to the most beneficial use of roof space should be undertaken.

179. **Large-scale wind:** Most likely available as off-site, grid connected development or associated with commercial or mineral proposals. The Derbyshire Renewable Energy Study identifies areas where there is a suitably unconstrained wind resource which may have potential to be developed on a commercial scale. It is unlikely that large scale wind turbines will be associated with residential development.

180. Suitable stand-off distances will be required between individual turbines and receptors sensitive to either noise or shadow flicker. The extent of these stand offs will depend on the size of the proposed turbine and its setting.

181. **Small-scale wind:** There may be scope for small scale wind on residential developments but is most likely to be associated with on-farm, rural or commercial developments. Proposals will include landscape, visual and ecological impact assessments. As with large scale wind turbines, noise and shadow flicker are potentially issues affecting detailed site location, vibration may also be an issue to be considered where small turbines are to be building mounted.

Griffe Grange and Bone Mill Quarry, Derbyshire

182. **Hydro Power:** The potential for hydro power development in Derbyshire will form part of the commissioned renewable energy study to accompany this guidance. It is however not thought that there is significant potential in Derbyshire. Individual commercial buildings may benefit from small scale schemes where an existing flow control structure exists. The energy potential from a hydro plant is largely a function of flow and head, the vertical distance the water falls. In Derbyshire there are few opportunities for high head hydro schemes. There are a number of weirs on Derbyshire rivers, but these tend to be low head with limited generation potential. Hydro schemes are also regulated by the Environment Agency, requiring an abstraction licence. Where opportunities for environmentally acceptable and commercially viable hydro power exist, these should be exploited where acceptable.

183. **Heat Pumps:** Heat pumps should be specified for residential space heating in preference to fossil fuel boilers, they can operate from a combination of grid connected electricity, battery storage, or on-site renewables. All forms of heat pump-based space heating systems are most suited to installation as part of the original construction of the building as they operate at relatively low temperature and normally take the form of under-floor heating. Retrofitting can therefore be costly and difficult. Air source heat pumps do not require trenching or bore holes. The heat pump is mounted externally and resembles an air conditioning unit.

Air source heat pumps, Over Haddon Village Hall, Derbyshire. Image with permission of Over Haddon Village Hall.

184. Ground Source heat pumps require either shallow trenching to accommodate heat exchanger coils extending over a substantial area of garden or other open ground, or deep bore holes drilled into strata a significant distance below the surface.

185. Similar to ground source heat, water source heat pumps require heat exchanger coils to be located in a water body or in some cases can be installed as an open loop system. Again, as with hydro schemes, these are regulated by the Environment Agency

and require a combination of ground water investigation consent, abstraction licence, ordinary watercourse consent or environmental permit.

186. All heat pump systems require an electrical connection to drive the pump, this can be provided by other renewable energy sources such as wind or PV with backup battery storage or grid connection to enable operation during unfavourable weather conditions. Other forms of low carbon space and water heating may also be considered.

187. **Mine-water heating and geothermal:** Mine-water heat is based on water source heat extraction on an industrial scale, making use of the relatively high temperatures present in deep min-water. Schemes will typically consist of a surface building to house the heat pump and ancillary equipment. Like district heating schemes, the commercial exploitation of mine water heating requires the heat source to be reasonably close to the recipient. The former coal field areas of the county may provide some opportunity for mine water heat to be exploited.

188. Geothermal energy typically comes from either residual heat in geologically active areas or from heat generated from natural radioactive decay. Derbyshire does have some natural ‘warm’ springs, notably at Matlock Bath and Buxton. The renewable energy study commissioned to accompany this guide is anticipated to provide more information on this topic although the exploitable resource is likely to be small.

189. Where geothermal energy is proposed, development should be accompanied by appropriate geological survey information to establish the viability of the heat source and the impacts of the associated bore hole drilling.

190. **District heating and Combined Heat and Power:** District heating including Combined Heat and Power (CHP) may be feasible where there is either a local heat or fuel source from nearby industrial or agricultural activities. Typically, a district heating system will include ducting from the source to end user, and in place of a domestic boiler, each property will include a controllable heat exchange unit. Alternatives may be comprised of a centralised CHP plant making use of a local fuel source, often a waste from other businesses, providing both heat and electricity to a development.

191. Centralised heat sources may be more suited to industrial or commercial development as the contractual arrangements between heat supplier and end user may be less complex. Where on-site renewables such as air source heating or roof mounted PV are feasible, district heating systems may be less attractive. District heating systems, where considered, will need to be developed and implemented at the time of construction as there is a significant level of infrastructure involved including heat ducting and domestic heat exchangers as well as contractual arrangements for the operation of the system and supply of heat. All of which must be in place before the development can be occupied. The retrofitting of district heating systems is likely to be prohibitively expensive.

192. **Biomass, energy from waste and anaerobic digestion:** A variety of fuel sources based on biomass can be used in heat or combined heat and power systems, including fuel crops, agricultural wastes and industrial or forestry residues. Biomass may

be considered to include anaerobic digestion and some forms of energy from waste. Typically, a biomass plant will be used for industrial or commercial energy supply and heating or a centralised energy and heat network for larger developments although small scale biomass boilers are available. The viability of such systems is reliant on the fuel supply chain and therefore needs careful planning. As with district heating systems, a management and maintenance body is likely to be required. Anaerobic digestion may include farm residues, sewage sludges or fuel crops for a CHP scheme.

193. **Hydrogen Technologies:** Hydrogen is most likely to be considered as a fuel source for industrial processes and fleet vehicles although fuel cell vehicles for the private market are being developed by several car manufacturers and the addition of hydrogen to the domestic gas supply is being considered. The production of hydrogen as a fuel will require a high-capacity electrical connection and either a water or natural gas feed stock. It can only really be considered to be low carbon if generated by the electrolysis of water using renewable energy sources. The UK government has published the 'UK Hydrogen Strategy' setting out a vision for the development of hydrogen production in the UK, both from blue, fossil fuel feed stock and by electrolysis to produce green H_2. Blue hydrogen may provide an easily accessible supply to kick start the development of H_2 vehicles and associated infrastructure but is unlikely to make a contribution to climate change adaptation unless coupled with carbon capture and storage, CO_2 being a by-product of blue H_2 production.

194. Hydrogen fuelling facilities are not considered suitable for residential installation. Proposals for commercial or publicly accessible hydrogen fuelling facilities are likely to come forward as the use of hydrogen is adopted, particularly for public service

and both light and heavy goods vehicles. It may therefore be prudent for emerging development plans to include consideration of the requirements for hydrogen fuelling infrastructure to enable its introduction in suitable locations.

195. **Community led Schemes:** Increasingly there are community groups seeking to develop environmental projects such as community funded renewables schemes, allotments, habitat creation or self-build programmes. Such schemes may be realised through collaboration or association with an enabling scheme but may also form part of allocations for self-build.

196. **Nuclear:** Government energy policy clearly indicates that nuclear fission technologies will play an ongoing part in the energy supply in the UK for the foreseeable future. The development of large-scale nuclear stations, such as that being developed at Hinkley Point in Somerset, take several decades to plan and implement. Their locational requirements are quite specific, and it is very unlikely that a site in Derbyshire could be identified. However, small modular and advanced modular reactors (SMR and AMRs), originally developed for maritime operations, are being considered as an option for onshore energy supply. These modular reactors can be accommodated in a wide variety of locations and deliver energy to the grid in around 5 years compared to 25 to 30 years for a large reactor. The locational requirements for AMR/SMRs are significantly more flexible than for large scale fission generators. The potential for deployment in Derbyshire should be considered.

197. Nuclear Fusion power is also referenced in government energy policy, but so far, no proven, working fusion reactor has been built. Research reactors have generated more energy than used for 'ignition', but to date running times are measured in fractions of a second and energy output is only 'measurable'. While several national and international agencies are conducting research,

the development of a commercial fusion reactor is likely to be many years, if not decades, away. However, if successful, fusion will have the potential to provide clean, GHG free energy without the long-term waste management issues or public safety concerns associated with fission. A site for a fusion research and demonstrator facility is being considered in the East Midlands.