ANNEX A

Renewable Energy

Renewable Energy, electricity and/or heat, is sourced from fuels;

- Which always replenish themselves, - such as the heat of the sun, wind and water movement
- Or with a little management can be continuously restored – such as wood, reeds, straw
- Or occur as the captured bi-product of other natural cyclic processes – such as the gasses produced from the anaerobic (airless decomposition by bacteria) of sewage or the decay of organic (primarily soft green) waste.

The following parts of the Chapter present a guide to;

- The different sources of renewable energy,
- Their associated technologies
- And practical considerations in respect of the applicability or ease of using a particular source in a given environment.

Biomass

Biomass: is the shared description for the controlled release and use of the energy potential locked up in **trees and plants** – straw, reeds or willow - or created as a part of regularly recurring natural processes – the bi-products of the process of decomposition or the bacterial **digestion** of natural things i.e. sewerage, various farm wastes or decaying material such as garden clippings and/or other largely natural materials such as paper.

Dry Bulk Green Biomass: releases the locked up energy through burning the primary fuel source - wood, straw, poultry litter (mix of straw and droppings) or crops purposely grown for energy such as miscanthus a perennial reed, rush or wet land grass. Energy produced from green biomass can be as adaptable as that from coal burning - i.e. everything from the heating of a domestic property to the fuelling of a national grid connected power plant. Like Coal burning green biomass produces Carbon Dioxide (CO_2), it fundamentally differs from the burning of gas, oil or coal however in the following respect plant life needs CO_2 which they take from the air or atmosphere to grow. As they do so they 'ground', or lock up the form of carbon that would otherwise contribute to global warming and release life giving oxygen to the animal kingdom. Green biomass fuel sources can therefore be described as 'Carbon Neutral' in that the carbon they produce as CO_2 on burning is generally less than or equal to the carbon they use and render safe whilst growing.

Green Biomass Primary Sources

- **Straw** is a natural bi-product of cereal or seed-oil crop production in the UK and can either be used straight after the harvest of grain, or burnt after it has been used as bedding for livestock; extending the marketable value of the product for our agricultural industry.

- **Wood** or more accurately trees, particularly those species that can be grown on short rotation coppice or pollard[1] like Willow, Plane and Poplar have a variety of additional benefits depending on the location of source. Willow has been used for many hundreds of years for the ability of its roots to stabilise and add structure to fragile river banks that would otherwise be more likely to silt up rivers and contribute to overspill and flooding; CO_2 related global warming has increased the likelihood of flood incident in the UK. Poplar and Sycamore are highly resistant to pollutants and can be planted in close proximity to city environments cleansing air and making city living healthier where other species would die. Vigorous young Poplars[2] are relatively resistant to pollutants, have a rapid growth cycle and add value as graceful compact shelter belt forms.

  Other sustainable sources of wood include forest management bi-products left over from timber processing, grounds maintenance/tree surgery waste and reclaimed demolition timber etc. Whilst non coppiced or pollarded wood is also a potentially valuable source of biomass it must come from FSC certified sustainable sources, where trees felled for fuel, are replaced by an equal or greater planting of new trees of the same kind.
- The growth of **Miscanthus** is best suited to water meadow (places that get wet or flooded in winter but drain naturally in summer; may sometimes be described as flood plain habitat. Historically these environments have been under threat due to forced drainage to create further space for economically viable agricultural land.
- **Oil seed crops** such as Rape, Hemp and Maize (Sweet Corn) are already being processed to produce alternative sources of transport fuels to petrol or conventional diesel such as ethanol (a form of alcohol) and **biodiesel**.

  In addition to the production of seed for oil, **Hemp** stem fibre can be used in the production of fine grade natural fibres equivalent to cottons, thermal mass insulation or as a fuel in the same way as straw. Unlike Cotton agricultural Hemp will grow in UK climatic conditions – cutting out or largely reducing the transportation impacts - and needs little or no pesticide or supplementary fertiliser minimising other environmental pollutants.

  The stem fibres and husk of other oil seed crops whilst not as adaptable as Hemp may be used in digested to burn or burnt.
- Non-hazardous organic industrial, construction or municipal bio-wastes (such as arboricultural thinnings) may also be applicable. Additional care must be taken with such sources to guarantee that emissions and residues from such waste to fuel sources don't cause environmental problems.

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[1] coppice or pollard: the controlled cutting of a tree to promote rapid shoot growth which is harvestable on a recurrent basis usually 3-4 years,

[2] Poplars due to their tall tongue shaped growth (which catches the full brunt of prevailing winds) and susceptibility to concealed heart wood rotting should, on a relatively short aging cycle, be renewal felled and replaced in the interests of public safety.

Anaerobic Digestion captures and diverts for fuel the methane produced by the rotting of **wet wastes** (such as soft green materials including municipal bio-wastes or slurry) in temperature-controlled containers through a process known as anaerobic digestion. This can then be used to fuel gas engines producing electricity and heat.
Examples of chicken litter combustion, animal slurry digestion and straw combined heat and power projects are already powering well in this country. Adoption of digestion systems may offer local authorities an opportunity to manage compostable green wastes more effectively.

Biomass to Power
At domestic to medium scale (municipal or office build) wood may be used as wood chip, wood pellets or logs, in wood/pellet burning stoves or wood chip/pellet boilers for space and water heating. For single room heaters or stoves with automated wood pellet feed used for heating a single rooms and hot water or a whole house.

For commercial or larger scale community electricity production wood and other biomass materials can be used in a variety of ways generally assessed on the scale of production desired;

- In electricity producing combustion plants the material is burned to effect steam generation.
- Gasification plants heat the material with air steam or oxygen in such a way that gases are given off for burning in boilers, chambers or turbines.
- Or through Pyrolysis processing plants where the green material is heated in the absence of oxygen producing;
  - Combustible gases of an energy value generally ½ that of natural gas,
  - Low energy charcoal which can be upgraded if required
  - and a bio-oil liquid effluent (which must be treated to prevent water pollution.

Most medium to large scale biomass generation lends itself to co-generation or the production of combined-cycle or combined heat and power (**CHP** see below) production improving the total energy output of the operating system. Depending on the primary fuel source and generating system deployed the ashes formed may be applicable for use as;

- Soil improvers/fertiliser for agricultural purposes
- Road clinker
- Or must be considered and assessed for safety as landfill

Large scale Biomass also presents established grid connected opportunities to explore **Co-firing Potential,** where a proportion of the energy produced from fossil fuel combustion is supplemented.

Critical Factors in Assessing the applicability of Biomass:-

Availability of primary fuel source: -

- Land use in the Yorkshire and Humber Region is chiefly agricultural, rural areas covering around 80% of the region; accounting for about $^{1}/_{5}$ of the population. Cereal, seed oil and hemp crop production are pre-established in the York area. In addition to which there may be sufficient animal husbandry – assessments regarding the relationship to pig, cattle and poultry - to support litter based and/or slurry digestion biomass systems. These possibilities could possibly create secondary income streams for the farming community, and additionally CHP nets for 'off-gas' communities which are generally rural thus creating a valuable sustainable cycle.
- Large tracts of the N.York Moors are given over to managed forestry, however, the home demand for the supply of good grade sustainably sourced building timber should take precedence over fuel supply, reducing likely overall volumes for biomass to sawmill processing waste.
- The Vale of York has some tracts of degraded or species poor flood meadow (which would need careful differentiation from species rich acreage) and river margin which might be considered for environmentally aware miscanthus production and/or willow coppice.

Security and Costs of Supply: -

- Transportation costs and associated emissions are a significant factor in determining the economic and sustainable viability of Biomass. Depending on the energy value of the primary fuel type, experts suggest that ideally the harvest or collection site should be between 10-25 miles from the energy conversion site.
- Secure primary biomass sources are well evaluated on their understanding of timed cycles of source renewal, demand, storage and handling required. Or the ability to predict the local capacity to produce the required volumes of the chosen fuel material to maintain constant and efficient operation of the system over a period ensuring systems life profitability once processing, generation, staffing, transportation, waste management and other associated costs have been deducted.

Design and Permissions: -

- Generally a high level chimney or twin walled stainless steel pipe flue are required to vent gasses released on combustion away from the building, for safe atmospheric dispersal; such flue systems may be fan assisted to improve performance.
- For medium to large scale combustion systems wall mounted air-grill ventilation is required to provide adequate combustion flow, domestic burners and stoves draw from room which will need adequate through flow from air-bricks or similar. Flow does cause some heat loss which can be compensated for by fitting positive pressure ventilation in the roof space and heat recovery systems.
- The Local Authority Planning Department should be contacted prior to flue fitment especially where proposed flue heights exceed the roof-line

as planning consent is likely to be required. The Planning Department will also wish to consider proposals in respect of their relationship to conservation areas and areas of outstanding natural beauty.

- Under the clean air act wood must only be burned on exempt appliances in smokeless zones.
- Installation must comply with safety and buildings regulations.
- Local Planning Authorities handling applications for anaerobic digestion, must carefully consider the potential impacts of odour and proposals put forward for its control. Where odour would have an impact, plants should not be located in close proximity to existing residential areas. (Planning Policy Statement 22: Renewable Energy)
- Whilst the need to transport fuel to Biomass plant may lead to increases in traffic in determining planning applications, and should ensure this is minimized by citing plants as close as possible to proposed fuel sources, the authority should recognise that the primacy of other considerations (i.e connections to the Grid and the potential for CHP). (Planning Policy Statement 22: Renewable Energy)

Biomass Exemplars
The UK has some of the largest examples of the use of Biomass to generate electricity in Europe.

Large Scale
At 38MW Ely Power Station generates over 270GWh each year and is possibly the largest straw burning power station in the world. Planning permissions have allowed Ely to successfully incorporate oil seed rape and miscanthus fuel sourcing in addition to cereal straw. The plant requires 200,000 tonnes of fuel each year; supplied by Ely's sister company Anglian Straw. The power output from the plant is sold under an NFFO contract that terminates in 2013.

At 38.5MW generation, Thetford chicken litter fuelled plant Norfolk consumes 420,000 tonnes of litter each year and is possibly the largest biomass plant in Europe. The plant located at the heart of poultry production in England uses litter sourcing managed by a dedicated team. The plant has successfully trailed the burning of feathers and other agricultural residues. EPR operates and maintains the energy plant and as a bi-product quality fertilizer is marketed through a group owned subsidiary. Power output from the plant is sold under an NFFO contract that expires in 2013.

Small-Medium Scale
In Feb 2004 RSPB Wetland Centre Old Moor South York's entered into contract with a local sawmill for delivery of 1 ton of sawmill off cut material – delivered bi-weekly (summer) and twice weekly winter - to power a 100KW boiler.

For more Information:-

British Biogen - The Industry Trade Association; for more information about every aspect of biomass in this area www.britishbiogen.co.uk

DEFRA, English Rural Development Programme; for advice about support schemes for growing energy crops and establishing producer groups. www.defra.gov.uk/erdp/shemes/energy/default.htm

The National Non-Food Crops Centre, York; for advice about systems, crops and industry contacts www.nnfcc.co.uk

Clear skies for; individual and community grant support for automated pellet feed room heaters and stoves. www.clear-skies.org

Heat Pumps

Heat Pumps rely on the absorption of the heat produced by the sun being drawn into a compression unit with an evaporator coil heat exchanger which works like a fridge in reverse; making it possible to produce heat from external air temperatures of as little as –15^{o} C, or constant UK ground (12ºC), or water temperatures.

All heat pumps require an **operating power supply**; preferably solar photovoltaic panels or a wind turbine if the system is to be considered truly renewable. For each unit of energy the pumps use they will generate 3-4 units of power so other sources of operating supply would still deliver 60-75% renewable heating. Users could also consider subscribing to a green tariff scheme, promoting the use of renewables by generation companies.

With Air Source;

- The Heat pump **compressor** which takes the air delivered and upgrades it using the latent heat of a refrigerant to up to 75^{o}C.
- The heat gained is transferred to a space heating distribution system such as conventional radiators.

Critical Factors in Assessing the Applicability of Air Source Heating

- Systems are low noise, robust and reliable requiring little maintenance and offering a typical 20 year life expectancy.
- The units are small (roughly the size of a large suitcase) and wall mounted
- Safety characteristics rank high as there is no reliance on combustion
- Systems are most effective for smaller scale units with fairly high constant level heating demands i.e. domestic or office space etc
- Systems are simpler to install than ground source

With Ground Source

- A **closed underground, piping circuit** which has water pumped through it as the conducting medium transferring the underground energy. There are two principal types;
  - **Vertical heat exchangers**; which run deep into a narrow shaft fairly close to the building

   - Or Horizontal or **Slinky Exchangers** where the pipes coil in long narrow trenches away from the building
- The Heat pump **compressor** which takes the water delivered at about 11°C and upgrades it using the latent heat of a refrigerant to between 40-50°C.
- The heat gained is transferred to a space heating distribution system i.e.
   - Under floor heating (which is the most efficient)
   - Low surface temperature radiators
   - Or low temperature air distribution

Critical Factors in Assessing the Applicability of Ground Source Heating

- Systems are low noise, robust and reliable requiring little maintenance and offering a typical 20-25 year life expectancy.
- Safety characteristics rank high as there is no reliance on combustion
- Reversible ground heat systems can also be used to remove heat from a building and deposit it back into the ground to cool the building during hot weather
- Supplementary systems are required if the system is used for hot water provision as ground source alone will not heat to required levels for pasteurisation; this could be solar.
- Systems are most effective for units with fairly high constant level heating demands i.e. schools, residential care homes etc
- Systems will actually work more efficiently in the presence of a high water table

Water Source; works roughly equivalent to ground source only the piping circuit is laid in flat loops at the bottom of a pond or lake.

Design and Permissions: -

The permissions pointers for the operating power supply will need to be considered i.e. if solar see relevant permissions summary.

There should not be need to obtain Planning Consents for the ground source system itself as it hidden within the building or ground.

There should not be need to obtain Planning Consents for the air source system in anything other than protected builds or conservation areas.

Heat Pump Exemplars: -

For more Information:-

Heat King manufactured in Brighouse for information about local supply www.heatking.co.uk

The European Heat Pump Website; www.fiz-karlsruhe.de/hpn/hpn.html

The UK Heat Pump Network for; finding out more about the developing market and environmental and economic best practice www.heatpumpnet.org.uk

The website of the Ground Source Heat Pump Club: www.gshp.org.uk

Clear skies for; general information about Ground Source Heat systems, and, individual and community grant support for installation www.clear-skies.org

The Geothermal Heat Pump Consortium for; a range of residential and commercial sector case studies as well as technological information www.geoexchange.org

The IEA Heat pump programme for; information serving the Industry needs on policy, development and distribution www.heatpumpcentre.org

Hydropower

For centuries we have used water wheels to drive mills and machinery, Hydropower could indeed be described as the catalyst of the industrial revolution in this country. In 2004 modern Hydropower accounted for the largest share of renewable sourcing, some 4% of all electricity produced in the UK. Most generation still comes from large dam projects installed many years ago but small scale hydro is increasing, and it is suggested that the York's and Humber region has potential to create at least 9.5MW of capacity from smaller scale generation.

All hydropower technologies turn the potential or kinetic energy of water into electrical generation by means of a hydro turbine.

Small Scale Hydro Turbines comprise of;

- Water power "dropped" from behind a dam or storage reservoir or from a flow head within the river such as water intake above a weir or behind a dam. It is now possible to produce a few tens of kilowatts of electricity from low water "heads" of 2 - 3 metres.
- After adequate volumetric flow and/or water pressure - which will determine the amount of power attainable - have been established most hydro systems require a water transport system and flow control system channelling the water to the turbine.
- Water passing through the turbine generates energy in the same manner as the blades of a wind system, the turbine is connected to an electrical generator converting the kinetic energy into electricity.
- The electricity generated in small systems may be direct current (DC) which can be stored in batteries but needs to be run through an invertor or DC/AC converter producing Alternating Current for domestic circuit use. Electricity may also be diverted to the grid.
- The water passed through the turbine then directed back to the water course through an outflow.

Critical Factors in Assessing the Applicability of Hydro Power: -

- As a general rule of thumb, capital costs rise as available head decreases. Sufficient head to give an output over the systems life ensuring payback of the installation investment capital should be established.
- A degree of existing infrastructure, i.e. a disused mill/weir etc are likely to improve project profitability.
- Costs vary immensely depending on the type of hydro resource available and the system installed.
- A system producing less than 10kW may not worth grid connecting, unless grid connection infrastructure is already present. 10kW size systems are better suited to battery charging or secondary backup for a critical load, such as old generators.

Design and Permissions: -

A licence needs to be obtained for a hydro project from the Environment agency.

Planning permission may also be required from the local authority.

Hydro Exemplars: -

For more Information:-

For more information about hydropower and list of suppliers, please visit the British Hydropower Association's website at www.british-hydro.org

For information on grants, please visit the Clear-Skies website at www.clear-skies.org

Solar Energy

Sunlight is a free, constantly renewed source of light and heat, and its benefits are increasing being built-in to new developments or added into refurbishment or re-use projects. There are three primary approaches used to harness solar power in the UK today;

- **Passive-solar gains**,
- **Photovoltaic** cells that generate electricity,
- and **Solar-thermal** panels that heat water.

Passive-Solar Gains: rely on design specifications and material elements aimed at maximising the conversion of sunlight into heat and significantly reducing the amount of heating required to achieve and maintain thermal comfort. To build in solar gains and maximise the absorption of radiant energy into the buildings fabric buildings should be;

- Orientated with the main elevation or glazed face of the building to within 30 degrees of due South
- Spaced to ensure buildings structures, shelter break planting and high walls don't overshadow. Note, however, that the planting of native deciduous trees to reduce overheating in summer whilst minimising shadowing in winter should be considered.
- Incorporating a greater proportion of glazed areas on the southern elevations to increase passive solar gain and natural day lighting.
- Using roof lights and atriums to bring light and solar heat into the centre of buildings.
- Using advanced solar and double glazing systems for windows and doors; preferably framed with sustainably sourced wood.

Whilst full application of passive-solar gains techniques may not be practical in all locations due to prior spatial positioning, as many of the techniques as possible should be incorporated into re-use, refurbishment or new build projects to reduce the reliance on supplementary energy sourcing.

Photovoltaics:

'Photovoltaic' is a word conflation of the Greek *photo* meaning light and *voltaic* associated with energy production.

Photovoltaic (PV) systems or PV cells are constructed using thin layers of semi-conducting material, most commonly silicon, which on exposure to light, generate electrical charges. The charges are conducted away by metal contacts as direct current (DC) to an invertor or DC/AC Converter providing Alternating Current for domestic circuit use. Alternatively DC can be used of a specific DC lighting circuit, but this technique is primarrly used in properties that are not grid connected.

To give the desired electrical output multiple cells must be connected together , as single cell output is small, the cells are encapsulated (typically in glass) to form a **module** or 'panel'. Electricity produced can either be used immediately or stored for later.

Photovoltaics lend themselves to a variety of familiar applications and operation scales. Simple cell systems are commonplace in calculators and watches, mini panels in some battery collector systems for domestic burglar alarms, garden lighting or fountains, and increasingly larger systems for parking meters and street lights.

The adaptability of PV lends itself to larger scale output where multiple PV modules or panels are connected together to form an **array**. When production exceeds demand arrays can be grid connected to the electricity network selling power back to an electricity supply company. Grid connection acts as an energy storage system, eliminating the need to include battery storage into the PV system.

Critical Factors in Assessing the applicability of Photovoltaics:-

PV technology offers enough scope to potentially generate pollution and noise-free electricity in any environment without necessarily using extra situational space.

- PV modules or arrays generate more energy when they are positioned in fixed units facing near south (south-east, south-west) away from any shadows from trees, surrounding buildings or chimneys at a tilt angle of 30-60 degrees or mounted on solar tracking systems.
- They can be incorporated into the buildings façade in a number of ways, sloping rooftops using frame mounts being ideal, where the frame provides an underflow air path to avoid excess heat build up under the panel.
- Photovoltaic systems can also be incorporated into the actual building fabric for example;
- Monochrystalline glass encapsulated cell systems – life expectancy 25-30 years - can be incorporated into the glazing of conservatories or sunroofs where the building provides airflow.
- Polychrystalline cell systems – life expectancy 20-25 years – have an iridescent blue black mirror glass finish which can be usefully incorporated to stunning aesthetic effect in wrapped roof arrays on modern builds.
- Amorphous systems have a matt colourised finish that may be more architecturally discrete for some locations. PV roof tiles are also now available and can be fitted as would standard tiles making them a good choice if re-roofing is required. This rapidly growing market in PV innovation, is being mainstreamed by the UK Major Photovoltaic Demonstration Programme who may provide project funding; see www.solargrants.org.uk.
- Photovoltaic systems can be the most cost effective power source where grid power supplies are unavailable or difficult to connect to. PV adapts well to combined sourcing for community generation networks where biomass, wind or other renewables generation, forms part of a hybrid power supply system.
- Consideration should always be given to the desired systems output or electricity needed which should be a determining factor in the type of system chosen.
- To directly generate hot water – solar-thermal not PV technology is required.

Solar-thermal
Solar Panels, also known as solar-thermal "collectors", use the sun's heat to warm water, or another liquid, as it is passed through the panel. The warmed fluid then progresses to a heat store (at the simplest level a hot water tank) supporting the provision of hot water or space heating via a central heating system. Solar thermal collectors will work throughout daylight hours, even if the sky is overcast and there is no direct sunshine.

Critical Factors in assessing the applicability of solar-thermal: -

Solar thermal technology comes in two varieties - flat plate and evacuated tubes - and will potentially generate around 50-60% of a buildings hot water requirements pollution and noise-free over the year; in summer months the output will be greater with either system. The Department of Trade and Industry estimate that half the existing UK housing stock could easily be fitted with solar hot water panels.

Flat plate collectors are the simplest form and generally have a lower efficiency than evacuated tube systems that may require location over a larger surface area to meet demand. They are constructed from sheet metal painted black (encouraging absorption of the suns energy) and housing coiled piping attached to the sheet panel that picks up the heat from the metal. The unit is set in an insulation box covered with glass or clear plastic at the front reducing heat loss and exposure, the pipes are generally copper improving conduction and in the UK climate pipe work contains non-toxic anti-freeze (glycol). The hot liquid passes through transfer piping which passes through the water storage system loosing its heat load before returning to the collector.

Evacuated Tube collectors: are more efficient systems, which rely on the grouping of highly insulated vacuum tubes, reducing heat loss from the absorption surface.

- Optimum systems size should be calculated using software to simulate system performance throughout the year. Typical UK domestic installation uses a flat plate panel of 3 to 4m^2 or evacuated tube system 2m^2 connected to a storage tank of 150- 200L, at the other end of the scale solar-collectors are being used for large scale water heating in swimming pools and leisure centres. Over-sizing of domestic systems is unlikely to justify the greater investment in additional energy savings.
- During the summer months modern systems can be so efficient that the hot water may run too hot, creating a risk of scalding. To protect the young and old who are most vulnerable and reduce this risk the installation of thermostatic mixing valves as part of the system approach should be considered.
- The system will usually require the installation of a new large hot water cylinder. Vented cylinder systems work with a cold pressure cistern systems housed in the loft. Mains pressure (un-vented) cylinders and thermal store cylinders ensure hot water is maintained at the same pressure as the mains supply allowing, for example, the running of power showers without additional pumping.
- Costs for professional installation vary significantly and independent advice should be sought to ensure the best system for the situation and value for money. Collectors should have been independently tested for thermal performance (to BS EN 12975 or BS EN 12976 standards) and suppliers should provide this information. The Clear Skies website (www.clear-skies.org) or scheme help-line on 08702 430 930 is a good first point of reference.

Design and Permissions

- The Local Authority Planning Department should be contacted prior to the installation of collectors or PV if there are proposals to install in conservation areas.
- Installation must comply with safety and buildings regulations.

Solar Exemplars
The Region already has some of excellent examples of the use Solar PV and Solar thermal

Large Scale
Primrose Hill Solar Regeneration Initiative, Newsome, Huddersfield
PV and solar thermal installation on 121 new and existing houses commenced in March 2005 on existing properties and new build in late 2005. On completion this will be one of the largest comprehensive solar installations in the country delivered as part of an overall regeneration plan for the Primrose Hill area. Combined capacity will deliver 76,706 kW/yr PV
108,990 kW/yr Solar Thermal creating annual savings of 33 tonnes of CO2 and £4,985.90 PV (@6.5p/kWh) from avoided electricity import.

Medium Scale
Titanic Mill CO_2 neutral development, Linthwaite, Kirklees
Mill conversion to luxury apartments project incorporating a roof mounted 50kWp solar PV system generating 38,115 kW/yr, saving annually 16 tonnes of CO_2 and £2,401 (@6.3p/kWh) in avoided electricity import. It is also proposed that the Mill uses hybrid sourcing through biomass, to make the development carbon neutral once completed.

Fieldside Place, York?

Small Scale

For more Information:-

Solar Trade Association's website at www.solartradeassociation.org.uk

PV-UK The Photovoltaics Industry Trade association www.pv-uk.org.uk

For UK PV grants; www.solarpvgrats.co.uk

Clear skies for; general information about Solar Collectors and PV systems, and, individual and community grant support for installing Solar Collectors and PV systems www.clear-skies.org

Wind

People have wind energy as basic mechanical power for grain milling and water pumping for centuries. Wind **turbine** technology harnesses the energy of the wind more fully to generate electricity for export to community networks, the grid or single applications.

Wind Energy is used across a broad spectrum of applications in the UK from the charging of small battery systems producing electricity remote from the distribution network, to large multi-turbined **wind farms** producing electricity on the scale of conventional power stations.

Wind turbine systems comprise of ;

- A set of blades - most commonly three - mounted on a horizontal axis with a rotation pivot which will move the blades to capture the most favourable directional force.
- The blades are connected by a rotor shaft, either directly to an electrical generator, or to a generator via a gearbox for larger turbines.
- The electricity generated in small systems tends to be direct current (DC) which can be stored in batteries but needs to be run through an inverter or DC/AC converter producing Alternating Current for domestic circuit use.

Critical Factors in Assessing the Applicability of Wind power: -

- Low cost electricity can be produced the windiest sites for as little as 2 pence per kWh, comparing more than favourably with increasingly costly electricity from conventional sources. Typical wind powered electricity costs between 2p/kWh and 10p/kWh dependant on scale and location.
- Wind power produces no pollutants or emissions during operation and modern designs are generally quiet. Energy used in the manufacture of the system is repaid within 3-9 months of operation.
- The near silent operation of modern designs is described as causing less noise than the wind in the leaves of a tree. Gearbox free turbines are always best for noise sensitive environments. Local Authorities are required to assess[3] aerodynamic noise from installations such as wind turbines and ensure that they are located and designed in such a way to minimize these. (Planning Policy Statement 22: Renewable Energy)
- Small wind turbines can be situated on the top of buildings or towers in the built environment to capture the increased wind speeds at higher levels; these must be very securely mounted however as strong gusts and turbulence will otherwise cause vibration of the turbine increasing wear. The advice of a structural engineer regarding mounting implications should be sought.
- Land used for situating turbines does not diminish in agricultural value and both short and long term job opportunities are created in the building and maintenance of turbines.
- Wind systems may be perceived as visually impacting upon the environment, whilst this is less likely to be a valid objection with small scale applications in built environments it is still the most contentious aspect in locating wind farms.

Design and Permissions: -

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[3] The 1997 report by ETSU for the Department of Trade and Industry should be used to assess and rate noise from wind energy development this is available at http://www.dti.gov.uk/energy/renewables/publications/noiseassessment.shtml

The Local Authority Planning Department should be contacted prior to the installation of turbines as they will wish to consider proposals in respect of their relationship to conservation areas or areas of outstanding natural beauty.

Local Planning Authorities should not treat wind turbine proposals prohibitively, issues of impact on air-operations and separation distances from power-lines, roads, and railways should be addressed by the developer before submitting planning applications and not included in local authority policy. (Planning Policy Statement 22: Renewable Energy)

Installation must comply with safety and buildings regulations.

Wind Exemplars: -

For more Information:-

The British Wind Energy Association – the largest renewable energy trade association in the UK - for; more information about wind power and a list of suppliers, www.bwea.com

Clear skies for; general information about turbine systems, and, individual and community grant support for installation www.clear-skies.org

Other

Biodiesel is primarily applicable to transport at the present time. Most car manufacturers will support a blend of 5-10% Biodiesel and 95-90% fossil diesel and this is increasingly available in petrol stations, blends can match conventional fuel performance in most cars without engine adaptation and consequently the market place availability of these new fuels is expanding.

With minimal cost engine modifications, filtered vegetable oils can also be used as effective fuel for diesel powered engines; modification kits are now readily available for DIY or garage adaptation and don't stop the engine running on fossil diesel if necessary. Biodiesel can also be prepared from used vegetable oils (from industrial food processing, restaurants etc.)

For more information: -

British Association for Bio Fuels and Oils (BABFO) – the trade body for producers: www.biodiesel.co.uk

Veg Oil Motoring: www.vegoilmotoring.com

For Biodiesel retailers: www.biodieselfillingstations.co.uk

For suppliers of Biodiesel: www.rixbiodiesel.co.uk
or www.broadlandfuels.co.uk

Or if your thinking of making your own: www.lowimpact.org

Geothermal energy takes the form of heat rapidly conducted from the earths molten core to reservoirs within 10K of the earths surface. This may naturally create, or be used to create, superheated steam powered generation and hot water and space heating for community networked industrial, agricultural and domestic application. Geothermal offers huge global energy supply potential and already powers plants in Italy, the USSR New Zealand and the US. Iceland's capital city Reykjavik sources 95% of its buildings heat requirements from geothermal springs supplying 86℃ heated water. Unlikely application to York's and the Humber.

Combined Heat and Power (CHP[4]) is not in and of itself a renewable energy source, CHP units were originally designed to maximise efficiency in fossil fuel firing, using natural gas, commercial grade oils and coal. Increasingly however CHP is used to maximise the energy potential of co-fired plants, waste to fuel systems and biomass combustion. The latter application being totally renewable, in this application CHP delivers the double bonus of creating significant reductions in greenhouse gas emissions additional to the carbon neutral primary sourcing.

The application of Combined Heat and Power improves the efficiency of traditional combustion power generation by reclaiming the heat produced as a by-product of electricity generation; as little as 35-50% of the energy value of fuels used in large power stations are converted to power. Diverting the reclaimed heat load through CHP systems for local space heating requirements raises the useable energy value of the primary fuel source by another 35-40%. CHP systems will also reduce the amount of primary fuel required for heating and electricity generation by around 35% and cuts in overall CO_2 emissions of 30% may also be expected.

The core components of a CHP system are;

- A fuel feed to a prime mover the combustion engine driving the generator and creating the heat source; in larger systems one or more prime movers usually driving electrical generators
- The generator itself producing electricity, coupled to the prime mover
- A heat recovery system processing heat from generator exhaust and the generator itself through a radial exchange cycle cooling system.
- Heat generated in the process is usually piped away into the equivalent of large-scale community or district radiator systems for space heating.

Critical Factors in Assessing the applicability of CHP: -

Primary considerations are the same as for biomass in respect of;

- Secure local availability of the fuel choice
- Permissions for chimney height and the appearance of the plant and measures for the mitigation of air pollution.

[4] Sometimes described as 'cogeneration' or 'total energy', particularly in the United States or European Union

The economic benefits of retro-fitting CHP – particularly when an old boiler system needs replacing for example - for smaller scale single user applications are well understood, in 2002 43% of UK CHP schemes had an installed electrical capacity of less than 100 kWe[5].

CHP at medium to large scale requires the co-development and installation of community heating network infrastructure lending itself well to the redevelopment of urban sites, new community build or rural cluster expansion.

- Higher build densities and layouts reduce the pipeline lengths servicing buildings thus reducing loss between point of heat production and delivery. Layouts of 40 to 45 dwellings per hectare have been suggested.
- Combined industrial and residential uses including hospitals and schools have been proven to successfully spread heat demand over different time periods making for better use of the output.
- A base with facilities for the CHP plant engineering, operations and maintenance staff will be required and including one major institution – i.e. government offices, a leisure centre or a hospital - may help provide this.
- Surplus power may be sold back to the grid.

Design and Permissions: -

See biomass

For more Information:-

www.cibse.org/chp

Information about micro-CHP which is expanding in the UK ;
www.microchp.co.uk

Hydrogen Fuel Cells are electrochemical conversion units which change oxygen and hydrogen into water producing electricity and heat during the process. The cells do not need recharging and will run constantly so long as they are fed oxygen and water.

Obtaining sufficient Hydrogen to feed the cells is done by splitting oxygen of from water molecules through electrolysis and this requires a power supply which will only make a fuel cell use renewable if the primary energy source is. The obvious benefit of renewably powered fuel cell technology is that the only by product is water.

Fuel cell technology is still at demonstration stage and therefore too costly and under tested for wide scale recommendation, wider scale commercialization is anticipated by 2010.

For more information: -

[5] DTI's Digest of UK Energy Statistics 2002

The Department of Trade and Industry website for independent information www.dti.gov.uk/energy/renewables/technologies/fuel_cells.html

Renewable Energy Standards, Policy and Legislation

Subsection of the Renewable Energy Chapter introducing policy framework containing the following information;

Local Context

The (*Local Authority)* (*add where applicable* Energy Strategy, Fuel Poverty Strategy, Climate Change Strategy, Environment Strategy) and vision place a strong emphasis on low energy design, the promotion of renewable energy and increased sustainability within the (*Local Authority)*.

The (*Local Authority)* Local Plan now (check) places requirements on most developers to demonstrate that they have fully considered the use of renewable energy technologies and the possibility of connecting to a community heating network system based upon CHP (*policy/policies???? see Appendix (X) consider Hyperlink for web based versions*). Energy efficiency issues must also be considered in the design process (*policy ???? see Appendix (X) consider Hyperlink for web based versions).*

Planning Policy Statement 22: Renewable Energy

States that;

1. **Developers** of renewable energy projects should engage in active consultation and discussion with local communities at an early stage in the planning process, and before any planning application is formally submitted.

2. **Local Development Documents should** contain positively expressed policies **designed to promote and encourage**, rather than restrict, the development of **renewable energy resources**. These should incorporate;

- Targets – which may be regionally devolved - for renewable energy projects in all new developments and some existing buildings, requiring a percentage of the energy to be used in new residential, commercial or industrial developments to come from on-site renewable energy developments. Such policies:
  - should ensure that requirement to generate on-site renewable energy is only applied to developments where the installation of renewable energy generation equipment is viable given the type of development proposed, its location, and design;
  - should not be framed in such a way as to place an undue burden on developers, for example, by specifying that all energy to be used in a development must be from on-site renewable generation.

Nb: Many Local Authorities are incorporating targets at levels above the recommended 10% by 2010 and 20% 2020 and/or at intervals interim to the basic targets to encourage more rapid assimilation of renewables into the locality.

- Only focus on the key criteria that will be used to judge applications. More detailed issues may be appropriate to supplementary planning documents.
- The specific requirements of renewable energy developments in both urban and rural areas.
- Recognise that some previously developed sites, whilst being unsustainable in terms of other land uses (e.g. a site in a remote location unsuitable for housing) may offer opportunities for developing some forms of renewable energy projects.
- The minimisation of visual effects (e.g. on the siting, layout, landscaping, design and colour of schemes
- Local Strategic Partnerships should foster and promote community involvement in, knowledge and greater acceptance by the public renewable energy projects
- Create criteria based policies which set out the circumstances in which particular types and sizes of renewable energy developments will be acceptable in nationally designated areas. Small-scale developments should be permitted within areas such as National Parks, Areas of Outstanding Natural Beauty and Heritage Coasts provided that there is no significant environmental detriment to the area concerned.
- Only allocate specific sites for renewable energy in plans where a developer has already indicated an interest in the site, has confirmed that the site is viable, and that it will be brought forward during the plan period.

Local Development Documents should not;

- Create planning policies ruling out or constraining the development any type of renewable energy technologies in any given location without sufficient reasoned justification. Government may intervene in the plan making process where it considers constraints proposed by local authorities are too great or poorly justified.
- Set arbitrary limits on scale of installations and noting for instance that visual impact may only be temporary if conditions are attached to permissions which require the future decommissioning of the installation
- Create “buffer zones” around international or nationally designated areas and apply policies to these zones that prevent the development of renewable energy projects
- Make assumptions about the technical and commercial feasibility of renewable energy projects. Technological change can mean that sites currently excluded as locations for particular types of renewable energy development may in future be suitable.
- use a sequential approach in the consideration of renewable energy projects (giving for example priority to the re-use of previously developed land for renewable technology developments) but encourage renewable

energy resources where ever the potential resource exists and will be economically feasible.

When dealing with Planning Applications Officers should;

- Recognise that 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.
- Deal with the visual effects of installations on a case by case basis according to the installation type location and the landscape setting using objective assessment
- Give careful consideration to the visual impact of projects, located in the green belt, and encourage developers to demonstrate that projects clearly outweigh any harm by reason of inappropriateness; including wider environmental benefits associated with increased production of energy from renewable sources.
- Only grant permissions for renewable energy projects in sites with nationally recognised designations where they demonstrate that the objectives of designation in an area will not be compromised, and that any significant adverse effects on the qualities for which the area has been designated are outweighed by the environmental, social and economic benefits.
- Consider if the renewable energy project would have an adverse effect on an internationally designated nature conservation site (Special Protection Areas, Special Areas of Conservation, RAMSAR Sites and World Heritage Sites), permission should only be granted where there is no better alternative solution and there are imperative reasons of overriding public interest, including those of a social or economic nature.
- Assess planning applications against specific criteria set out in regional spatial strategies and local development documents, ensuring that such criteria-based policies are consistent with, or reinforced by, policies in plans for assessing other issues for renewable energy applications.

When dealing with Planning Applications Officers should not;

- Use local landscape and local nature conservation designations in themselves to refuse planning permission for renewable energy developments.
- Reject planning applications simply because the level of output is small.

Further guidance on the framing of such policies, together with good practice examples of the development of on-site renewable energy generation, are included in the companion guide to PPS22.

Regional context

A Regional Energy Strategy for Yorkshire and the Humber is currently being drafted. The Regional Policy Statement setting renewable energy targets for the region has been published (*see Appendix (X) consider Hyperlink for web based versions)*. The Regional Spatial Strategy incorporates an energy hierarchy highlighting the regions priorities, these are;

- Reducing the Need for Energy
- The Conservation of Energy
- The Generation of Energy from Renewable sources.

These priorities will need to be implemented through the development planning process.

Planning Policy Statement 22: Renewable Energy
States that the **Regional Spatial Strategy should include;**

- Set targets for renewable energy capacity in the region to be achieved by 2010 and by 2020. Targets should be expressed as the minimum amount of installed capacity for renewable energy in the region expressed in megawatts and possibly additionally in terms of the percentage of electricity consumed or supplied.
- Where appropriate, targets in regional spatial strategies may be disaggregated into sub regional targets, possibly giving a broad indication of how different technologies could contribute towards regional targets. Specific technologies should not be given fixed targets such that technological change may make new sources of renewable energy more applicable in the longer term.
- Monitoring of progress towards achieving targets and regular review and revision of targets upwards should be by regional planning bodies. The fact that a target has been reached should not be used as a reason for refusing planning permission for further renewable energy projects.
- Criteria based policies applicable across the region, or clearly identified sub-regional areas. These should be used to identify broad areas at regional/sub-regional level where development of particular types of renewable energy may be considered appropriate.

National Context

The UK has committed to reducing the 1990 level of CO_2 emissions by 20% by 2010 and 60% by 2050.

The Energy White Paper '*Our energy future – creating a low carbon economy'* reminds us that whilst our demands for primary energy are still increasing our levels of self reliance on coal, gas and oil are declining and by 2020 we could be dependent on imported energy for three quarters of our total primary energy needs. The paper also suggests that the best way of maintaining energy reliability will be through energy diversity. To help us avoid over-dependence on imports, the paper suggests that by 2020 there will be;

- Much more local and community generation from sustainable sources
- Increasingly stringent efficiency standards for buildings and electrical goods

- An increasing number of Zero CO_2 Standard homes and business premises.

In January 2005 national government[6] published its Low or Zero Carbon Energy Sources – Strategic Guide (Interim Publication), outlining the principal reliance will come to depend upon renewables sources and their performance levels.

The Utilities Act 2000 obliges electricity and gas suppliers to achieve energy efficiency improvements and for electricity suppliers to purchase a minimum 10% of their supplies from renewable sources.

Planning

Revisions to the Planning Policy Statement 22 on Renewable Energy (incorporated under the local and regional sections above) now make clear that the wider benefits of renewable energy developments are material considerations in the approval of planning permissions.

European Context

EU Directive on Energy Performance of Buildings: Directive 2002/91/EC of the European Parliament and Council, on the energy performance of buildings, came into force on 4 January 2003 and must be adopted into UK legislation by January 2006. It will greatly affect awareness of energy use in buildings. All new buildings must meet the minimum energy performance requirements. For those with a useful floor area over 1000 m2 governments must ensure that, before construction starts, formal consideration is given to the following alternative systems for heating:

- CHP
- district or block heating or cooling
- heat pumps
- decentralised energy supply based upon renewable energy.

Governments must ensure that, whenever an existing building with a total useful floor area of over 1000 m^2 undergoes major renovation, its energy performance is upgraded

International Context

By becoming a signatory nation of the 1997 Kyoto Protocol the UK has signed up to a legally binding target of reducing greenhouse gases as a whole by 12.5% by 2008-12. In line with the advice of the Intergovernmental Panel on Climate Change (IPCC) the UK must aim for a reduction of 60% in CO_2 emissions by 2050.

[6] Office of The Deputy Prime Minister

It will be impossible to achieve such targets without developer maximising the integration of energy from local renewable sources where ever possible**.** This might include solar space and water heating, solar electricity generation (photovoltaics), wind power, biomass fuel and other sources of energy.

Voluntary Standards

In addition to all the legislative standards there are also some voluntary standards that developers are increasingly choosing to meet. The Energy Efficiency Best Practice Programme offers a set of standards for sustainable homes, these include;

- **Zero CO_2 Standard**. When energy demand is reduced as far as possible and you have replaced as much fossil-fuel use as possible with renewable energy, you may be able to create a 'zero CO_2' development. This may be achieved by buying electricity on a 'green' tariff from a company supplying renewable energy. If you use any non-renewable energy - eg, gas for cooking, you will need your own renewable electricity-generation capacity large enough to export sufficient power to the grid in any year to compensate for the CO_2 emissions associated with importing non-renewable energy.
- **Zero Heating Standard**. If, in addition to the Zero CO_2 Standard, you can obtain all your heating from passive solar gains and internal gains from the occupants, then you will have achieved the higher 'zero heating 'standard.
- **Autonomous Standard**. If, in addition to the Zero Heating Standard, you can obtain all your services from on-site resources, then you will have achieved an 'autonomous' standard. A grid-linked electricity system can be used as long as it is a net exporter rather than user of power.

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