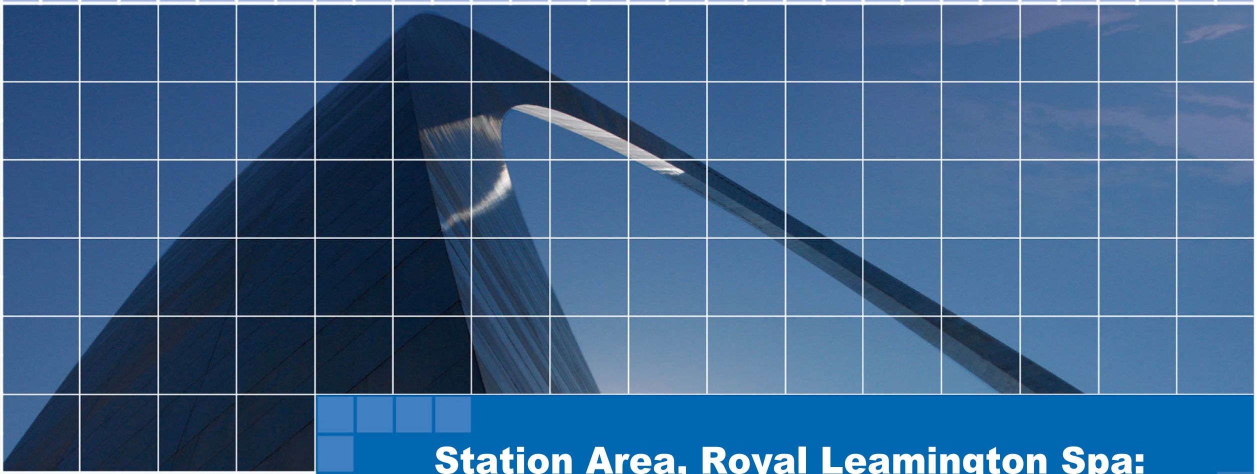

Station Area, Royal Leamington Spa: Low/ Zero Carbon Technologies Appraisal

Warwick District Council

May 2008

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Contents

1 Introduction

1.1.1 This briefing document outlines recommendations for on-site renewable and low carbon energy generation and energy efficient design for the proposed development of the Station Area, Leamington Spa. It is a strategic level appraisal using the final masterplan and seeks to identify which technologies are potentially most suitable for the redevelopment.

Planning Policy

1.1.2 The most relevant local and national planning policy has been summarised below. This is not intended to be an exhaustive list but rather the main policies relating to energy and energy efficiency.

Warwick District Council Local Plan

1.1.3 Policies DP12 and DP13 relating to Energy Efficiency and Renewable Energy have been considered within this document.

1.1.4 Policy DP12 promotes sustainability in the layout and design of a development and specifically the following issues

- opportunities to maximise passive solar gain, minimise heat loss and wind tunnelling and eddying;
- opportunities to limit overshadowing of buildings to minimise loss of useful solar gain;
- opportunities for landscaping to provide shelter belts to improve energy conservation;
- the use of materials with a reduced energy input, such as recycled products; and
- the use of sustainable and renewable forms of heating such as solar panels and CHP (Combined Heat and Power) schemes.

1.1.5 Policy DP13 relates to the provision of renewable energy and contains the following target:

- In appropriate residential and non-residential developments, including conversions, the Council will require 10% of the predicted energy requirements to be produced on site, or in the locality, from renewable energy resources.

Supplement to Planning Policy Statement 1: Planning and Climate Change

1.1.6 This supplement to PPS1 places more emphasis on creating communities with the supporting infrastructure and technologies to reduce carbon emissions and promote a sustainable approach to living. Of particular relevance is the desire to promote the development of decentralised systems providing heat, power and cooling on a local basis thereby instantly removing the inefficiencies of high voltage, long distance energy transmission.

Planning Policy Statement 22: Renewable Energy

1.1.7 The document states that developments should provide at least 10% of their energy via renewable sources with a target of 20% by 2020. The document lists these sources and provides guidance as to how the 10% contribution can be met. The document also presents an energy hierarchy to provide an indication of how energy should be sourced in a development. The policy supports the move toward decentralised energy through the development of district heating and power systems.

Issues Considered

1.1.8 With regards to the issues appraised within this report the following areas have been examined:

- Energy efficiency
- Low carbon energy generation
- Renewable energy technologies
- Water efficiency
- Waste

1.1.9 This report aims to provide recommendations for the development it is not intended to be a detailed assessment of each technology. We would recommend that a further detailed assessment of the recommended technologies be undertaken by the developer.

2 Site Energy Demand

2.1.1 This section describes the potential energy and carbon profiles of the Station Area development for the baseline scheme and compares them with established benchmarks. Anticipated energy demands consistent with Building Regulations Part L 2006 are in Table 1 below:

Table 1: Benchmarks

Accommodation	**Fossil Fuel** Benchmark (kwh/m^2 pa)	**Electricity** Benchmark (kwh/m^2 pa)
Hotels	300	90
Education	100	67
Technology park	97	128
A3 (assumed with bar)	1100	650
Commercial (office)	97	128
Light Industrial	96	-
Retail	300	55
Residential	75	45
Car parking; bus pick up and parking; taxi rank	0	1
Landlord Circulation Areas	0	15

2.1.2 The baseline energy consumption profile, that is the heat and power that the development may use over the course of a year is very approximate at this stage and is intended as a guide only. This will then enable the next step to be taken – to evaluate the benefits of introducing additional energy efficiency and sustainable energy options. The development is mixed use, consisting of the following elements based on the Masterplan.

Table 2: Indicative Area Schedule:

Accommodation	Area (m^2)
Hotels	15,500
Education	12,400
Technology park	12,400
A3 (assumed with bar)	1,655
Commercial (office)	28,055
Light Industrial	5,300
Retail	155
Residential	30,450
Car parking; bus pick up and parking; taxi rank	12,225
Landlord Circulation @ <10%	9,500

2.2 SUMMARY OF SITE LOADS

2.2.1 The figures below summarise the estimated energy demand from the proposed Station Area development, assuming compliance with Part L of Building Regulations Part L (2006). With appropriate additional passive design measures the energy performance can be improved.

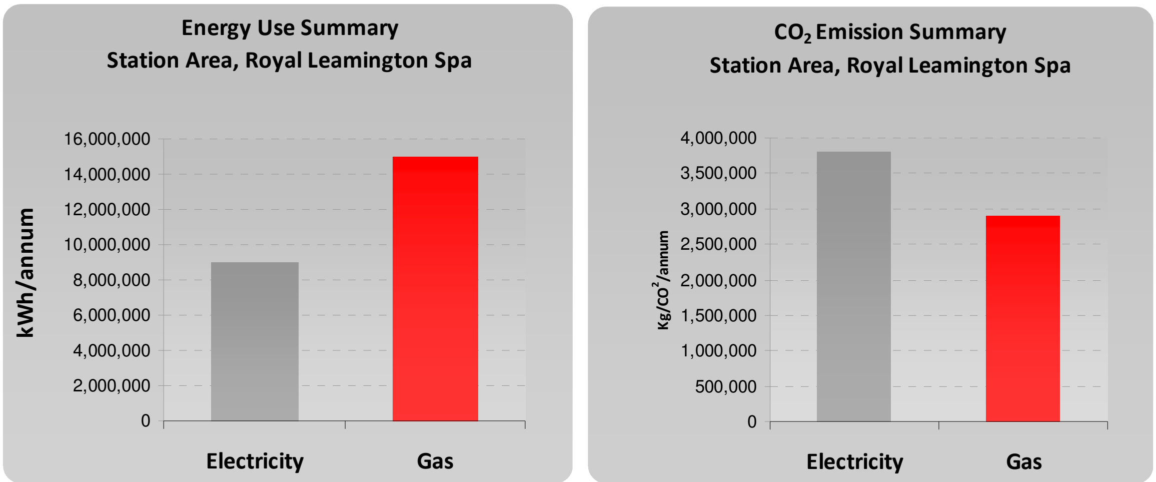

Figure 1: Energy use and carbon emissions summary for potential site gas and electricity consumption

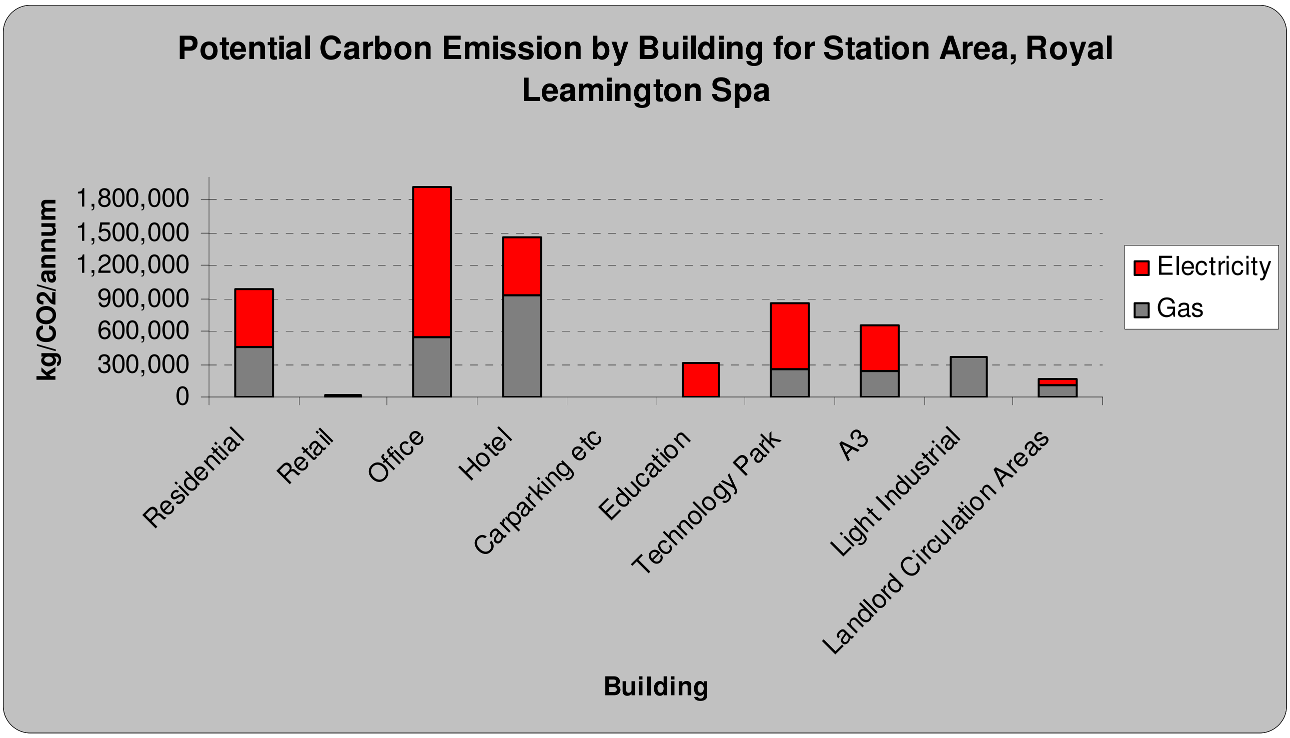

Figure 2: Potential Carbon Emissions by Building for Station Area, Royal Leamington Spa.

3 Energy Efficiency

Background Methodology towards Energy Efficiency

3.1.1 To reduce the energy use of the buildings below Building Regulation requirements and in line with local policy DP12, the developers will be expected to promote good design practice incorporating the following principles. It should be noted that it is important in the first instance to reduce energy requirements by initially implementing energy saving measures where practically possible.

Step One

Initial energy demand reduction via passive measures to the dwelling envelopes:

- Reduce the air permeability of the building envelope;
- Decrease the U-Values of external walls to 0.25 and windows to 1.5 W / m^2K

Step Two

Initial energy demand reduction via systems by implementation of low-cost energy-efficient measures such as:

- Selecting boilers with high efficiency e.g. SEDBUK A rated.
- Delayed-start controls
- Zone time and temperature control to heating system for different parts of the building
- Timed and thermostatic control to hot water system
- Passive design to encourage daylighting and reduce artificial lighting demand
- Thermal design to reduce overheating and the need for chillers

Step Three

Robust supply strategy by combining efficient delivery of energy with low and zero carbon technologies:

- Installation of on-site renewable energy sources.
- Use of shared site-wide infrastructure such as CHP; district heating systems.

BREEAM and Code For Sustainable Homes

3.1.2 Achieving a Code for Sustainable Homes (2006) Level rating of 4 and BREEAM Green Office standard will have the effect of also being in line with the West Midlands Regional Sustainability Checklist section *Climate Change*: Cooling; Heat Island; Water Efficiency; Sustainable Energy (both in terms of energy efficiency and installation of renewable technologies). The *Buildings* section of the Checklist "to ensure that individual buildings underpin the sustainability of the development" via specified BREEAM, is also achieved via the BREEAM Green Office standard. The *Resources* section regarding Water Resource Planning; Water Efficiency in Use and Refuse Recycling are also achieved via the Code rating of 4 and BREEAM.

Impact of Improved U-Values

3.1.3 The external envelope of a building can have considerable impact on the energy performance. The basic function sought from optimum fabric design is to protect against the unwanted effects of the external environment whilst allowing the maximum benefit that can be achieved from the positive impacts. Envelope design for the proposed Station Area development should include full consideration of glazing area, glazing type, shading, building mass and insulation, air-tightness and infiltration.

3.1.4 For instance, by optimising the building envelope for the residential, educational; hotel; and commercial areas, significant reductions can be made in the amount of heating required in winter and will also reduce the amount of cooling required in summer, particularly as summer temperatures increase in the UK.

3.1.5 Consideration of U-values and the above efficiency measures are also in line with Policy DP12 in minimising heat loss and heat gains and the *Climate Change* section the West Midlands Regional Sustainability Checklist with regard to Sustainable Energy: “ to increase the overall efficiency of the development through energy efficiency design and management.”

4 Low Carbon Options

4.1 COMBINED HEAT AND POWER (CHP)

4.1.1 CHP is not a renewable source, unless it is powered by biofuels. It is included here as it can be a significant step to reducing carbon emissions by reducing the amount of electricity imported from the utility supplier. An outline of the technology can be found at Appendix B. National electricity generation and distribution is only about 35% efficient and consequently it has a relatively high carbon content compared to natural gas generation.

4.1.2 CHP is effectively a mini power station generating heat and electricity on site. The power and heat can serve a single building or site, although there are examples of them serving whole towns. For the system to be economical, it must be possible to use the full output of both electricity (power) and heat; that usually means sizing the plant below the peak demand of both heat and power.

4.1.3 The heat can be stored quite simply, and as such, it is usually possible to make a scheme cost-effective provided that the hot water produced as a by-product of the electricity generation can be used within a few days. Demand profiling is therefore an important factor in the sizing of a CHP system. For example, it is unlikely to be cost effective to size the plant on the basis of space heating requirements when there are no space heat losses for several months of the year. Usually a CHP plant is sized on the basis of the domestic hot water demand, or for swimming pools, laundries or industrial processes.

4.2 COMBINED COOLING, HEATING AND POWER (CCHP)

4.2.1 Mixed use schemes such as this where offices are included can typically have a high demand for cooling due to heat gains from the employees and lighting in the units. This is traditionally met by electrically powered cooling units installed individually by each tenant. Coupled with lighting loads this creates a high electrical demand that can often exceed the heating requirement. One solution to this is the use of CCHP which generates on-site electricity using gas-fired engines or turbines. This also generates large amounts of high grade waste heat which can be used in heating and, via the use of absorption chillers, cooling. The complete process is approximately 80% efficient by utilising both the generated electricity and the free heat produced. This means that carbon emissions from such a scheme could be significantly less than from a scheme using conventional electrical supplies.

4.2.2 An absorption chiller uses heat to power the refrigeration cycle rather than an electric compressor. Using heat off an electrical generator, two-stage absorption chillers can achieve CoPs of up to 0.7 – for example, for every 1000 Watts of waste heat, 700 Watts of cooling can be delivered.

4.2.3 Additional carbon savings can be made by use of absorption/adsorption chillers; however this can be expensive for the carbon savings produced.

4.3 DISTRICT HEATING

4.3.1 The use of a centralised heating and domestic hot water system requires a central servicing strategy to provide the hot water and heat to each property within the development. This is typically termed community, or district heating. The district heating plant essentially works like a large scale domestic central heating system and could offer hot water for providing both space heating, domestic hot water and optional chilled water for cooling via an absorption chiller should there be a demand for local commercial premises. CHP technology is often used in site-wide strategies with the heat distributed within a loop which runs around the site, allowing connection to all areas with a heat demand.

4.3.2 Usually, in such systems, the hot water provided is circulated through an underground network via well insulated pipes. Typically, customers are connected to the network via a pair of pipes with isolating valves, differential pressure regulation and a heat meter. These replace a conventional boiler. Radiators are fed directly from the pipe network and domestic hot water is produced via heat exchangers connected to the pipes. Occupants could either pay a service charge for the heat used or can be separately metered on their use.

4.3.3 Such a scheme would help achieve the West Midlands Regional Sustainability Checklist's requirement for an energy management scheme under *Site Infrastructure.*

4.4 ENERGY SERVICES COMPANY (ESCo)

4.4.1 There are many possible variations of how an Energy Services Company (ESCo) will operate, each related to particular projects. In broad terms an ESCo will provide heat and power to a development for an agreed revenue income. Additional utility services might be provided. The complete package can include:

- the provision of energy infrastructure (pipes and cables)
- all equipment necessary to deliver the service such as a power generation or heating equipment
- the financing of the capital investment
- the expertise needed to maintain the equipment

4.4.2 Some ESCos will provide capital funding for the scheme, up to 100% of the additional cost of the integrated energy solution, in return for an energy supply contract. The size of the capital contribution will depend on the available revenue streams. Some ESCos also provide WiFi services which increase the revenue streams and therefore the potential proportion of capital contribution. A detailed feasibility study should determine these costs and investments.

4.4.3 Tenants benefit from lower energy costs, planning and building regulations are satisfied and the ESCo takes responsibility for metering and collecting revenues.

4.4.4 Energy Service Companies are vehicles for the procurement of energy services which can include any or all of the following:

- Project design
- Capital finance
- Construction
- Management
- Fuel purchase
- Billing
- Plant operation
- Maintenance
- Long-term replacement and risk management

4.4.5 ESCo's are typically used to provide capital finance on long-term profitable energy supply contracts.

4.4.6 The main benefit of using ESCo's to deliver schemes is the establishment of predictable and competitive cost benefits. The energy costs of the scheme are fixed in advance and the ESCo will usually finance the scheme taking the risk on any capital cost overrun. The ESCo will usually also be responsible for meeting all of the plant operation and maintenance costs. The charges that the ESCo makes for the energy consumed will be determined at the outset. Over the contract term these charges will be varied only in line with agreed indices, ensuring parity with alternative energy costs and the maintenance of best value.

4.4.7 ESCo's can also provide a wide range of services and works to improve the energy efficiency of the buildings served by the scheme. This may include the provision of building energy management systems (BEMS), contract plant operation and maintenance or energy efficiency advice. An ESCo would also be responsible for certifying CHP plant under the QA scheme and obtaining tax and business rate concessions.

4.4.8 A typical contract would be set up for the long-term - 15 to 25 years - to ensure that it is attractive to potential investors. A full whole life cost analysis will be made and included in the Tender package. There can be no compulsion on third parties to purchase electricity, heat and cooling from the ESCo and therefore the ESCo must be in a position to supply at an advantageous price ensuring long-term commitment from the purchasers.

4.4.9 An example of a scheme that has been in operation for several years in the West Quay shopping centre in Southampton, details of which can be found at the Energy Saving Trust website.

5 Renewable Technologies

5.1 BACKGROUND

5.1.1 This section is a brief overview of the renewable energy technologies which may feature in the proposed development in the Station Area site. The technologies considered include:

- Wind
- Biomass Heating
- Biomass CHP
- Solar Hot Water
- Photovoltaics
- Ground Source Heat Pumps
- Ground Water Abstraction

5.1.2 Adoption of renewable technologies not only helps to comply with Code level 4 but is also in line with the West Midlands Regional Sustainability Checklist's requirement for the use of sustainable energy under *Climate Change* and local policy DP13. A brief review of each technology can be found at Appendix D

5.2 WIND

5.2.1 The parcel of land is bounded by the railway viaduct and Grand Union Canal. A large part of the proposed development directly to the North and to the South is edged by residential premises; indeed the site itself will comprise dwellings and as such noise and flicker from wind turbines could be a significant nuisance. It is considered good practice that wind turbines should be at least 500m away from any residential property. The surrounding existing buildings will also cause turbulence of flow and affect any efficiency of the prevailing winds in relation to the turbine performance. The local wind speed from information gathered from the BERR database[1] suggests that wind speeds are viable but in view of the residential element of the proposed development and proximity of surrounding dwellings, the inclusion of wind turbines are not recommended for this site.

5.2.2 Victoria Park exists to the North of the site sandwiched between the railway and the River Leam and a recreation ground to the South but even these locations are not considered viable for a stand-alone turbine due to proximity of residential property; surrounding buildings and obvious impact on the landscape which may encounter local objection.

5.2.3 Building-integrated turbines in the proposed Station Area development are also, for reasons stated above and including visual impact, not recommended for inclusion in this site.

5.3 BIOMASS HEATING

5.3.1 Biomass can be installed in central plant or individual dwellings. However, it is recommended to install on a central plant basis for this site due to fuel sourcing issues for individual home owners. If biomass is considered, the proposed development would require use of a central energy centre within the development (as outlined above) and this centre would have to have suitable access and space available to incorporate the requirements of biomass storage and delivery. A landlord responsible for the energy centre is likely to be a sensible option and would have an on-going maintenance commitment and it would thus be likely that a service charge to the tenants would be necessary. A long-term reliable fuel source would also be required and there would be a boiler flue rising through the building containing the energy centre. It should be noted that due to the Air Quality Management Area (AQMA) to the East of the site, it is likely that biomass would not be a suitable form of technology due to the emissions it creates and the prevailing South–westerly winds, without the addition of flue-scrubbing equipment.

[1] BERR Wind database available from: http://www.berr.gov.uk/cgi-bin/nre/noabl1.pl Accessed 02.04.08

5.3.2 Due to the urban environment; difficulty with delivery and storage requirements of biomass heating and the impact on the AQMA; it is not considered suitable for site-wide inclusion. However, it should be investigated for part of the site for its contribution to achieving ten percent energy from renewable technology.

5.4 BIOMASS CHP

5.4.1 Biomass CHP technology is more expensive than biomass heating; requires greater maintenance; and also has the inherent impact on the AQMA outlined above. It is also not as efficient at this scale and therefore it is not considered suitable for this site.

5.5 SOLAR HOT WATER

5.5.1 The majority of heat output from solar hot water systems is achieved during the summer and mid seasons, with the least heat energy obtained during the winter. In the UK, this type of system can provide up to 50% domestic hot water requirements. However, due to practical considerations of the limits on pipe length between the solar collectors and hot water cylinders; the SHW system for the Station Area would only be able to furnish the top two storeys with domestic hot water for the apartment residential units. It is also important to achieve a South-west orientation and so based on the Masterplan SHW would only be likely to be suitable for approximately half of the individual residential dwellings proposed, thus numbering around 125 units.

5.5.2 Each individual dwelling would require approximately 4m^2 of panel. 500m^2 of panelling might achieve in the region of less than one percent of the energy requirement for the entire Station Area site.

5.5.3 The use of SWH should also only be considered assuming meeting 50% of the proposed Station Area's DHW demand is met after CCHP contribution.

5.6 PHOTOVOLTAICS

5.6.1 PV makes a contribution to a renewable energy strategy on the Station Area of an estimated less than one percent of anticipated base building energy requirements for an area of 500m^2 using optimal tilt and orientation. The hotel; office; retail; technology park; education and light industrial units lend themselves to the installation of PV. However, it should be noted that PV is expensive and requires a suitable Southerly aspect to gain maximum output. For the individual dwellings if SHW is used then it should also be noted that the inclusion of PV as well may not be possible due to constraints of roof space.

5.7 GROUND SOURCE HEAT PUMPS

5.7.1 In this instance, boreholes are the only viable option for GSHPs as there is insufficient open ground for any horizontal installation on the site. A specialist company will be required to determine the ground conditions and assess their suitability for GSHPs. Should this prove favourable, test drills to confirm the ground conditions would then be required.

5.7.2 Enquiries with the Environment Agency indicate that there is a minor aquifer in the area. Further investigation would be needed, but it is considered that if there is such an aquifer, this improves the potential for GSHPs (closed loop) in that water creates a better temperature difference and the GSHPs are then more effective.

5.8 GROUND WATER ABSTRACTION

5.8.1 Enquiries with the Environment Agency suggest that the minor aquifer in the area (location illustrated in Figure 3 below) already supports two abstraction licences. Any abstraction over 20m^3 per day would have to be supported by a licence to abstract. Further investigations would be necessary and any boreholes drilled would require permission from the British Geological Survey (BGS).

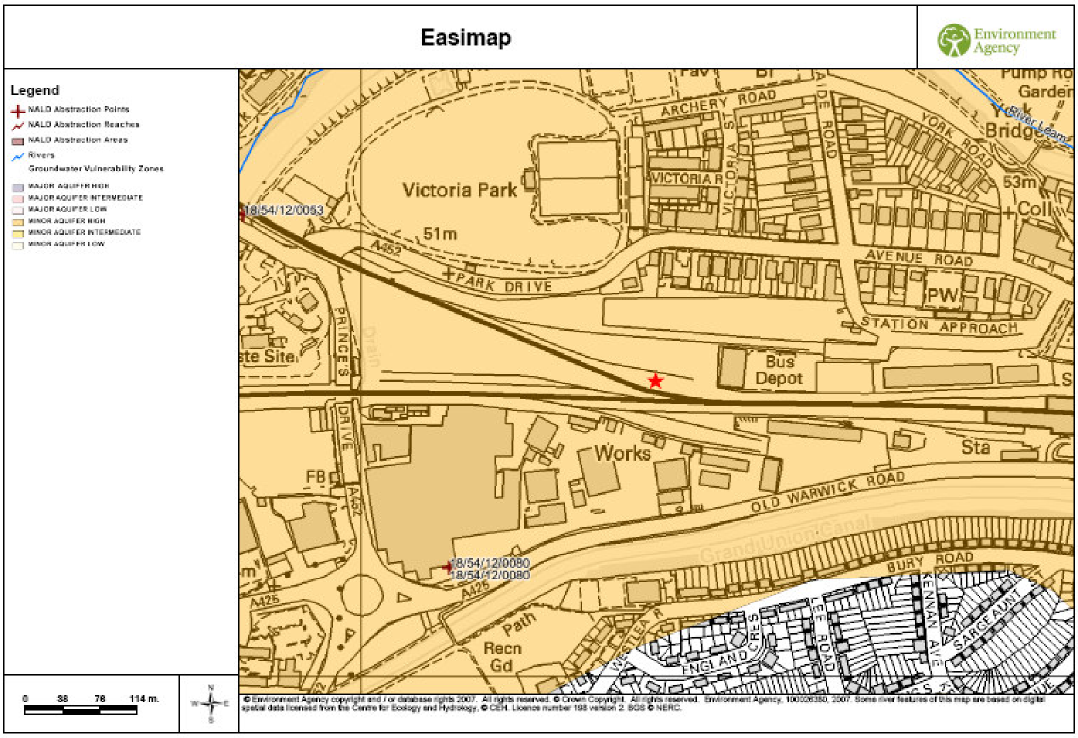

Figure 3: Location of Minor Aquifer at Station Area.

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6 Water Efficiency

6.1 BACKGROUND

6.1.1 Nationally DEFRA's Water Efficiency in New Buildings Construction Document (2006) requires:

- Dual flush WCs
- Urinals with IR control
- Water minimising taps
- Showers with flow rate below 9 litres per minute.

6.1.2 Water efficient fittings should be utilised throughout, including spray heads/aerated taps, water cistern inlet valves to WCs, low flow showers and low flow WCs.

6.2 INTRODUCTION

6.2.1 Potable water consumption within developments is largely a function of occupancy behaviour; however design can play a significant role reducing this demand. The first order priority for any scheme or building design is to ensure that water is used appropriately according to water hierarchy principles (see Figure 4 below). Not all water uses require potable grade water, which is both costly and places a heavy burden on the environment. Replacing potable demand with suitable non-potable water sources can achieve significant reductions in potable water, for example toilet flushing with non-potable water in dwellings could reduce potable water consumption by ~30% depending on dwelling type and behaviour.

6.2.2 The water hierarchy below illustrates how water efficiency may be achieved by the proposed development:

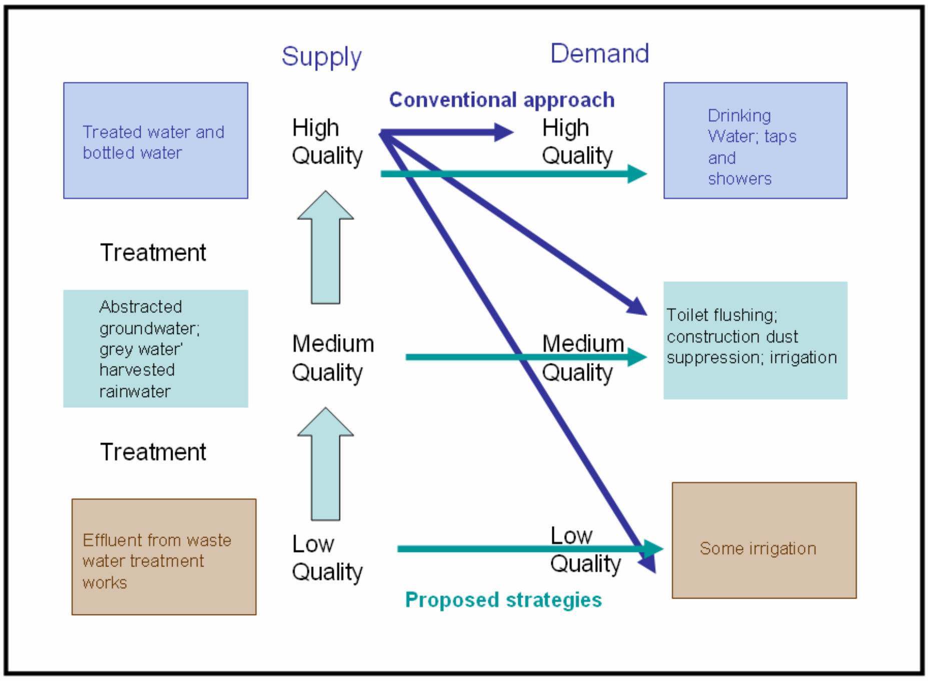

Figure 4: The water hierarchy principles for appropriate use

6.3 WATER DEMAND REDUCTION

6.3.1 There are two main issues to be considered.

1. The reduction of water consumption at the point of demand by means of end use appliances and fittings.

2. The reduction of water supplied by the consideration of alternative water sources.

6.3.2 A by-product of both strategies is a reduction in energy consumed, due to reduced pumping requirements.

Appliances and fittings

6.3.3 Careful consideration to appliances and fittings can significantly reduce water consumption for the Station Area site. An outline of efficient appliances and fittings can be found at Appendix E.

6.3.4 Case studies suggest that there are significant water consumption savings to be achieved through the installation of water and energy saving products, such as sensor urinal flush valves; water saving flow regulators for taps and showers and sensor WC flush systems. See Appendix F.

6.3.5 At this stage it is not possible to accurately quantify the savings from all appliances if the above measures are used; but conservative estimates of 60% water saving through the use of both low flow appliance and control such as PIR may be achieved.

Landscaping

6.3.6 Advice on landscaping and the use of appropriate plants would cut down on the amount of water used in irrigation, if any. Planting adapted to local climatic conditions, drip irrigation and watering only at night will all make a difference to the amount of water consumed. This is particularly important for the design of the Eco Park in Area 14.

Alternative water supply

6.3.7 Three water supply strategies could be considered for the Station Area development:

(a) Water recycling - grey water

(b) Rainwater harvesting

(c) Use of borehole water

6.3.8 Each supply strategy is outlined at Appendix G.

Grey Water Recycling

6.3.9 The maintenance issues in general rule out the use of large scale schemes in the UK. Elsewhere large schemes are generally managed by the local utility due the potential impact on public health.

6.3.10 For reasons of maintenance; the site may have several differently tenanted areas and the associated infrastructure cost, it is considered here that a large-scale scheme is not suitable for this project.

6.3.11 Small-scale units could either serve each individual dwelling or serve two toilets from the service voids between two toilets in office; retail; educational establishment and technology park toilet blocks and between two rooms in the hotels; providing bathroom design is such as to accommodate this. The components of the system comprise a cleaning tank; storage tank and control unit.

6.3.12 Grey water recycling can achieve savings of approximately 30% toilet flushing water requirements for given areas, such as the dwellings; office and education accommodation.

Rainwater harvesting feasibility

6.3.13 There is likely to be substantial water demand from the proposed development and careful consideration needs to be given at design stage to the type of roofs installed as different building materials utilised will have different drainage co-efficients (run-off factors) affecting the efficiency of any rainwater harvesting system.

6.3.14 Further points for consideration and comparison purposes:

- The annual rainfall average in Leamington Spa is approximately 622 mm/m^2 (www.metoffice.gov.uk); which is considered significant for rainwater harvesting purposes.
- The annual water demand to achieve Level 4 of the Code for Sustainable Homes is 105 litres per person per day (38.3m^3 per person per annum) for the residential.

- The rule of thumb water requirements for office accommodation is approximately 40 litres per person per day ($14.6m^3$ per person per annum), (BSRIA Rule of Thumb, UK 4th Edition, 2003)[2]
- The rule of thumb water requirements for educational buildings is approximately 20 litres per person per day ($7.3m^3$ per person per annum), (BSRIA Rule of Thumb, UK 4th Edition, 2003)
- The rule of thumb water requirements for an hotel is approximately 135 - 200 litres per person per day (depending upon star rating and existence of a swimming pool) ($49.3m^3$ - $73m^3$ per person per annum), (BSRIA Rule of Thumb, UK 4th Edition, 2003)

6.3.15 Rain water collection has a potential to provide (Market Transformation Programme, 2007)[3]:

- 25% WC flush water
- 25% clothes washing;
- 20% garden watering; and
- 25% car wash water.

6.3.16 If rainwater harvesting is employed as an integral part of Sustainable Drainage Solutions (SUDS) it may be considered as contributing towards discharge control consents for local planning purposes; as it can play a role in flood management by holding back storm water run-off.

Groundwater Abstraction (Borehole water)

6.3.17 Any groundwater abstracted for use in the cooling process could be re-used for grey water uses, such as flushing WCs. The grey water would then be discharged to the sewer as black water.

6.3.18 Use of the cooling water would also reduce the discharge volumes of water going to sewer, or back into the ground water in line with policy DP11.

[2] BSRIA Rule of Thumb, UK 4th Edition, 2003. Available from www.BSRIA.co.uk

[3] Market Transformation Programme, 2007, BNWAT 19: Alternative sources of water – grey water and rainwater reuse: Innovation Briefing Note. Available from: www.mtprog.com

7 Waste

7.1 BACKGROUND

7.1.1 Nationally, the Government published its *Waste Strategy 2007*[4] in May 2007 setting out the UK's vision for sustainable waste management and its target of 45% recycling by 2015.

7.2 INTRODUCTION

7.2.1 Recovering value from waste as energy should be pursed only after other recovery of recyclables and recoverable materials have been maximised in order to comply with the waste hierarchy principles taken from *Waste Strategy 2007*; detailed below in Figure 5:

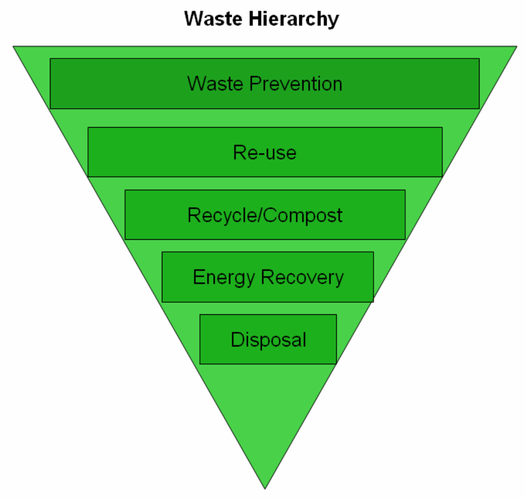

Figure 5: Waste Hierarchy 2007

7.2.2 Recycling is in line with the West Midlands Regional Sustainability Checklist's requirement for refuse recycling under *Resources* and local policy DP1 to include a sustainable waste management plan.

7.3 TECHNOLOGY OPTIONS

7.3.1 To recover energy from waste materials there are a limited range of processes or options available. These are:

- Biological
  - Aerobic systems
  - Anaerobic systems

7.3.2 It is unlikely that there will the form of waste from this proposed development suitable for aerobic or anaerobic systems.

- Thermal
  - Combustion/incineration (in the presence of air or oxygen)
  - Gasification (partial air or oxygen)
  - Pyrolysis (absence of air/oxygen)

7.3.3 The output from the above processing is either a synthesized gas and or solid fuel which can subsequently be converted to energy.

[4] Waste Strategy 2007 Available from: www.defra.gov.uk/environment/waste/strategy/

Each thermal technology is outlined at Appendix H

Combustion /Incineration

7.3.4 Smaller scale incineration may be a method of energy recovery which could be utilised in conjunction with Leamington Spa's household waste site located to the West and immediately adjacent to Area 14. However, it should be noted that the South-westerly winds may prove this unsuitable due to the AQMA to the East.

Gasification and Pyrolysis

7.3.5 Gasification, like pyrolysis, is not a common technology in the UK presently, but it is emerging as favoured approach over combustion incineration. They are technologies showing promise for converting Refuse Derived Fuel RDF or Solid Recovered Fuel SRF to energy. They appear to offer a role in the future but are as yet unproven beyond pilot scale development and are as such considered unsuitable for inclusion in the Station Area site.

8 Metering Strategy

8.1 BACKGROUND

8.1.1 Metering does not in itself save energy, but it is those actions taken as a result of installing meters and monitoring the data collected that saves energy. Actions taken as a result can often save between 10 and 15% of the metered energy.

8.1.2 To this end current regulations ensure that buildings include appropriate metering to help establish where energy is consumed. The Building Regulations require that all building engineering services should be provided with sufficient energy meters and sub-meters to enable owners and occupiers to measure their actual energy consumption. To comply with Part L 2006, each area with a specific type of use above 500m^2 must be metered for electricity and natural gas. In addition large tenancies of 2,500m^2 and more should be metered for heating and cooling.

8.2 MULTIPLE TENANCY

8.2.1 Due to the nature of the proposed Station Area development and the potential multiplicity of tenants and uses of the development, individual tenant metering of electricity is recommended as an effective means of energy management and cost recovery. Direct and accurate billing encourages tenants to take responsibility for their energy use and manage their own consumption. We would further recommend that metering of central services such as lighting, cooling, ventilation and heating plant is considered by the developers. This allows ongoing monitoring of system performance as well as accurate cost allocation on an activity basis (e.g. floor area)

8.2.2 All installed metering should have the facility for an electronic output to an Automatic Monitoring and Targeting System (AM&T) and the Building Energy Management System.

8.3 BUILDING ENERGY MANAGEMENT AND AUTOMATIC METERING

8.3.1 It is cost effective to install meters that can communicate to an AM&T system. AM&T can provide valuable means of locating and investigating any atypical or excessive consumption of energy. These tools are particularly essential should a central energy management centre for the facility be included, to provide the energy manager with assessments of the anomalous consumptions of tenants, such that the appropriate corrective action can be taken.

8.3.2 Meters should be linked to the building energy management system (BEMS) to provide automatic meter reading facilities. The consumption data should also be audited against pre-set targets and consumption profiles that could be derived from best-practice benchmark figures and historical performance. Note that this can be achieved using a BEMS in conjunction with proprietary AM&T software.

8.4 METERING METHODOLOGY AND STRATEGY

8.4.1 There are five levels of metering solutions: Direct metering, hours run metering, indirect metering, by difference metering and estimate of small power metering (outlined below in Appendix I). Within the Station Area proposed development it is recommended that consideration is given by the developers to direct metering to be used whenever possible. In certain instances one can estimate small power in a BEMS/AMS.

9 Summary of Options

9.1 RESIDUAL EFFECTS

9.1.1 CHP/CCHP will require substantial plant space but it is possible that it can be adequately housed in an Energy Centre in Area 14 screened by development of an Eco Park in the same area. Acoustic insulation will probably be required to reduce any associated noise to acceptable levels in the surrounding development. The installation of the unit may have to be phased to match the construction programme.

9.1.2 Biomass heating would require storage space for the fuel and daily deliveries of wood chip at peak load times of the year (depending on the size of the delivery vehicle and access constraints) and due to the associated emissions and impact on AQMA is not considered suitable for the proposed Station Area development.

9.1.3 GSHPs generate substantial carbon savings and provide little visual disturbance. However, it should be noted that the area required for installation of the collector is likely to be considerable and therefore is not considered practical for large scale application.

9.1.4 SHW and PV provide opportunity for carbon emissions' reduction but have associated visual intrusion and potentially significant commercial considerations.

9.1.5 Wind has considerable visual impact which needs to be considered and the proximity to local residential buildings also makes the installation of a large wind turbine inappropriate.

9.1.6 Ground water abstraction has the benefit of possibly being able to utilise the existing minor borehole, but requires further exploration.

9.2 POLICY CONTEXT COMPLIANCE

9.2.1 Encouraging the preferred developer to focus on energy efficient building design instead of adding renewable energy solutions onto inefficient buildings.

9.2.2 Achieving a 10% reduction in site energy requirements through the provision of renewable energy in accordance with policy DP13 of the local plan is likely to potentially feasible via the use of Photovoltaics and Solar Thermal cells but further technical work will be needed to confirm commercially and technical viability.

9.2.3 Inclusion of the CHP/CCHP plant will be in line with the West Midlands Sustainability Checklist's expectation that all major developments demonstrate that decentralised systems have been considered and implemented where possible.

9.3 RECOMMENDATIONS

9.3.1 The optimum solution would be to provide a robust scheme for the Station Area site that can be integrated with the services and sized appropriately to suit the site's visual and planning restrictions. It is considered that such an option would be most efficiently deployed were it to cater for the entire site utilising an Energy Centre placed at Area 14.

9.3.2 A gas fired CHP/CCHP has the potential to offset site CO_2 emissions and reduce energy requirements and is recommended for further investigation at design stage for possible inclusion in the scheme. The existing gas supply infrastructure must be examined to determine whether the additional demands from the CHP units can be met in addition to the other site demands. The peak gas demand will be determined at detailed design stage when the energy demands from the scheme can be more accurately sized. The use of this technology however will not meet the 10% renewable requirement in the local plan but will make a significant carbon saving and is in accordance with the Supplement to PPS1.

9.3.3 Of the renewable technologies reviewed, GSHPs provide an option for the site, although space requirements and financial restrictions may rule this option out although the low operating costs should also be considered in the appraisal. SHW and PV are potentially the most appropriate technology to achieve the 10% target but will need further assessment at detailed design. A summary of the technologies considered and the main advantages and disadvantages are contained within Appendix A.

9.4 CARBON SAVINGS

9.4.1 Table 9.1 below contains an estimate of the quantity of carbon savings that could potentially be generated through the application of each of the technologies. It can be seen that the greatest savings can be developed from the building design (44%) followed by the use of a gas fired CHP unit (13%).

9.4.2 The estimates for renewables have been based on 500m2 of panels. A significantly greater area of panels would be needed to achieve a 10% saving. The exact area would need to assessed during a detailed design assessment.

Table 9.1. Estimated Carbon Savings from each of the relevant low/ zero carbon technologies and design measures.

Energy Efficiency Measures and Low and Zero Technology Options	% End demand met	% Reduction in energy requirement for site	% Reduction in site carbon emissions
Energy efficiency measures applied to individual dwellings		30%	44%
Gas fired combined heat and power unit in energy centre serving whole site	15%	0%	13%
Biomass boiler in energy centre to supplement gas fired CHP	20%	11%	8%
Photovoltaic (500m^2) on dwellings only		0.3%	1%
Ground source heat pumps applied where feasible	30%	12%	6%
Solar hot water heating (500m^2) on dwellings only		1%	0.6%

Appendix A Summary of Low and Zero Carbon Technologies Appraisal.

Ranking	Measure	Description	Advantages / Disadvantages	Recommendations for this Scheme	Relevant Policy and Legislation
A	Energy efficiency measures	Passive design measures to reduce building energy demand Examples are: Improved thermal insulation Improved window and building layout to maximise solar contribution to heat demand Improved building layout to minimise over heating effects during summer	Helps to reduce energy requirement for base building May increase building footprint with no increase in accommodation area reducing site build density	Always provides the most sustainable form of energy. That which is not required in the first place. Recommended as primary energy reduction initiative.	West Midlands Regional Sustainability Checklist section Climate Change DP12 and DP13 Warwick Council Local Plan (Adopted September 2007) Code for Sustainable Homes (2006) Level 4

Ranking	Measure	Description	Advantages / Disadvantages	Recommendations for this Scheme	Relevant Policy and Legislation
B	Combined heat and power	Electricity is generated in site by a gas engine and alternator. Waste heat is reclaimed and distributed with generated electricity realising an improved efficiency above grid electricity	Improved utilisation of primary fuel when suitable mix of thermal demand available Installation of site wide heat pipes required (considered cost effective for apartment buildings but high cost for connections to individual dwellings) Energy centre required on site taking space and requiring ongoing management	Recommended for further investigation A preliminary space identified on site master plan for energy centre	West Midlands Regional Sustainability Checklist section Climate Change DP12 and DP13 Warwick Council Local Plan (Adopted September 2007) Code for Sustainable Homes (2006) Level 4
C	Biomass (site wide)	Combustion of biomass in a boiler produces heat Biomass must be from sustainable source such as energy crops from set aside farm land or forest residues	If configured to serve the whole site from an energy centre can integrate well with combined heat and power installation described above Reliable source of the correct biomass fuel is required Flue gases contain sulphur and require expensive scrubbing equipment	Recommended for further investigation subject to reliable local source of fuel being identified Area of site is constrained due to AQMA issues so cost of flue gas cleaning might prove high	West Midlands Regional Sustainability Checklist’s requirement for the use of sustainable energy under Climate Change Warwick Council Local Plan (Adopted September 2007) DP13 Code for Sustainable Homes (2006) – level 4

Ranking	Measure	Description	Advantages / Disadvantages	Recommendations for this Scheme	Relevant Policy and Legislation
D	Solar hot water heating	Collectors on roofs absorb solar energy during summer months and heat hot water in domestic hot water cylinder	Probably one of the most cost effective technologies A number of suppliers available and reasonable high volume of installations Unobtrusive Collectors need to be installed close to cylinders as limit to interconnecting pipe lengths	This is a good solution for individual dwellings as works well with pipe limit constraints Application to apartments is limited as pipe length constraints limit to upper floor/s only This technology clashes with combined heat and power installations as both seek to serve summer thermal demand so co-ordination required Recommend considered for individual dwellings	West Midlands Regional Sustainability Checklist's requirement for the use of sustainable heating techniques under *Climate Change* Warwick Council Local Plan (Adopted September 2007) DP13 Code for Sustainable Homes (2006) – level 4
E	Ground source heat pumps (vertical coil)	As above but due to space constraint pipes installed in vertical bore holes	Provides low grade heat that works well with under floor heating systems Uses electricity to power heat pump but at high efficiency Requires expensive bore holes to provide sufficient energy	Technology should be considered however high civil costs associated with bore holes are likely to prevent application	West Midlands Regional Sustainability Checklist section Climate Change DP12 and DP13 Warwick Council Local Plan (Adopted September 2007) Code for Sustainable Homes (2006) Level 4
E	Ground source heat pumps (open loop)	Operates as ground source heat pumps above but uses the ground water as the heat transfer medium direct and abstracts the water	The efficiency of open loop systems using abstracted ground water improves over closed loop systems An agreement is required from the Environment Agency to permit abstraction of ground water	There is known to be a minor aquifer on site and it is recommended that this system be investigated	West Midlands Regional Sustainability Checklist's requirement for the use of sustainable heating techniques under *Climate Change* Warwick Council Local Plan (Adopted September 2007) DP13 Code for Sustainable Homes (2006) – level 4

Ranking	Measure	Description	Advantages / Disadvantages	Recommendations for this Scheme	Relevant Policy and Legislation
F	Photovoltaic panels	Collectors on roofs absorb solar energy during summer months and generate electricity	A number of suppliers available Unobtrusive An effective renewable energy technology but relatively expensive	Recommended for consideration but is only likely to be viable if factors other than cost are applied	West Midlands Regional Sustainability Checklist's requirement for the use of sustainable heating techniques under *Climate Change* Warwick Council Local Plan (Adopted September 2007) DP13 Code for Sustainable Homes (2006) – level 4
G	Combined heat, power and cooling	As combined heat and power except absorption chillers added to convert heat in summer months to cooling water	Improved utilisation of primary fuel when suitable mix of thermal demand available Installation of site wide heat and cooling pipes required Energy centre required on site taking space and requiring ongoing management (larger space required than CHP alone due to absorption chillers) Absorption chillers expensive	Consider for further investigation if combined heat and power plant proves viable	Warwick Council Local Plan (Adopted September 2007) DP12 Code for Sustainable Homes (2006) Level 4 West Midlands Regional Sustainability Checklist's requirement for the use of sustainable heating techniques under *Climate Change*
H	Large Wind turbine	A single large wind turbine installed locally and electrical output connected directly into Station Area network	For wind turbines to be viable it is normally better to construct as large a turbine as possible Normal design practice is to limit proximity of turbine to dwellings	Not recommended due to noise, visual intrusion and proximity to existing dwellings	Warwick Council Local Plan (Adopted September 2007) DP 13 Code for Sustainable Homes (2006) Level 4

Ranking	Measure	Description	Advantages / Disadvantages	Recommendations for this Scheme	Relevant Policy and Legislation
I	Small scale building mounted wind turbines	Single or multiple wind turbines installed on buildings	Wind turbulence around buildings reduces viable wind speeds and performance of turbines Proximity to dwellings considered a problem	The general consensus is that insufficient wind speed is available around urban sites and it is unlikely that building mounted wind turbines will prove viable	West Midlands Regional Sustainability Checklist section Climate Change DP12 and DP13 Warwick Council Local Plan (Adopted September 2007) Code for Sustainable Homes (2006) Level 4
J	Biomass (individual dwellings)	A biomass fired boiler is installed in each dwelling in lieu of gas fired central heating boiler	Residents of each dwelling responsible for sourcing fuel on transporting to site Storage of fuel at each dwelling needs space allocated	Considered that at a dwelling level this option is a lifestyle commitment and would reduce value of dwellings hence not recommended for investigation	West Midlands Regional Sustainability Checklist section Climate Change DP12 and DP13 Warwick Council Local Plan (Adopted September 2007) Code for Sustainable Homes (2006) Level 4
K	Ground source heat pumps (horizontal coil)	The earth below a certain depth remains at a fairly constant temperature and with heat exchange pipes energy can be extracted for heating purposes	Provides low grade heat that works well with under floor heating systems Uses electricity to power heat pump but at high efficiency Requires a large open ground area to provide sufficient energy	Generally considered unworkable due to lack of open space in development	West Midlands Regional Sustainability Checklist's requirement for the use of sustainable heating techniques under *Climate Change* Warwick Council Local Plan (Adopted September 2007) DP13 Code for Sustainable Homes (2006) – level 4
L	Biomass CHP	The technology to produce sufficient heat from biomass fuel to also generate electricity via a turbine exists	The technology is in early stages of development and only a few installations in operation	Not considered a mature or viable technology at this stage	Warwick Council Local Plan (Adopted September 2007) DP13 Code for Sustainable Homes (2006) – level 4