GD04	LZC & Renewable Technologies	UNIVERSITY OF LEICESTER

Document Control

Rev	Date	By	Comments
A	Jun'16	L. Davies	Technical review update
B	Oct'17	L. Davies	Technical review update
C	Dec 17	UoL	Sign off for release
D	July 2020	UoL	Minor Updates

Design Guidance

1. The technical feasibility of installing each renewable technology must be made on a case by case basis considering the energy demand profile of the building in question and the requirements of the Low Energy Design principles outlined within GD01. Particular attention must be given to the carbon content of each of the technologies. A summary of the pros and cons associated with each system is tabulated below as a guide to discount any unsuitable options at an early stage.
2. At each stage of the development process a detailed full life cycle operational performance evaluation shall be undertaken in line with CIBSE TM54 including a detailed costed analysis outlining payback projections including all elements of capital and operational system costs which themselves include energy, carbon and maintenance costs. Capital costs should include life cycle refresh costs.
3. To take advantage of any current Government backed tariffs and initiatives/payments, the design, system installer and chosen equipment must be in accordance with any necessary requirements and/or any approved Micro-Generation Certification Scheme (MCS) list. Details of which can be found at http://www.microgenerationcertification.org/. In addition, OFGEM approved metering must be installed to monitor system performance.
4. The design shall always include aa LZC appraisal assessment being specific to each project and it is imperative that the LZC assessor considers the following key criteria in their overall feasibility appraisal:
    - The LZC study as a minimum must be structured to get the credits available for the "feasibility study" under BREEAM ENE04 Low Carbon Design.
    - CDM implications associated with the ongoing maintenance of the systems proposed will need to be considered in relation to costs and practicability.
    - Whole life cycle costing appraisal to be conducted to accurately assess the system's lifecycle cost inclusive of all ongoing maintenance, energy, carbon and system replacement costs. All life cycle costing assessments must include access, installation and disposal costs where appropriate.
    - Funding streams and incentive schemes must be considered as available at the time of concept planning to accurately inform the potential benefits of system proposals to understand where incentivised schemes may prove beneficial to the capital and operational budgets throughout the lifecycle of each system considered.
    - For all benchmark costing exercises undertaken it is essential that accurate load profile and demand calculations provide accurate energy and CO_2 assessments to offer realistic proposals.
5. For the purpose of renewable technology appraisals, the University acknowledge that the district heating scheme may not be useful in reducing carbon consumption. The University consider this may be a less clean energy source than those contained within this guide and shall not be considered in relation to the renewable energy strategy outlined in GD01 – 'Low energy design' and GD03 – 'Sustainable Design & Planning'.

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UOL Accepted Renewable Technologies

Technology	Brief Description	Benefits	Issues/Limitations
Solar Photovoltaic	Solar photovoltaic panels convert solar radiation into electrical energy through semiconductor cells. They are not to be confused with solar panels which use the sun's energy to heat water (or air) for water and space heating.	Low maintenance/no moving parts Easily integrated into building design Excellent learning resource Potential grid export	Any overshadowing reduces panel performance Panels ideally inclined at 30° to the horizontal facing a southerly direction
Solar Thermal	Solar thermal energy can be used to contribute towards space heating and hot water requirements. The two commonest forms of collector are panel and evacuated tube.	Low maintenance Little/no ongoing costs Excellent learning resource Income generated from Renewable Heat Incentive (RHI) scheme	Must be sized for the building hot water requirements Panels ideally inclined at 30° to the horizontal facing a southerly direction Twin coil solar hot water cylinders shall be used with the solar element serving the bottom coil Possible legionellae.
Hybrid Phovoltaic-Thermal (PV-T) Solar Collectors	Hybrid Photovoltaic-Thermal (PV-T) solar collectors produce both electricity and thermal energy simultaneously from solar radiation. A PV-T collector is a combined assembly of a PV module for the conversion of electrical energy and a high efficiency flat plate solar collector for the conversion of thermal energy.	Low maintenance Little/no ongoing costs Increased electrical yield Reduced installation footprint Excellent learning resource Income generated from Renewable Heat Incentive (RHI) scheme	Any overshadowing reduces panel performance Must be sized for the building hot water or air heating requirements Panels ideally inclined at 30º to the horizontal facing a southerly direction Possible legionellae.
Ground Source Heat Pump (GSHP)	GSHP systems tap into the earth's considerable energy store to provide both heating and cooling to buildings. A number of installation methods are possible including horizontal trench, vertical boreholes, piled foundations (energy piles) or plates/pipe work submerged in a large body of water. The design, installation and operation of GSHPs is well established.	Use of low/zero grid electricity with high COP equipment. Minimal maintenance Unobtrusive technology Flexible installation options to meet available site footprint Income generated from Renewable Heat Incentive (RHI) scheme	Large area required for horizontal pipes Full ground survey required to determine geology More beneficial to the development if cooling is required Integration with piled foundations must be done at an early stage Only the heating cycle considered as a renewable technology and reverse cycling for cooling shall not be considered as an LZC

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			benefit
Open Loop Water Source Cooling	Open loop water source cooling systems pump water from a lake, river or canal through a coarse filter and simple heat exchanger that feeds a water-cooled chiller. Warm water is discharged to surface waters and never mixes with other fluids within the building, thereby eliminating the risks of Legionella.	Use of low/zero grid electricity with high COP equipment. Relatively low capital costs Minimal maintenance Potential high Coefficient of Performance (COP)	Environmental impact on water resources to be assessed Abstraction licence required from the Environment Agency Discharge consent to be sort for disposal of water to surface waters Limits imposed on the water discharge temperature
Open Loop Ground Water Cooling	Ground water cooling exploits the relatively constant ground temperature to provide summertime cooling through water-to-ground heat exchangers (aquifers). An aquifer is essentially a layer of water-bearing rock which readily transmits water to wells and springs. Open loop systems pump ground water to the surface, where it passes through a heat transfer system, before being disposed of (at a different temperature) to waste or by re-injection back into the ground.	Use of low/zero grid electricity with high COP equipment. Relatively low capital costs Minimal maintenance Potential high Coefficient of Performance (COP)	Environmental impact on water resources to be assessed Abstraction licence required from the Environment Agency Discharge consent to be sort for disposal of water to surface waters Limits imposed on the water discharge temperature
Outside Ambient Air, Air Source Heat Pump. **Exhaust Air, Air Source Heat Pump.**	Electric or gas driven air source heat pumps extract thermal energy from the surrounding air and transfer it to the working fluid (air or water).	Use of low/zero grid electricity with high COP equipment. Efficient use of fuel Relatively low capital costs Income generated from Renewable Heat Incentive (RHI) Scheme Better COP (than ambient air) with exhaust air in winter but must not negate the use of simple AHU heat recovery devices.	Specialist maintenance More beneficial to the development if cooling is required Requires defrost cycle in extreme conditions Some additional plant space required Only the heating cycle considered as a renewable technology and reverse cycling for cooling shall not be considered as an LZC benefit
Solar Assisted Air Source Heat Pump	Combination of solar thermal and water source heat pump.	Combinations of the above technologies.	May not need heat on good days for solar. Needs large thermal store. May be better use of solar thermal for domestic hot water.
Wind Turbine *(Stand-alone column mounted)*	Wind generation equipment operates on the basis of wind turning a propeller, which is used to drive an alternator to generate electricity. Small scale (1kW – 15kW) wind turbines can be pole	Low maintenance/ongoing costs Minimum wind speed available *(www.bwea.com)* Excess electricity can be exported to	Planning issues Aesthetic impact and background noise Space limitations on site

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	or roof mounted.	the grid Excellent learning resource Income generated from Feed-in Tariff (FIT)	Wind survey to be undertaken to verify 'local' viability
Wind Turbine *(Roof Mounted)*	As above	Low maintenance/ongoing costs Minimum wind speed available *(www.bwea.com)* Excess electricity can be exported to the grid Excellent learning resource Income generated from Feed-in Tariff (FIT)	Planning issues Aesthetic impact and background noise Structural/vibration impact on building to be assessed Proximity of other buildings raises issues with downstream turbulence Wind survey to be undertaken to verify 'local' viability
Gas Fired Combined Heat and Power (stand alone)	A Combined Heat and Power (CHP) installation is effectively a mini on-site power plant providing both electrical power and useful heat. CHP is strictly an energy efficiency measure rather than a renewable energy technology.	Potential high energy saving available with efficient use of fuel Excess electricity can be exported to the grid Excellent learning resource Benefits from being part of an energy centre/district heating scheme	Not good at reducing carbon as mains gas supply is high carbon content. Maintenance intensive Sufficient base thermal and electrical demand required Some additional plant space required
Bio-fuel Fired Combined Heat and Power (stand alone)	As above.	Potential high CO_2 saving available with use of biofuels. Efficient use of fuel and high energy savings Excess electricity can be exported back to the grid Excellent learning resource Benefits from being part of an energy centre/district heating scheme Income generated from Renewable Obligation Certificates (ROCs) and Renewable Heat Incentive (RHI) scheme	Maintenance intensive Sufficient base thermal and electrical demand required Significant plant space required Biomass fuelled systems are at preliminary stages of commercialisation Large area needed for fuel delivery and storage Reliable biomass fuel supply chain required
Anaerobic Digestion	Anaerobic digestion consists of a series of biological processes in which micro-organisms break down biodegradable material in the absence of oxygen releasing a	Potential high CO_2 saving available when teamed with a CHP engine Biogas produced from waste	Maintenance intensive Significant plant space required Large area needed for waste

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	methane (CH_4) and carbon dioxide (CO_2) rich biogas (60% CH_4 and 40% CO_2) suitable for energy production; particularly via CHP.	By-product (digestate) used as fertiliser Income generated from Feed-in Tariff (FIT)	delivery and storage Reliable waste stream required
Bio-Renewable Energy Sources *(Automated feed – wood-fuel boiler plant)*	Modern wood-fuel boilers are highly efficient, clean and almost carbon neutral (the tree growing process effectively absorbs the CO_2 that is emitted during combustion). Automated systems require mechanical fuel handling and a large storage silo.	Stable long term running costs Potential good CO_2 saving Excellent learning resource Income generated from Renewable Heat Incentive (RHI) scheme	Large area needed for fuel delivery and storage Reliable fuel supply chain required Regular maintenance required Significant plant space required
Water Turbine (Hydroelectric)	Hydroelectric power comes from the potential energy of a flowing body of water driving a water turbine and generator. Micro-hydro power systems typically range from 1kW to 100kW.	Low maintenance/ongoing costs Reliable constant electricity generation Excess electricity can be exported back to the grid Income generated from Feed-in Tariff (FIT)	Minimum head of water required Potential ecological impact to be assessed Abstraction license required
Fuel Cells and Fuel Cell Combined Heat and Power	Fuel cells convert the energy of a controlled chemical reaction, typically involving hydrogen and oxygen, into electricity, heat and water vapour. Fuel cell stacks operate in the temperature range 65°C – 800°C providing co-generation opportunities in the form of Combined Heat and Power (CHP) solutions.	Zero CO_2 emissions if fired on pure hydrogen and low CO_2 emissions if fired on other hydrocarbon fuels Virtually silent operation since no moving parts High electrical efficiency Excess electricity can be exported back to the grid Excellent learning resource Benefits from being part of an energy centre/district heating scheme	Expensive Pure hydrogen fuel supply and distribution infrastructure limited in the UK Sufficient base thermal and electrical demand required Some additional plant space required Reforming process, used to extract hydrogen from alternative fuels, requires energy; lowering overall system efficiency
LDEC Existing District Heating	District Heating, also known as community heating, provides heat from a central source to more than one building/ area via a network of heat mains	CO_2 savings are marginal and in some circumstances are negative. Possible capital and space savings	Dependent on distribution network and capacity Commitment to single fuel provider Consider fuel resilience (in case of main plant failure)

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