PEARSON
DESIGN & PROJECT MANAGEMENT

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Heat Decarbonisation Plan – P1
PSDS Phase 4

October 2024

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Revision Record

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1.0 Executive Summary

A number of green / low carbon technologies have been considered and provisionally assessed through the support tool to check eligibility with the low carbon skills fund and other technologies excluded through not meeting the pre-requisite (CO2e) £510.00 requirement.

The report has been developed with a wholistic building approach taking account of existing services infrastructure and building fabrics. We have considered both target CO2 reduction against commercial viability and practical suitability for a retrospective installation on this project.

It has been concluded that the Alsager Civic Hall building will benefit from the installation of new air to water heat pumps in lieu of the existing gas-fired boiler plant to provide the building space heating.

The proposals will also include for a new BMS mechanical control system, consisting of a new panel and associated wiring.

The ASHP's are to be located externally as provisionally indicated in this report with new heating mains routed within a new below ground trench into the existing plant room area before being integrated into the existing heating system.

As the heat pump's operates at much lower flow temperatures, a sum of money has been allocated to upgrade a percentage of the existing radiators and for the installation of dynamic radiators valves to enable the system to operate on the new, lower mean water temperature.

Allowance has been made for replacement of the existing fluorescent luminaires and fittings with new high efficiency LED fittings to improve energy efficiency and lower annual energy consumption.

The final technology highlighted for inclusion, which compliments the new electrical base load of the ASHP and the centres operational profile is a new 31KWe photo voltaic array, the new array is to maximise on site generation through a new 80-panel system south facing on pitched structural frame requiring Approx. 146m² of roof area.

In addition to the above proposed technologies, the upgrade of the existing building fabrics have been highlighted for inclusion in the form of additional levels of roof insulation throughout the building to improve buildings thermal efficiency in conjunction with ASHP proposal.

Reduction in CO2 emissions has been calculated and assessed through the support tool and installation life spans have been taken from CIBSE guide M. It is concluded that Alsager Civic Hall, based on this outline sketch design and supporting contractors budget costs included within this report, that this building is eligible for low carbon skills funding when assessed as part of overall council application.

The cost data utilised for analysis to determine eligibility have been derived from actual contractor's quotations, this figure was then reduced by the business-as-usual cost (BAU) to replace the existing boiler plant which was detailed at approx. £22k and cross referenced against CO_2e saving associated.

The building would benefit both operationally and commercially whilst massively reducing its carbon impact on the environment.

2.0 Introduction

Pearson Surveyors (PS) have been appointed by Bloom Procurement Services and Cheshire East Council to support its decarbonisation plans through the following work;

- Obtain current/historical energy consumption data for the council building.
- Carry out a building audit including fabric, heating, solar PV potential and energy efficiency upgrade assessments at the town council site with post site survey report produced.
- Feasibility study
- Investment grade proposals for each of the decarbonisation measures identified for the site
- Deliver a heat decarbonisation assessment action plan which can be used as the basis for future capital heat decarbonisation plan grant funding.

The purpose of this report is to provide a concept appraisal of potential low and zero carbon technologies to be incorporated, followed by a high-level assessment of each technology using bench marking energy values and also the Salix calculation template to ascertain base case energy values and potential values generated via proposed LZC technologies. This report details the following:

a) Energy generated from LZC energy source per year
b) Carbon dioxide savings from LZC energy over lifetime.
c) Life cycle cost of the potential specification.
d) Feasibility of exporting heat/electricity from the system
e) If technologies suits criteria to satisfy grant approval
f) All technologies appropriate to the site and energy demand of the development
g) Reasons for excluding other technologies

The purpose of this Grant Scheme is to help make eligible buildings more energy efficient and install low carbon heating measures, for example building fabric insulation, glazing, heating controls, and heat pumps. Eligible technologies are split into 4 different categories, which are explained further in this section. Eligible bodies can apply for up to 100% grant funding for projects which meet the compliance criteria below:

- The projects are taking place in buildings for which the Applicant pays the energy bills and will benefit from any resulting savings. Eligible bodies which do not own the building but have a long-term lease arrangement can apply, provided the contract allows for any savings to be passed to the eligible body.
- The cost to save a tonne of carbon (CO_2e) over the lifetime of the project must be no more than £510, which is automatically calculated by the Support Tool in the Grant Application Form.
- The Grant Scheme is primarily for capital works, however external consultancy and management fees may be included. Existing employee costs or any costs previously incurred may not be included. Further enabling costs not eligible for the Grant Scheme may be eligible for the Low Carbon Skills Fund where they are related to support to deliver the project.
- Note, the Council have the option to "supplement" any shortfall in funding via their own capital pot.
- Applicants must contribute the funding equivalent to the like-for-like costs of replacing their fossil fuel heating plant and any supporting infrastructure within the plant room. For Phase 4, this cost is set at a minimum of 12% of total project cost.

3.0 Site Location & Particulars.

3.1 Site Overview

Alsager Civic Hall is located in the centre of Alsager town centre, adjacent to both Alsager Library and Alsager Town Council building.

The civic hall accommodates a number of function and meeting rooms of various sizes, as well as office spaces, a bar and the main civic hall area which is shown in the figure below.





3.2 Future Plans for Site

We have liaised with the client to seek clarity on the future plans for the future building and site in question. We have had subsequent confirmation that this building is to for part of its ongoing operational stock with no plans for demolition.

3.3 Site Address & Orientation

Alsager Civic Hall
3 Lawton Road
Alsager
Stoke-on-Trent
ST7 2AE



3.4 Met Office Weather Data

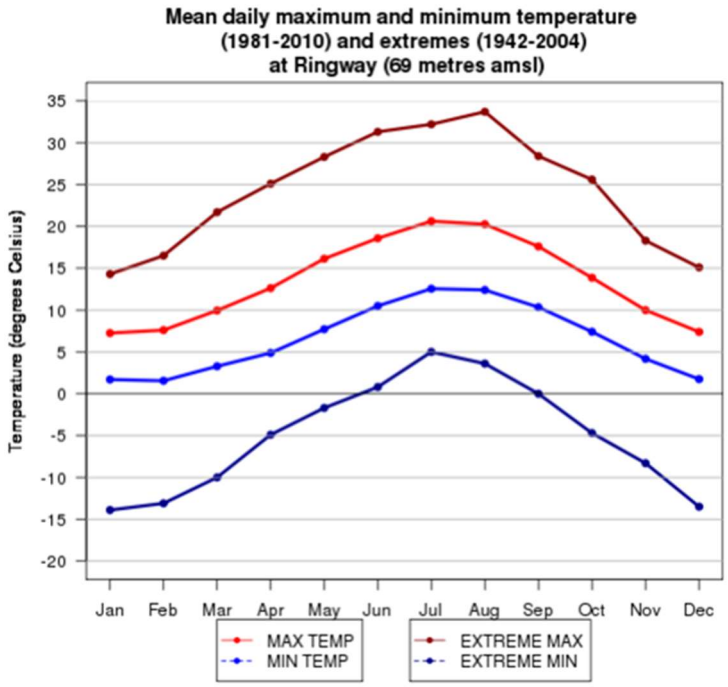


Figure 1 - Mean daily maximum and minimum external temperatures (69 m ASL) – Met Office

Figure 1 (above) and figure 2 (below) detail maximum and minimum external temperatures annually in the North West of England from various heights above sea level. These figures will have an impact on the levels of heating/cooling required within the building and will form part of calculations to determine plant capacities.

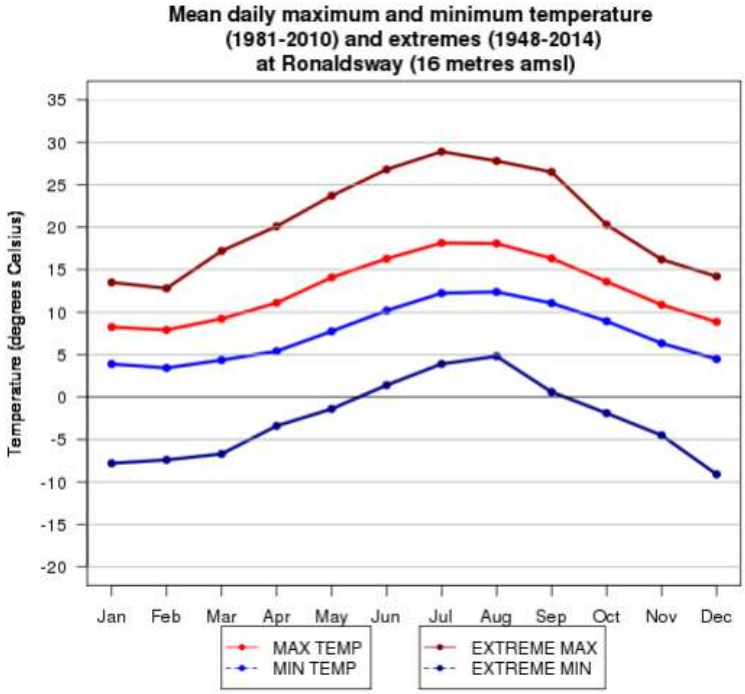


Figure 2 - Mean daily maximum and minimum external temperatures (16 m ASL) – Met Office

3.5 Existing Services Systems

Mechanical Services

The main heating plant serving the building is housed within a central plantroom area, located within the basement of the town hall.

The main plant items located within the plantroom area include:

- 2 x Ideal Evomax 60 Gas Fired Boiler Modules (2 x 60kw)
- Circulation Pumpset.
- Pipework and Ancillaries.
- Local Boiler Controls.
- LTHW heating circuits serves a combination of steel panel radiators and fan convectors.

Boiler plant was installed in circa 2013 and it is anticipated that they will be past economic life expectancy (In line with CIBSE guide M) prior to projected end of construction programme.

Hot Water in generated on the site via electric point of use water heaters.









Electrical Services

The main electrical switchgear is located within a designated ground floor mounted electrical switch room. The incoming supply to the building is a 200A TP&N supply.

Lighting within the building is a combination of new LED lighting and old inefficient fluorescent fittings throughout.







3.6 Existing Building Fabrics

The existing building fabrics have been subject to minor improvements since the building's construction. The building fabrics appear to be of generally good construction type and are assumed to be of fair thermal performance.

External Walls – Brick external leaf, a 50mm insulation and a dense block inner leaf finished with 13mm lightweight plaster. (Assumption)

Assumed U value – 0.8 W/m²K

Windows – UPVC frame double glazing throughout.

Assumed U value – 2.4 W/m²K

Roof – Pitched roof with slate tiles and assumed fair level of insulation.

Assumed U value – 1.0 W/m²K





3.7 Proposed Design Criteria

All calculations as part of calculations supporting this document are based on the following design criteria.

Internal Room Design Criteria.

AREA TYPE	WINTER DESIGN TEMPERATURE
Civic Hall	19°C
Offices / Staff Areas	21°C
Meeting Rooms	21°C
Bar Area	19°C
Kitchen Area	19°C
Toilets	18°C

External Design Criteria.

Alsager, Cheshire

Design Maximum External Summertime Temperature = 28°C
Design Minimum External Wintertime Temperature = -5°C

Design calculations for systems and plant are based on the above stated design criteria.

3.8 Technical Standards for Compliance

As part of this LZC assessment, the following acts/regulations shall be adhered and form basis for future design works:

a) Health and Safety at Work Act, 1974.
b) The Electricity at Work Act, 1989.
c) The Workplace (Health, Safety and Welfare) Regulations 1992
d) The Regulatory Reform (Fire Safety) Order 2005
e) The Construction (Design and Management) Regulations 2015
f) UK Building Regulations: Approved document L2A: Conservation of Fuel and Power in existing buildings other that dwellings 2010 incorporating amendment up to 2016.
g) UK Building Regulations: Approved document Part F Ventilation 2013.
h) UK Building Regulations: Approved Document B Fire Safety. Volume 2: Buildings other than Dwellings.
i) UK Building Regulations: Approved Document H. Drainage and Waste Disposal.
j) Disability Discrimination Act 2005.
k) S.I.1999 No. 1148 – The Water Supply (Water Fitting) Regulations 1999.
l) The Gas Safety (Installation and Use) (Amendment) Regulations 2018.
m) HSE Legionnaires' disease. The control of legionella bacteria in water systems.

To ensure this project complies with the relevant British Standards, the following standards will apply:

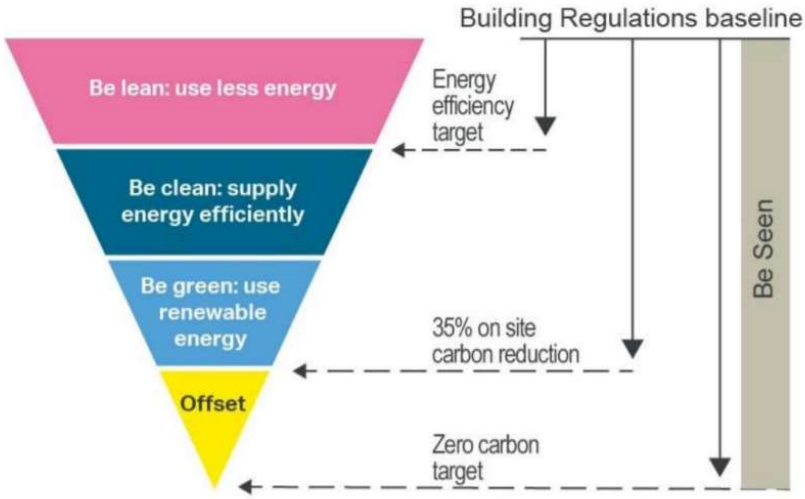
a) BS 7671:2018+A1:2020 Requirements for Electrical Installations. IET Wiring Regulations
b) BS 7430:2011+A1:2015. Code of practice for protective earthing of electrical installations
c) BS 5266-1:2016. Emergency lighting. Code of practice for the emergency lighting of premises

d) BS 5839-1:2017. Fire detection and fire alarm systems for buildings. Code of practice for design, installation, commissioning, and maintenance of systems in non-domestic premises
e) BS 8300-2:2018. Design of an accessible and inclusive built environment. Buildings. Code of practice
f) BS EN 62606:2013+A1:2017. General requirements for arc fault detection devices.
g) BS EN 62305-1:2011. Protection against lightning. General principles.
h) BS EN 62305-2:2006. Protection against lightning. Risk management
i) BS EN ISO 16890-1:2016. Air filters for general ventilation. Technical specifications, requirements and classification system based upon particulate matter efficiency (ePM)
j) BS EN 12056-2:2000. Gravity drainage systems inside buildings. Sanitary pipework, layout, and calculation
k) BS EN 12056-3:2000. Gravity drainage systems inside buildings. Roof drainage, layout, and calculation
l) CIBSE Guide A: Environmental Design
m) CIBSE Guide B1: Heating
n) CIBSE Guide B2: Ventilation & Ductwork
o) CIBSE Guide E: Fire Safety Engineering
p) CIBSE Guide K: Electricity in Buildings
q) TM39: Building Energy Metering
r) DW/142: Specification for Sheet Metal Ductwork: low, medium, and high pressure/velocity air systems. Addendum A.
s) CIBSE TM46 Energy Benchmarks
t) UK Government Carbon Conversion Factors 2020

3.9 Energy Hierarchy Methodology

As part of all new projects, it is recognised best practice to follow an Energy Hierarchy ensuring design are as energy efficient as possible. The main premise is to be lean, be clean and be green (Figure 3).

Figure 3: 'Be Lean, Be Clean, Be Green' Energy Hierarchy



Initially the development must first be designed to use less energy through passive measures, such as improved fabric and glazing, low energy lighting and being more airtight (Be Lean).

The second stage is to supply energy efficiently, such as utilising an Air Source Heat Pump (be Clean).

The third and final stage is to assess whether other Low and Zero Carbon (LZC) technologies can be incorporated, such as a Combined Heat and Power (CHP) engine or Photovoltaic panels which this report focuses (Be Green).

For this study, energy benchmarks are used to create simplified base case values and LZC energy impacts directly assessed according to their overall technical parameters.

4.0 Sustainability

The main objective of any energy strategy should be to reduce the CO_2 emissions from the proposed development. The strategy should also aim to reduce the use of non-renewable resources and to reduce the other emissions related to building energy use.

Energy benchmarks can be used to provide an estimate of energy consumption per annum. These figures can be used to determine a target figure for incorporating renewable energy resources into a scheme.

The initial review of the opportunities and constraints of the site have been undertaken from an engineering perspective covering issues such as:

- Sun path and shading.
- Potential biomass resource.
- Ground conditions for ground source heat pumps.
- Prevailing wind.
- Wind resource.
- Sources of noise or air pollution.
- Orientation of building.
- Building fabric.
- Avoidance of potential pollutants (refrigerants)
- Use of water

In addition to these practical issues relating to the construction, clients should also be aware that sustainability extends far beyond the methods used in building and should consider long term operational issues such as:

- Waste management and recycling
- Transport to and from the place of work.
- Materials and equipment considering the embodied lifetime environmental impacts.
- Social issues
- Health and wellbeing.

The objective has been to produce a design which achieves a significant reduction in CO2 emissions whilst being commercially viable at less than £325/tCO2 lifetime.

5.0 Low & Zero Carbon Technologies

5.1 Overview

The opportunities for providing Low or Zero Carbon technologies on this site are as follows, and we detail the concepts in the following pages.

Solar
- Solar hot water
- Photovoltaics (PV)

Water
- Small Scale Hydro Power

Wind
- Wind turbines

Biomass
- Biomass boilers

Combined Heat and Power (CHP)
- Biomass
- Natural gas
- Sewerage gas and other biogases
- Absorption Cooling

Heat Pumps
- Ground Source Heat Pumps
- Water Source Heat Pumps
- Air Source Heat Pumps

Heat Networks
- Existing Heat Networks

Good design practice

- Low energy lighting
- Natural ventilation
- Maximising daylight
- Heat recovery ventilation

5.2 Solar Hot Water

Solar energy emitted by the sun can be harnessed using specifically designed mechanical systems which use solar collectors to absorb the suns energy and provide heat for hot water.

The heat energy absorbed by the collectors is transferred through interconnecting pipework linking an internal storage vessel which enables the demand to match availability.

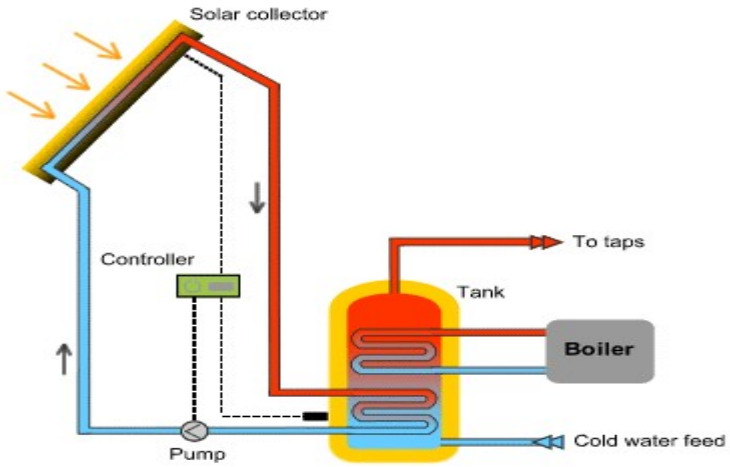
The circulation of heat can either be by passive means i.e. relying on the natural convection to circulate the water through the system or by active means which uses a circulation pump often powered by a small built in photovoltaic collector to run the pump.

There are several types of hydronic solar collectors but the two most common are:

Flat plate collectors: These are simple but effective devices containing a dark plate within an insulated box with a glass or plastic cover.

Evacuated tube collectors: These are more sophisticated devices offering higher efficiencies under a wider range of conditions but are more expensive.

Heat Pipe Collectors: A superior vacuum is maintained over a longer period of time through:
• Glass to metal seal – unique fusing process for durability.
• Superior vacuum – by creating a vacuum of 10-6 mbar within the tube, thermal losses caused by conduction and convection are eliminated.
• High quality glass – unique properties give good transmissibility with low reflection losses and increased durability.
The dry fit of heat pipe tubes allows easy maintenance as tubes can be removed without draining the system down and are generally the most efficient.



To maximise output solar collectors are best located at an angle of 45° and facing south.

Systems are supplemented by secondary energy supplies from traditional means but solar collectors can provide up to 50% of the annual hot water demand. Typically the performance of collectors range from 800 kWh in the North to 1200 kWh in the South for a panel of approximately $3m^2$.

Systems are completely silent in operation and have minimal local impact but may require planning approval from a visual perspective.

5.3 Photovoltaics' (PV)

Solar energy emitted by the sun can be harnessed using specifically designed mechanical systems which use solar cells to convert sunlight in to electricity. Each cell has one or two layers of semi-conducting material which respond to light to create an electric field across its layers causing electricity to flow.

There are three basic types of solar cells and these are:

Monocrystalline: These have a typical efficiency of up to 21% and are the most expensive.

Polycrystalline: These have a typical efficiency of 13%

Thin Film: These are generally applied to other materials such as glass or metals and have a typical efficiency of 7%



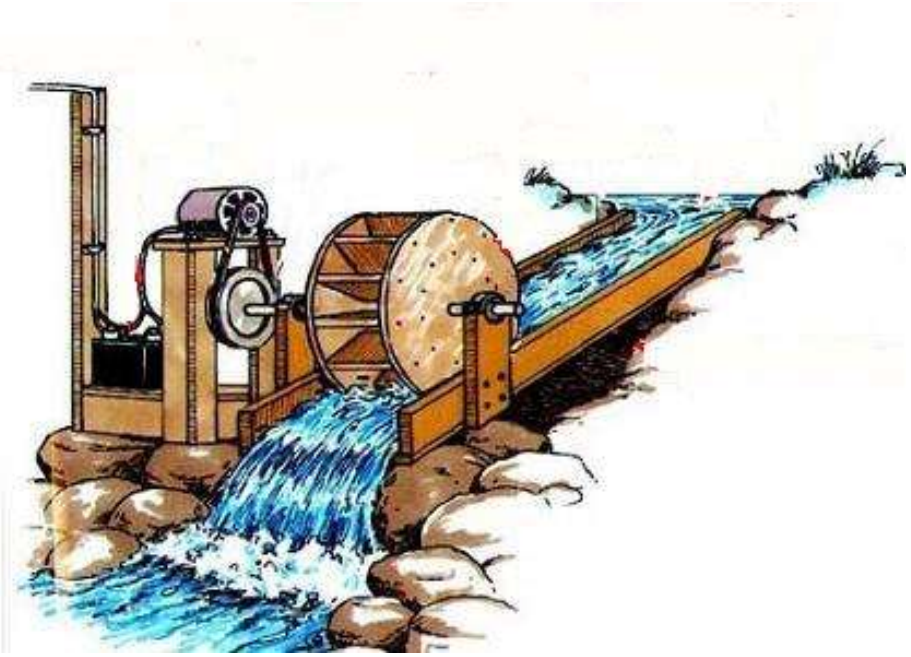
A collection or array of cells are linked together and their total output is normally installed in parallel to the grid. Current glazing technologies are seeking to combine PVs within standard glazing elements which in time will become more economically viable.

To maximise output PVs are best located at an angle of 30- 40° south facing. Shaded areas will substantially reduce output and should be avoided.

Systems are completely silent in operation and have minimal local impact but may require planning approval from a visual perspective.

5.4 Water

Hydroelectricity systems generate electricity from running water - usually a stream or river which converts potential energy stored in water to kinetic energy. Hydro power systems use the running water to turn a turbine which generates electricity. The faster the water flows and the more water there is, the more electricity can be generated.



The amount of electricity a system actually generates depends on how efficiently it converts the power of the moving water and how much water is available. However there is considerable opportunity to generate electricity from such a resource.

Such systems are limited to specific sites with available resources but by default tend to be noisy due to the flowing water.

5.5 Wind

Wind power can be harnessed by the use of turbines which captures the wind energy which generates electricity. The electricity produced can be directly fed back in to the grid or can be stored via battery cells.

There are two basic types of turbines and these are:

Horizontal Axis: These are the more common typically seen with three evenly spaced blades rotating around a central hub.



Vertical Axis: These can be installed without a tower on to buildings and operate with a twisted blade structure rotating around a vertical axis.



In order to operate satisfactorily a minimum wind speed of 3.5 to 5m/s is required and ideally a consistent wind speed of 5 to 6m/s are typically required to generate worthwhile quantities of electricity.

The power output from a wind turbine depends upon wind speed and the swept area of the rotor. The higher the rotors the more opportunity there is to maximise the wind speed and increase the output.

Wind turbines are more suited to rural locations as the size and impact within an urban setting tends to limit outputs to an extent where they are unfeasible. Visually they are likely to require planning consent and noise generated by the rotor blades can be considered a nuisance. Rotating turbines can also affect electromagnetic radiation and radiological surveys may be required in sensitive areas such as close to airfields.

5.6 Biomass

Heat energy is generated by the burning of organic matter such as trees, crops or animal waste which is harvested and processed to create bio-energy. Liquid fuels can also be generated from plant matter and this is referred to as biofuel.

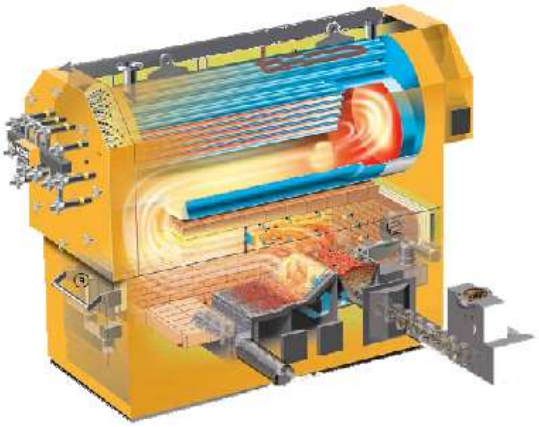
Whilst biomass produces carbon emissions when used as a fuel the carbon released during combustion is equivalent to the amount that was absorbed during growth and the technology is therefore considered to be carbon neutral. However, the availability of the fuel is important to consider as there are secondary carbon emissions generated by transport and treatment.

The main types of biomass are:

Woody Biomass: These are wood based which include forest products, short rotation coppice such as willow, hazel, poplar, miscanthus and other wood wastes such as pallets and construction timber waste. Most products require drying out as the moisture content of woody biomass affects the energy content.

Biofuel: Liquid fuel can be created from cellulose and vegetable oil crops such as palm oil and rapeseed which can be processed and used as vehicle fuel and to power engines and generating plant.

Animal Residues: Cattle, chicken and pig waste can be converted in to bio-energy by conversion to gas or other fuel types.



The use of biomass as a fuel can be used to generate heat within a specifically designed boiler which can replace traditional boilers or can be used as a lead boiler to deal with the base load in a system thus satisfying the requirement to supply a certain percentage of renewable resources and the comfort of a back up system when employing both technologies.

Ideally the use of biomass boilers is best utilised when a healthy supply of fuel is available locally. Provision should be made to store a sufficient supply of fuel and the overall design of such systems tend to be space hungry in comparison with traditional boilers. Provision must be considered for operational maintenance and the disposal of ash.

The installation of such systems may require consultation with the local authority to ensure compliance with the 'Clean air act' if located in a smoke control area and to ensure access is available for the delivery of fuel.

5.7 Combined Heating & Power.

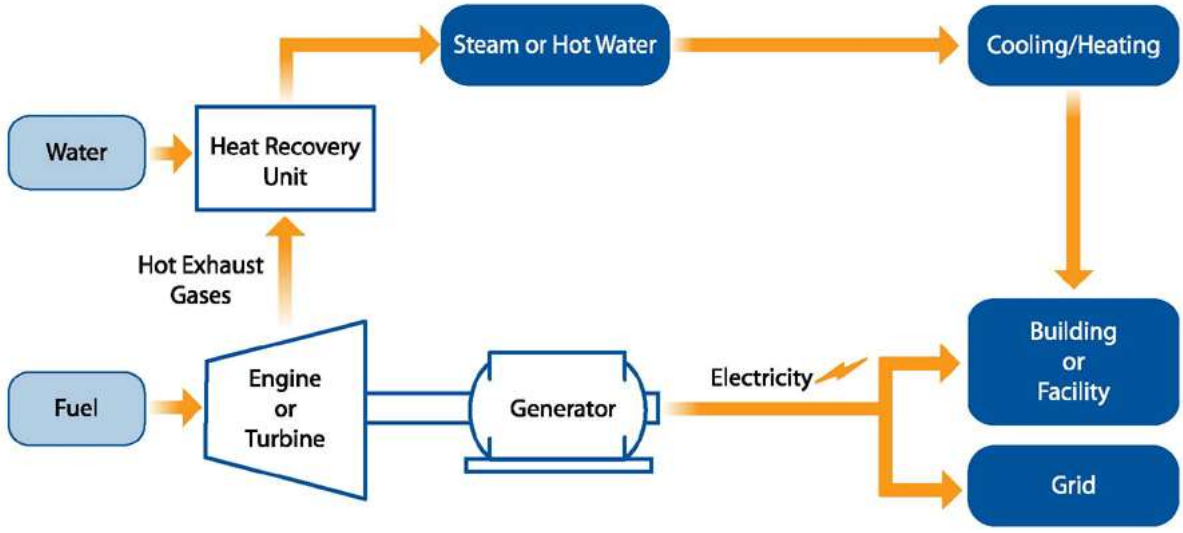
Combined heat and power (CHP) is the term used to describe the process of generating electricity whilst producing heat as a by-product. Electricity is generated using an engine and heat is recovered from the exhaust gases and cooling system.

The fuel used to produce electricity within a CHP can be:

- Biomass
- Natural gas
- Sewerage gas

The process of burning fuel still releases carbon but the by product of heat as a result of the primary function offsets the emissions and the production of electricity on site is far more efficient than an average power station increasing from typically 40% to 80% efficiency.

The use of CHP is most appropriate to buildings which have a constant year round base load demand for heat and can operate at a minimum of 4000 to 5000 hours each year. Units are available to match any output but systems can be employed in parallel with traditional heating boilers thus satisfying the requirement to supply a certain percentage of renewable resources. Normally around 5% of max heating load.



Micro CHP are now also entering the market for smaller systems which are an option to explore further.

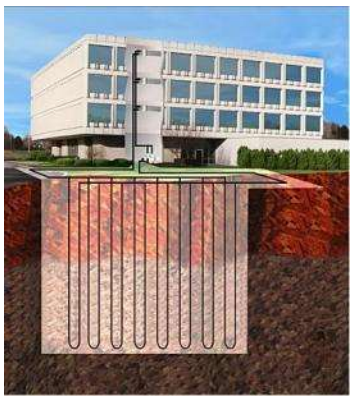
The demand for heat during the summer can often diminish leaving a limited hot water requirement which may be insufficient to satisfy the economies expected to efficiently run a CHP system, but use can be made of the heat energy during summer to operate an absorption cooling system which can provide an effective medium for cooling a building during the summer period. Domestic hot water pre-heat can also assist in the CHP operation during summer providing an all year round base load.

CHP systems like other generating systems do produce noise but can be effectively treated by use of purpose designed acoustic enclosures. The space requirements are generally larger than traditional boilers and consideration is needed in relation to the products of combustion but these are similar to those that would be required for boilers.

5.8 Ground Source Heat Pumps

The principle operation of a heat pump is the use of refrigerant gases and an electrical compressor to take heat from a source and deliver it to an output. For many years this process has been used by refrigerators to remove heat from a product and to remove heat from a building. This process can be used in reverse to add heat to a building by converting the energy available into useful energy as heat.The ground acts as a vast solar collector and thermal store which has a relatively all year round stable temperature and a good source of energy for this process to tap in to.

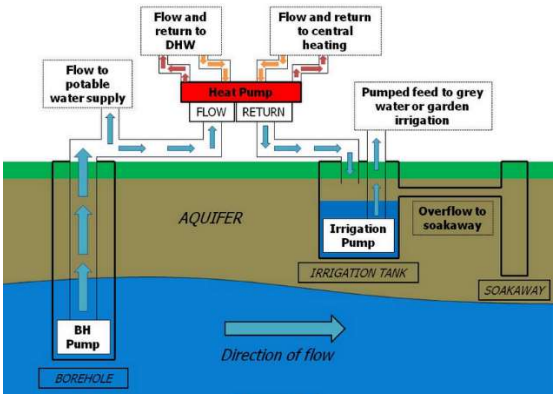
A fluid is circulated via a series of pipework buried in the ground which can either be vertically driven in to the ground or if the area permits, horizontally laid out in loops. The length of the pipework is proportional to the extent of energy required to satisfy the design conditions. The fluid is circulated through a heat pump which extracts the energy and converts this in to usable heat with temperatures in the region of 40 to 50°C which can be used to heat buildings via underfloor heating or radiant panels.



In order that the process can be considered renewable it is important that the depletion of the heat energy is matched by the rate of heat flow back in to the surrounding earth. The process can be used in the summer in reverse and buildings can be cooled by the same technology which assists in maintaining the energy balance.

5.9 Water Source Heat Pumps

The principles of water source heat pumps are the same as ground source but larger systems can use groundwater directly from suitable aquifers which can result in very efficient solutions.

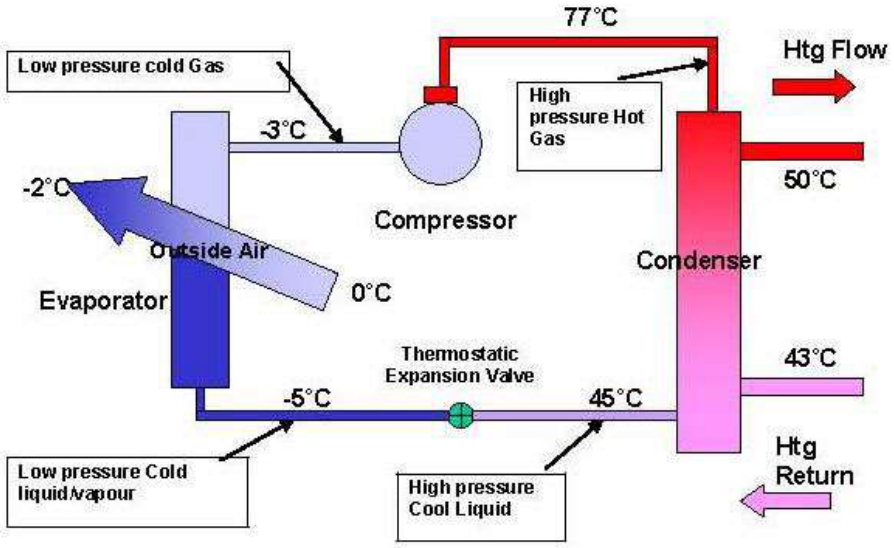


5.10 Air Source Heat Pumps

'Air to air' source heat pumps have been around for a long time and are used extensively to cool buildings during the summer and heat buildings during the winter.

'Air to water' source heat pumps are less prominent but use the same technology and instead of heating air within a building they are used to heat water which in turn can be circulated within a traditional low temperature heating system such as radiators.

This technology has recently seen much improvement and provides a medium for servicing a conventional heating system without the need for boilers and yielding high efficiencies. This cycle can also be reversed in summer to provide cooling to a building.



The choice of heat pump is very much dependent upon individual design circumstances. Whilst GSHP can offer high efficiencies its viability is very much dependent upon the geology of the site which will remain unknown until significant expenditure is committed to testing.

Water source heat pumps require careful design and tend to be more suited to larger scale schemes and can come under scrutiny of local authorities in terms of the impact on the aquifer.

'Air to air' and 'air to water' heat pumps are more safe in terms of technology as they are not dependent upon unknowns and whilst not as efficient as the other two technologies they are still high in comparison to more traditional techniques for heating and cooling and are renewable.

A new addition to the 'air to water' heatpump family is the CO_2 based unit. This type of heat pump varies greatly to the refrigerant-based models in terms of how it functions. The CO_2 variant operates with high efficiencies when subject to a large difference in flow and return temperature. These units can also provide leaving flow temperatures of up to 90ºC making them ideal for the generation of domestic hot water.

Systems are generally quiet in operation and have minimal local impact environmentally and visually.

5.11 LED Lighting

In recent years the improvement to lamp types has been significant. Compact fluorescents have become the norm and recently LED technology has improved to such an extent that LED is now challenging and rapidly replacing the fluorescent market.



Starting with the acronym LED itself, it stands for Light Emitting Diode and is the name for an electronic component which gives off light. These diodes are assembled into lamps, called luminaires, for use in a range of commercial and domestic applications. LED bulbs are far more energy efficient than conventional incandescent light bulbs, and have a much longer operating life.

It is proven through lux plots that LED offers up to eight times more brightness than incandescent lamps and can have a life span of up to 13 years when operating 10 hours per day.

With LED lighting, the watt is no longer an indication of brightness as most people are used to with traditional bulbs. Though wattage is still shown on LED bulbs, this is purely an indicator of their power consumption. The measurement to look out for is the lumen (lm), and the higher the lumen, the brighter the bulb. 230lm is equivalent to a traditional 25W bulb, and at the opposite end of the scale, 1340lm is about as bright as an old 100W light bulb.

As LEDs operate on DC power, they require electronics in the luminaire to convert mains electricity and power the light source. This is called the driver.

Unlike conventional light bulbs, LED lighting doesn't simply 'burn out' like old-fashioned bulbs when it reaches the end of its useful life (except in the case of driver failure). Instead, its light output gradually decreases over a long period of time, known as lumen depreciation.

The widely-accepted standard is L70, which is the point at which light output falls below 70% of its original level. This measurement shows the number of operating hours you can expect from the LED before its output falls below a useful level.

While a lumen is used to express how much illumination a source of light provides, the lux measures the intensity of light as seen by the human eye. The lux is measured by luminous flux per unit area and one lux is equal to one lumen per square metre.

Glare is the term used to express the visual discomfort experienced by excessive brightness and is calculated using a precise formula.

UGR (Unified Glare Rating) measures the luminance of a lamp divided by the background of visible luminance from the room. The number calculated is the UGR and the lower, the better. Low levels of UGR will go unnoticed whereas higher levels will definitely cause a distraction.

Frequently referred to simply as LED colour, this is a measurement which indicates the warmth of the light emitted from the luminaire. It is measured in degrees Kelvin and, put

simply, the higher the number, the whiter the light. The most common colour temperatures are as follows:

2700k – Often called Warm White, it emits a colour about equivalent to a conventional light bulb

3000k – Slightly less warm in appearance, roughly corresponding to halogen lamps such as those used in floodlights for exterior lighting solutions

4500k – Sometimes called Natural or Neutral White, this colour temperature is similar to natural daylight

6000k – A bright blue-white sometimes termed Cool White which is similar to the flash of a camera

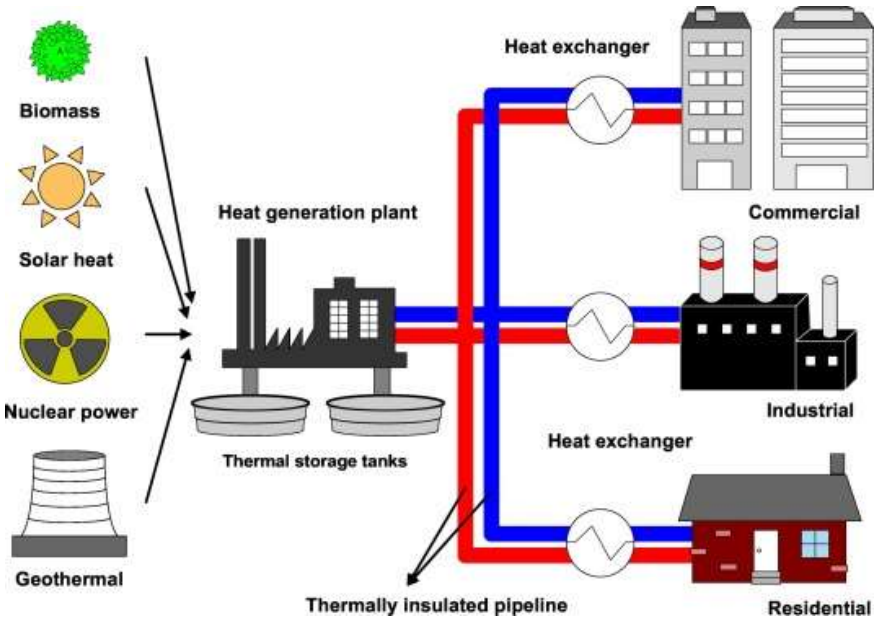
LED light fittings can also be used externally and high-powered LED light sources are extremely efficient returning a 50 to 75% saving over conventional sodium and mercury lamps without the yellowing over time due to their low temperature operation.

5.12 District Heat Networks

Heat networks (also known as district heating) supply heat from a central source to a project, via a network of underground pipes carrying hot water. Heat networks can cover a large area or even an entire city or alternatively be fairly local supplying a small cluster of buildings.

This avoids the need for individual boilers or electric heaters in each building. Heat networks are sometimes described as "central heating for cities". The central heat source is often referred to as 'the energy centre'. There are many possible technologies that can provide the input to a heat network including power stations, energy from waste facilities, industrial processes, biomass and biogas fuelled boilers and Combined Heat and Power (CHP) plants, gas-fired CHP units, fuel cells, heat pumps, geothermal sources, electric boilers and solar thermal arrays.

Heat is brought into each building through a 'heat exchanger' which, for a residential connection, is about the same size as a small gas boiler. All the same heating controls are available and to the end user the central heating and hot water system works in the same way as a domestic gas-fired central heating system without the need for any combustion to take place inside the building. Heat networks can be various sizes and serve various combinations of building types. Heat networks can be extended over time, and new heat demands, and heat sources can be added to the network.



Heat networks are particularly attractive in high-density built-up areas such as city centres, and also work well for new build developments and campuses, and for some more rural off-gas grid communities. They can deliver a wide variety of benefits to the environment, to consumers and to the wider economy.

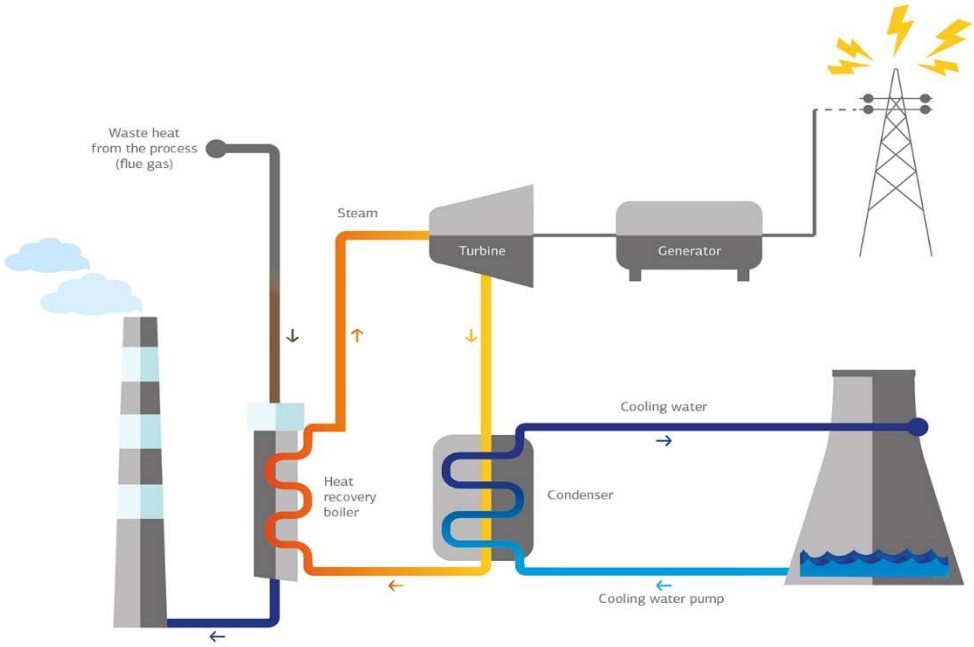
5.13 Waste Heat Recovery

Waste heat recovery systems work to recover the thermal energy from exhaust gas and convert it into electrical energy, while the residual heat produced can also be used for hot water generation to be used for services within a building.

Industrial waste heat is the energy that is generated in industrial processes which is not put into any practical use and is wasted or dumped into the environment. Sources of waste heat mostly include heat loss transferred through conduction, convection and radiation from industrial products, equipment and processes and heat discharged from combustion processes.

Similarly, energy production from agricultural waste can be harvested for use within building processed and added back into both electrical and heating networks.
Waste heat recovery methods include capturing and transferring the waste heat from a process with a gas or liquid back to the system as an extra energy source. The energy source can be used to create additional heat or to generate electrical and mechanical power.

Waste heat can be rejected at any temperature; conventionally, the higher the temperature, the higher the quality of the waste heat and the easier optimisation of the waste heat recovery process.



In order for this innovation to be highlighted for incorporation into a project it must first be ensured that there is suitable infrastructure in place to allow for incorporation. However even if infrastructure is in place, the inclusion of such technologies can have high capital costs associated.

6.0 Suitability to Project

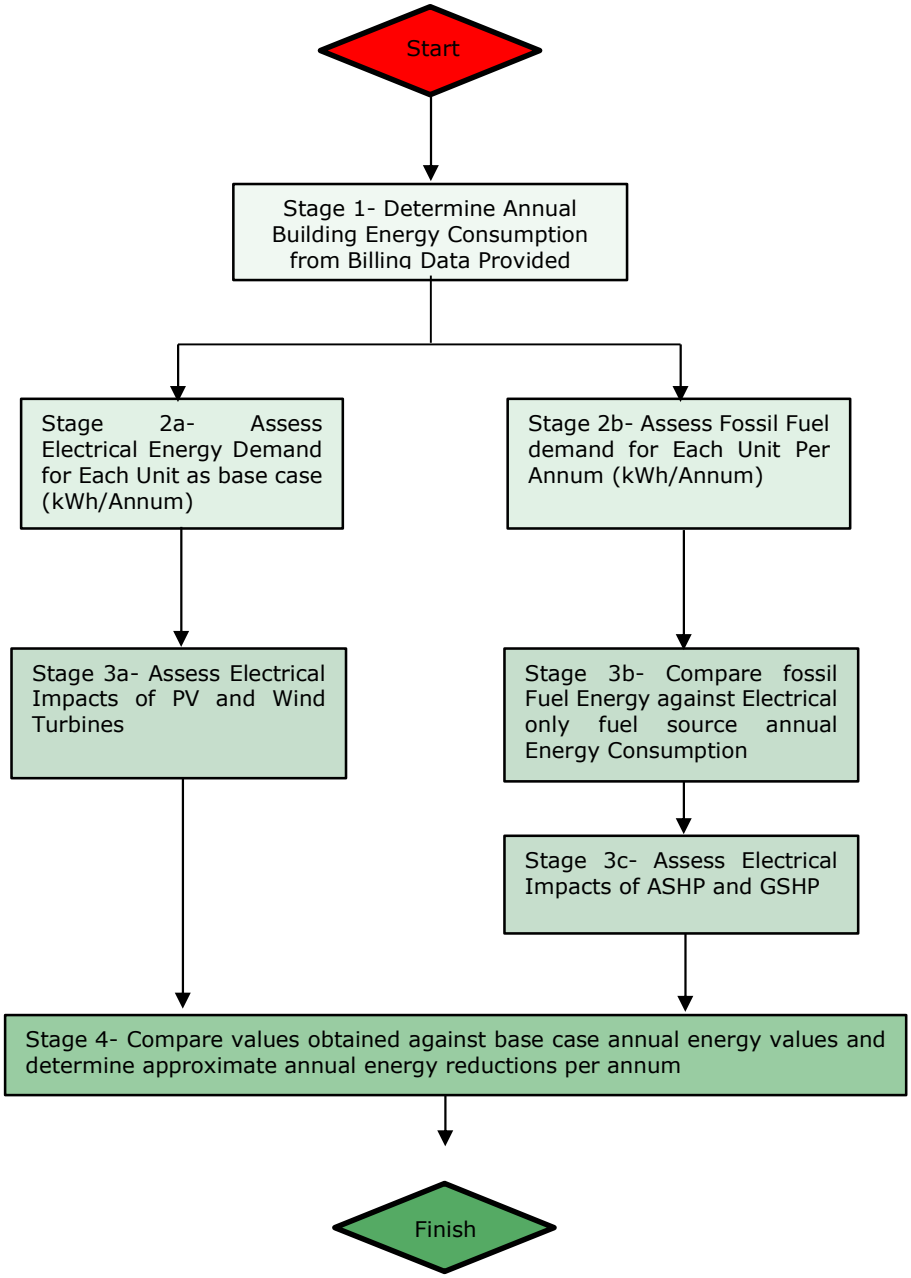
6.1 Overview

The section of the report provides a high-level assessment on how LZC technologies impact base case energy demand.

Building energy consumption data from billing information has been provided by Cheshire Council and forms the basis of analysis calculations.

The methodology in Figure 4 below sets out how each system is analysed in terms of their performance.

Figure 4- LZC Energy Assessment Methodology



6.2 LZC overview

Having examined all the possible options for providing low or zero carbon technologies we summarise our conclusions as follows:

Opportunity	Observations	Consideration
Solar Hot water	Ruled out due to cost associated.	Not considered due to suitability and high CAPEX.
Photovoltaics	Viable on flat and pitched roof space area.	To be included in assessment
Hydro power	No water course	Not considered as no known aquifer within the proposed area of work
Wind Turbine	Quantity is impractical and wind speed inadequate	Not considered due to planning constrains, capital cost and spatial requirements
Biomass boiler	Too expensive, high maintenance	Not considered due to shortage of fuel source, ongoing maintenance and back up gas boiler requirements
Combined heat and Power	Highly reduced efficiency due to improvements to electric emission factor.	Not considered due to natural gas requirement to generate
Ground source heat pumps	Risk in ground	Not considered due to requirement for auxiliary boiler requirement
Water source heat pumps	No known aquifer	Not considered as no known aquifer within the proposed area of work
Air to water heat pumps	Viable with available plant space	To be included in assessment
Co2 heat pumps	No common system.	Not considered as cannot be used on wet heating systems.
Low energy lighting	Viable to replace existing inefficient fittings.	To be included in assessment
Heat Networks	No existing heat networks in the area.	Not Considered as no communal opportunity for district heating in area
Waste Heat Recovery	Geographical location concludes that there are no opportunities for anaerobic digestion from cattle / methane recovery from landfill.	Not Considered as no known waste plant in the vicinity to utilise

The concept of using solar collectors to embrace solar energy to provide primary heating to hot water cylinders is possible as there is a constant all year-round hot water demand.

The relatively high capital cost and unreliability of solar hot water photovoltaics has deemed these inadequate for the project.

Biomass boilers were not considered. The overall capital cost of such a solution is excessive and more importantly the reliability of fuel resource is questionable. The sourcing of the fuel is difficult to guarantee and when considering the secondary carbon emissions through transportation etc a biomass solution does not provide a satisfactory solution.

The use of CHP has not been considered, as the future decrease in carbon savings due to changes in emission factors provides a less attractive source of low carbon technology. The large percentage decrease in the emission factor for electricity has prompted the use of ASHP's as a superior alternative for decreasing building carbon emissions.

Ground source heat pumps are not being considered for this scheme. High capital costs and high level of design/installation works has led to this system being outlined as unsuitable. The same applies to water source heat pumps as no water source is available for this site.

Air source heat pumps are to be considered for the energy and carbon assessment for this building.

ASHP's offer a large reduction to the buildings carbon emissions, and this will become more evident year on year with the constant reductions to emission factor for electricity due to the decarbonisation of the electrical grid.

Solar photovoltaics are viable for this project, considering the carbon and energy savings they can provide and the large additional available space on the roof. Photovoltaics have the least demand in terms of maintenance and provide a long economic life.

LED lighting upgrades are to be considered in lieu of old inefficient T5 fluorescent fittings throughout the building, it has been assumed following investigations that circa 50% of existing fittings are T5/T8 fluorescent.

Separate metering is to be provided in line with CIBSE TM39 guidelines for each renewable technology installed. The meters shall be linked back to the BMS which shall log all data relating to energy use and GHG emissions to provide a platform for the energy monitoring for the building.

6.3 Plant Locations

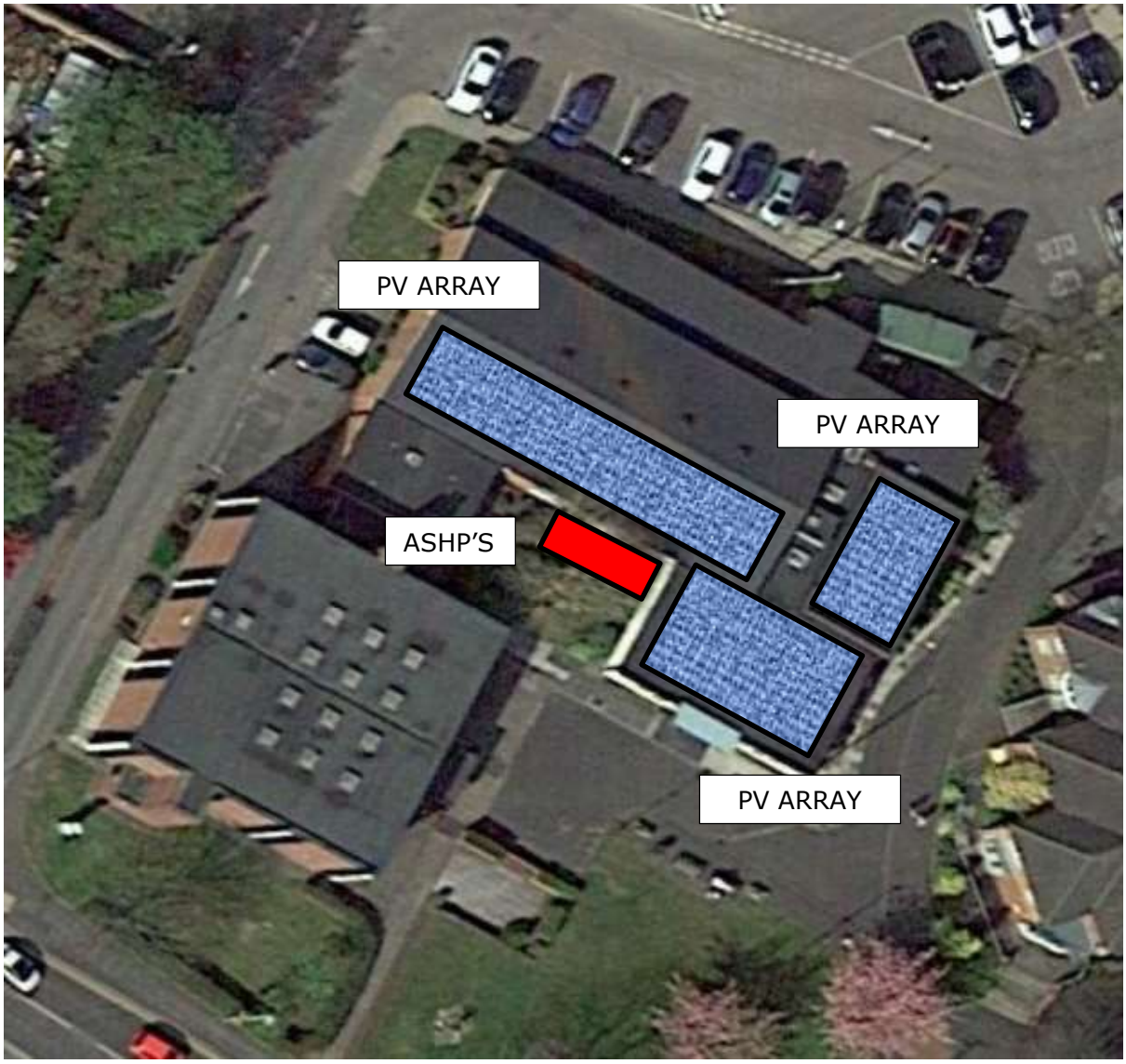
Photovoltaics

From the initial site investigations, there appears to be available areas to the roof sections of the building to house photovoltaics with a South-West facing orientation on suitable pitched structure mounting. The proposed quantity of photovoltaic panels and the anticipated area required for installation are detailed within section 8.1. The inverters for the system can be housed within the boiler room.

To confirm the roof has sufficient structural integrity for the additional weight of the photovoltaic installation it would be recommended a full structural survey of the roof be carried out by a structural engineer. The estimated weight of the photovoltaic installation is detailed within section 8.1 - photovoltaics.

Air Source Heat Pump's

Space heating air source heat pump can be located on the vacant grassed area on the perimeter of the Alsager Civic Hall site. Primary heating flow and return pipework shall be routed through at high level from the ASHP to the internal plant room area.



7.0 Estimation of Annual Energy Consumption

Building energy consumption:

Gas	73634	kWh/m²/annum
Electric	46891	kWh/m²/annum
Total	**120,525**	**kWhrs/annum**

Estimated building GHG emissions:

Gas	13,254	kgCO2/annum
Electric	9,941	kgCO2/annum
Total	**23,195**	**kgCO2/annum**

Annual Energy Consumption x Carbon Intensity Factor = Estimated Building GHG Emissions

** Carbon intensity values from 2023 UK Government Conversion Factors for greenhouse gas (GHG) reporting*

Gas	*0.18*
Electricity	*0.212*

Full chart and current fuel emission conversion factors available at:
https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2023

8.0 Energy Analysis Calculations

8.1 Predicted Energy Analysis Calculation

Below represents the predicted energy and carbon savings for each of the considered technologies.

Fabric Upgrades

The anticipated potential fabric upgrades for this building include:

External walls: Not included
Roof: Additional Roof Insulation.
Windows: Not included

Predicted fabric upgrade energy savings:

Annual Energy Consumption - Pre Incorporation	**73,634**	**kWhr/annum**
Building Heating Demand Reduction	**10%**	
Annual Energy Consumption - Post Incorporation	**66,271**	**kWhr/annum**
Annual Energy Saving	**7,363**	**kWhr/annum**

BEMs

It is predicted that the new controls and building management system will provide a 3% reduction in gas energy usage

Annual Energy Consumption - Pre Incorporation	**66,271**	**kWhr/annum**
Annual Energy saving	**1,988**	**kWhr/annum**
Annual Energy Consumption - Post Incorporation	**64,282**	**kWhr/annum**
Energy saving over system lifetime	**49,703**	**kWhr**
BEMs predicted economic life expectancy	*25*	*Years*

** System lifetime based on CIBSE Guide M*

ASHP'S (Air to Water)

Air Source Heat Pumps's are to replace existing gas fired boiler plant.

	Gas boiler	Heat Pumps
Annual Energy Output (kWhr)	49,498	49,498
Seasonal Efficiency	0.77	3.20
Annual Energy Input following fabric and BEMs upgrades (kWhr)	64,282	15,468

Oil Boiler Annual Energy Input – Heat Pump Annual Energy Input = Total Energy Reduction

Annual Energy Consumption (Gas) - Pre Incoporation	**64,282**	**kWhr/annum**
ASHP vs Gas Boiler Annual Energy saving	**48,815**	**kWhr/annum**
Annual Energy Consumption (Gas) - Post Incoporation	**15,468**	**kWhr/annum**
ASHP vs Gas Boiler Energy saving over system lifetime	**976,290**	**kWhr**
ASHP predicted economic life expectancy	*20*	*Years*

** System lifetime based on CIBSE Guide M*

Photovoltaics

Predicted number of PV panels	80	
Area per PV panel	1.82	m²
Total PV Area	146	m²
Weight of PV System	1680	kg
Total power of system	31	kWp
Annual Energy Consumption - Pre Incorporation	**46891**	**kWhr/annum**
Annual Energy Generated via PV	**23,063**	**kWhr/annum**
Annual Energy Consumption - Post Incorporation	**23,828**	**kWhr/annum**
Energy saving over system lifetime	**576,575**	**kWhr**
PV predicted economic life expectancy	*25*	*Years*

** System lifetime based on CIBSE Guide M*

LED Lighting

Existing Luminaires	72	W (inc. losses)
New LED Luminaires	35	W (inc. losses)

Existing Luminaire (w) - New LED Luminaire (W) = Energy Saving Per Luminaire

Saving per luminaire	37	W (inc. losses)
Number of Luminaires	55	
Total energy saving	**2035**	W (inc. losses)

Anticipated Operational Hours

Hours per day	8	
Days per week	7	
Weeks per year	48	
Total	**2688**	hrs
Annual Energy Consumption - Pre Incorporation	**46891**	**kWhr/annum**
Annual Energy Saving	**5,470**	**kWhr/annum**
Annual Energy Consumption - Post Incorporation	**41,421**	**kWhr/annum**
Energy saving over system lifetime	**136752**	**kWhr**
LED predicted economic life expectancy	*25*	*Years*

** System lifetime based on CIBSE Guide M*

Combined System Savings

The predicted net saving in energy for this project is as follows:

Total annual energy saving	**79,336**	**kWhr/annum**
Energy saving over lifetime	**1,739,320**	**kWhr**

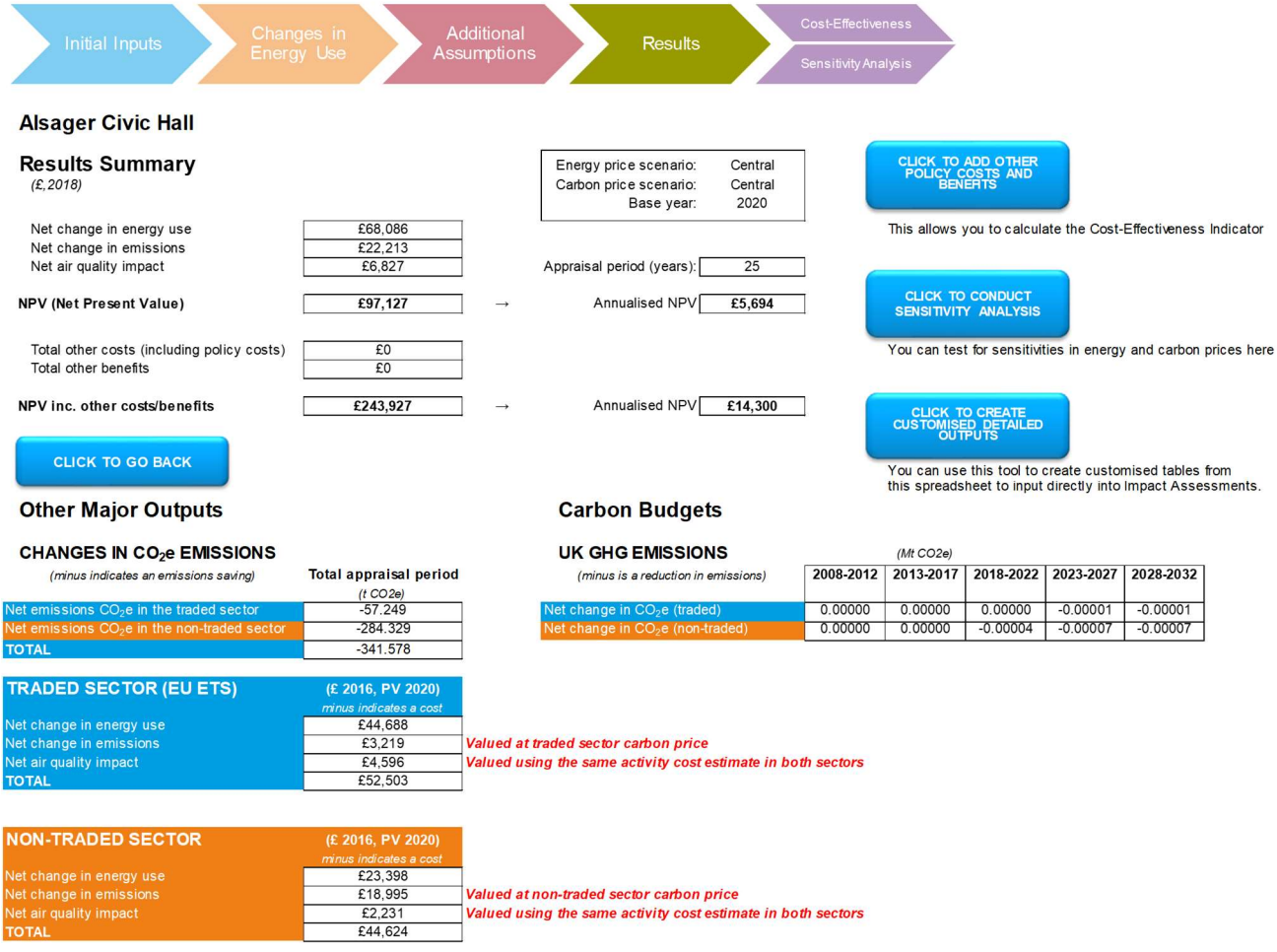
8.2 Support Tool Extract Confirmation.

The below displays the output figures from the 'IAG spreadsheet tool for valuing changes in greenhouse gas emissions'.

The input figures for energy reduction for both gas and electricity have been extracted from section 8.1.

Rebound effect has been neglected for this calculation.

HTM green Book recommended discount rates applied.



** The above carbon saving figures are inclusive of Sailx predicted future change to carbon intensity factors for both gas and electricity based on the Salix calculation methodology.*

** The above spreadsheet tool relates to phase 1 of the Public Sector Decarbonisation scheme with dates pre-set from 2020. As no updated toolkit has been made available the above has been used to demonstrate/confirm carbon savings in line with previous Salix guidance.*

9.0 Compliance with Funding

The below provides a breakdown for the budget costs associated with each technology proposed for this project. The total carbon savings generated for the combination of the proposed technologies has been taken from the Salix support tool output as detailed within section 8.2 of this report.

System Costs

Fabric Upgrades (Roof)	£13,800.00
ASHP System	£82,600.00
LED Lighting	£19,960.50
Photovoltaic Installation	£36,975.00
BEMs Upgrade Cost	£19,500.00
Electrical Works	£19,500.00
Minus Business as Usual Costs	£22,000.00
Total Grant Application	**£170,335.50**
Total Carbon Savings (tCO2)	**341**
Total cost per tCO2 saved	**£499.52**

Note – The BAU cost of £22,00.00 has been shown here for information purposes only. The Salix application tool qualifies this cost as a separate input, therefore the cost to input into the Salix application tool is in fact £192,355.50 (minus BIU cost of £22,000.00)

As highlighted above, the proposed LZC technologies detailed within this report falls within the maximum £/TC02e criteria.

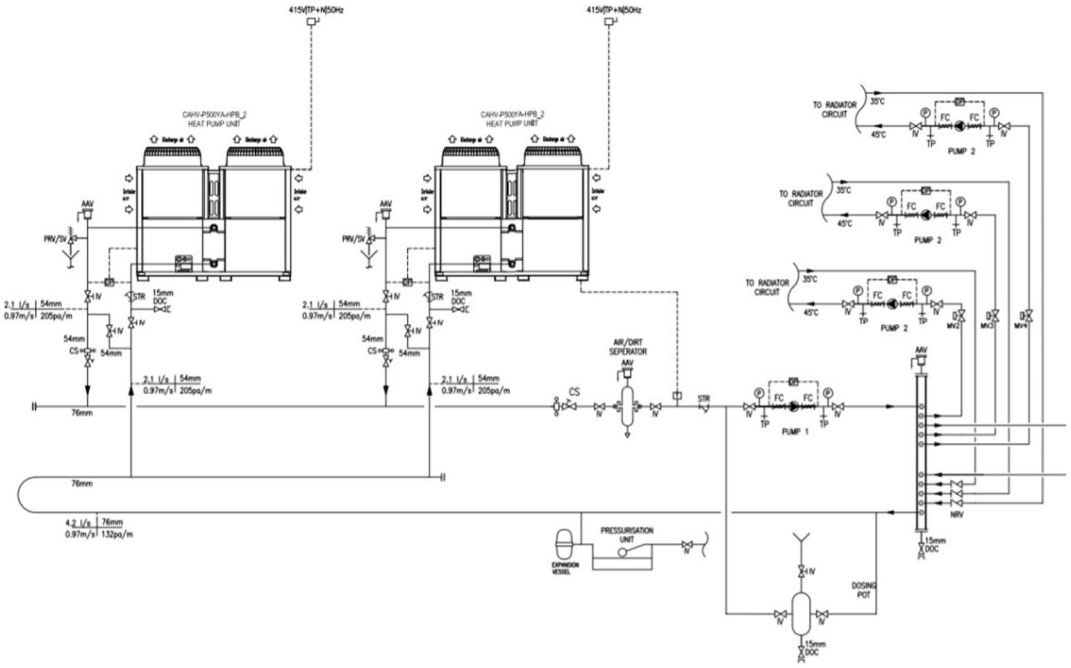
The systems provide a large saving on energy and carbon over the lifetime of the installation instigating a good cost to benefit ratio in this respect. Outline proposals are also viable in the sense of the practical installation and integration of the systems into the current building.

10.0 Concept ASHP System Details & Schematic

The below outline typical options for installing the air source heat pumps for the space heating. This is a standalone system intended to fully replace the existing boiler plant.

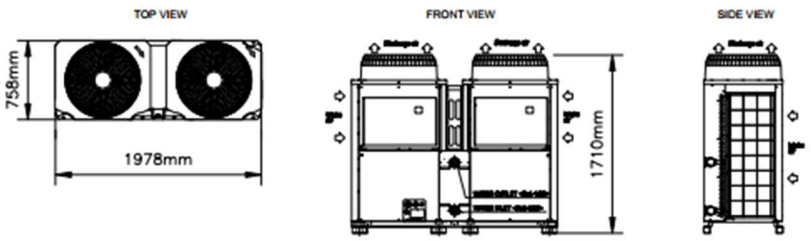
During the detailed design period, a full survey and assessment will be carried out to determine the best piping and connection method at site level.

Note the below are indicative only at this stage.



Mitsubishi CAHV Air to Water Modular ASHP for Space Heating – Typical Schematic

PRELIMINARY ASHP SCHEDULE								
System	Manufacturer	Model	Flow Temp (ºC)	Duty (kW)	Electrical Supply	Running Current [Max] (A)	Fuse Rating (A)	Quantity
Space Heating	Mitsubishi	CAHV-P500YB-HPB	55	42	380-415v, 50HZ	17.6 [52.9]	63	2

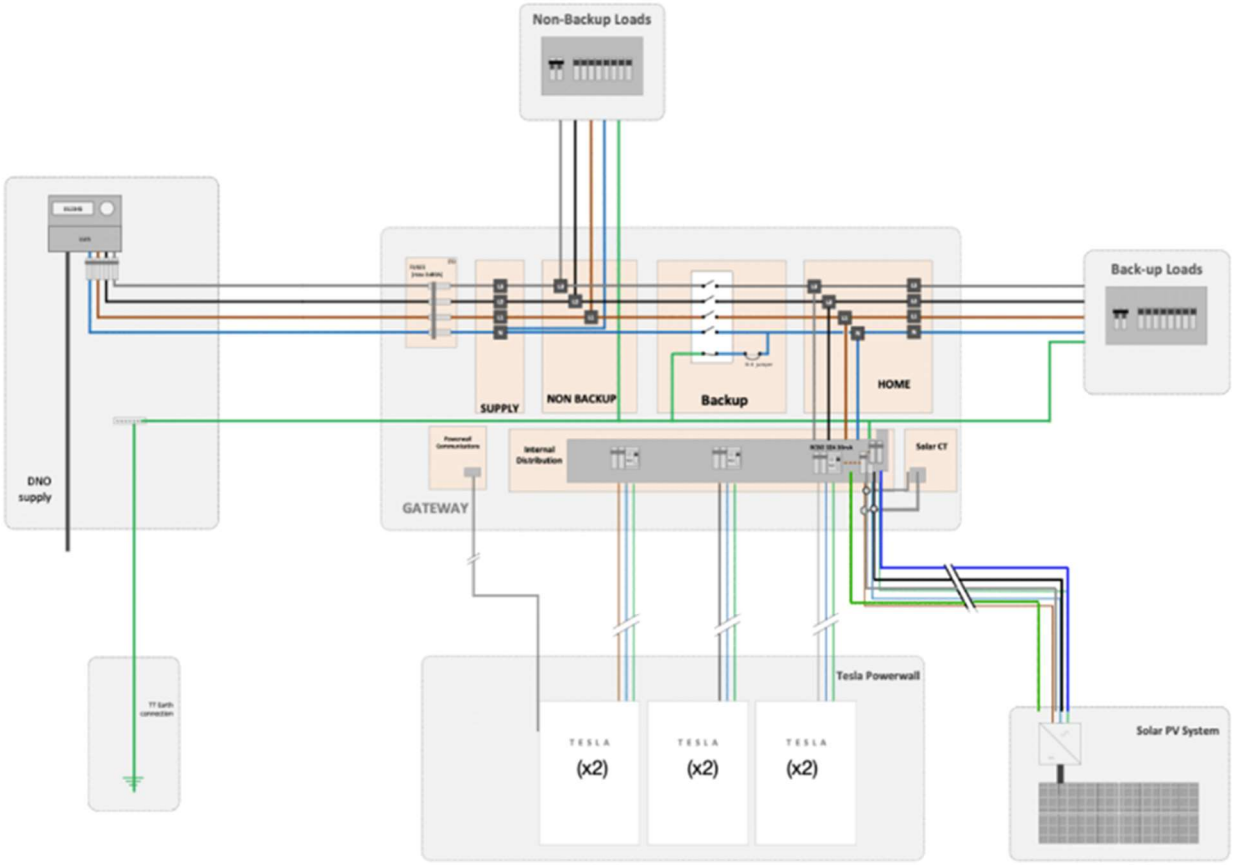


The above represents a typical installation for the anticipated quantity of units required for this project. Refer to Mitsubishi installation manual for alternative installation methods. The requirement for a plant screen / protective enclosure may need consideration around the external ASHP units.

ENA available electrical capacity application shall be made as part of this application and is currently on going.

11.0 Concept Photovoltaic System Schematic

The below outlines a typical system schematic for installing the photovoltaic array with the inclusion of battery storage.



G99 application shall be made as part of this application and is currently on going.

12.0 Predicted Annual Energy Costs

Annual Energy Costs

Below indicates the predicted annaul running costs for each of the considered technologies.

Photovoltaics		
Annual Energy Saving	23,063	kWhr/annum
Annual Energy Cost Saving	£3,690	
Annual generation tariff	£9	
Total Annual Energy Cost Saving	**£3,699**	

Energy Costs		
Electricty	0.16	£/kW
Gas	0.067	£/kW
Gen tariff	0.0004	£/kW

ASHP's		
Gas annual energy Input	64,282	kWhr/annum
Annual cost of energy	£4,307	
Electrical energy input	15,468	kWhr/annum
Annual cost of energy	£2,475	
Annual Energy Cost Saving	**£1,832**	

LED Luminaires		
Annual Energy Savings	5,470	kWhr/annum
Annual Energy Cost Saving	**£875**	

Total Annual Energy Cost Savings		
Annual Energy Cost Savings	**£6,407**	**/annum**

13.0 Budget Costs

Budget cost estimates have been completed for the extent of the proposed installation works as detailed below. These figures have formed part of aforementioned calculations.

Project	**Alsager Civic Hall**	*Total Cost*	*Total Sales Price*
Section	**Summary Sheet**	**£ 155,835.00**	**£ 192,335.50**
		Total w/MCD	~~£ 197,267.18~~

Item No.	*Description*	*Cost*	*Sales Price*
1	Working Drawings	£ 2,000.00	£ 2,600.00
2	Project Management	£ 1,500.00	£ 1,950.00
3	Preliminaries	£ 3,000.00	£ 3,900.00
4	Isolations, Disconnections & Strip Out	£ 2,000.00	£ 2,300.00
5	Air Source Heat Pump Works	£ 39,750.00	£ 51,675.00
6	Trenching & Pre-Insulated Heating Mains (External)	£ -	£ -
7	Plantroom Ancillary Works (Pumps, Pipework, Press. Unit etc)	£ 5,000.00	£ 6,500.00
8	BMS Works	£ 15,000.00	£ 19,500.00
9	Thermal Insulation	£ 1,000.00	£ 1,300.00
10	Electrical Upgrade Works & Plantroom Electrical Works	£ 15,000.00	£ 19,500.00
11	Heating Emmiter Upgrades	£ 8,000.00	£ 9,200.00
12	Test & Commission	£ 1,500.00	£ 1,950.00
13	Solar PV System Quote inc. Scaffold	£ 31,000.00	£ 34,100.00
14	G59 & Associated Electrical Switcvhroom Works	£ 1,500.00	£ 1,725.00
15	Test & Commission	£ 1,000.00	£ 1,150.00
16	Supply and Fit of New LED Lights	£ 12,375.00	£ 16,087.50
17	Rewire of new Switches inc Lighting Wiring Using Existing	£ 1,210.00	£ 1,573.00
18	Test & Commission	£ 2,000.00	£ 2,300.00
19	O&M Manuals	£ 500.00	£ 650.00
20	As-Fitted Drawings	£ 500.00	£ 575.00
21	External Wall Insulation (Injection)	£ -	£ -
22	Roof Insulation (Mineral Wool Mat)	£ 12,000.00	£ 13,800.00
23	Double Glazed Windows	£ -	£ -

Note – The above are budgetary costs only and should be verified by a supporting contractor.

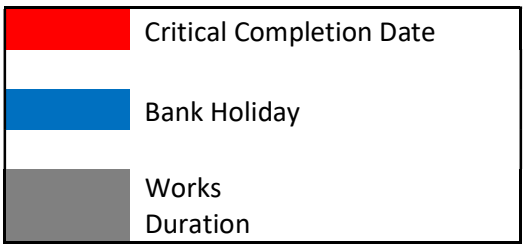
The council 12% project management and health & safety / principle designer costs need to be allocated separately as part of the application along with any specific project contingency.

It's important to note that should the £510 per Co/tonne be exceeded, the council are eligible to offer up the difference to supplement the project financials.

14.0 Programme

A programme has been developed for the proposed works. It has been envisaged that these works shall take place over the period detailed in the programme below within critical complete date set at Friday 19/10/25.

The proposed indicative programme is detailed as Appendix 5 of this report and details the stages of work from pre-construction up to final completion on site in-keeping with critical completion date.



15.0 Project Risks & Mitigation

Below is a matrix of the MEP services residual technical risks and mitigation for the site. The risks shall be reviewed during the detailed design stage with a view to mitigate as part of any future development of the design works:

No.	Risk	Rag	Proposed mitigation
1	Preliminary Structural appraisal required for ASHP's to finalise location and to determine required scope of works and costs.	A	Engage structural engineer to review proposals. Costs to be reviewed thereafter.
2	Preliminary acoustic appraisal required for ASHP's to determine the proposed location suitability	A	Engage acoustic engineer to review proposals. Costs to be reviewed thereafter.
3	Planning implications for ASHP's as well as fabrics etc.	A	Engage planning consultant for early input and advice
4	Integration of ASHP technology electrically into the building may lead to additional unforeseen costs.	A	Review peak building electrical capacities and electrical infrastructure. Engage with local utilities provider / DNO. G99 and ENA applications to be made.
5	Works require substantial phasing leading to additional risk and costs	R	Develop outline programme and phasing strategy and cost impact.
6	Confirmation that spatial requirements are sufficient and will not impact any other services.	A	Initial survey suggests special layouts are adequate. To be reviewed further during detailed design stage.
7	Asbestos present within building. (No allowance has been made for removal works).	A	A Full asbestos survey for the building is to be undertaken.
8	ENA application for the connection of the ASHP's to the electrical supply.	A	Engage with local DNO for confirmation and acceptance.