KINVER SPORTS AND COMMUNITY ASSOCIATION

Energy & Sustainability Feasibility Report

Kinver Sports & Community Association

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Contents

1. Financial and Carbon Impact Executive Summary

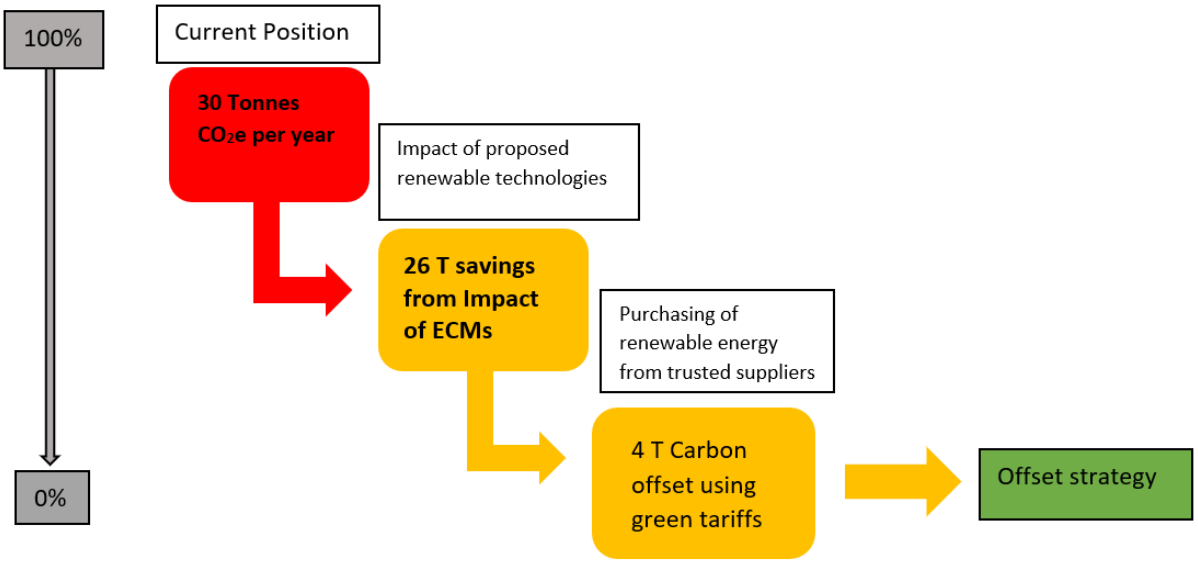
Maloney Associates have undertaken a comprehensive energy and carbon appraisal of Kinver Community Centre located in KInver.

The purpose of the review was to identify effective energy efficient and low carbon conservation measures that will deliver operational cost savings and increase the energy performance of the Centre. The review also provides a roadmap to show how the Centre can progress to a Zero Carbon footprint. A Glossary was provided in section 18 for the reader to define, refer to or expand upon various terms and abbreviations used in this paper.

In addition, the audit has been undertaken to the required standards of an Investment Grade Audit (IGA). This includes detailed energy appraisal, calculations, and investment payback calculations. A Methodology was included below, followed by details on comprehensive energy saving measures.

The headline energy savings have identified potential savings that represent an annual reduction of **79,794 kWh** in gas consumption and **47,399 kWh** in electricity consumption (this includes the calculated electricity consumption needed for the operation of the ASHP). This equates to a carbon emission reduction of **15 tonnes** for gas, and **11 tonnes** for electricity. This totals an **87.8%** reduction in energy consumption, and a **86.3%** reduction in associated carbon emissions. This will result in the Centre having 4 tonnes of carbon (associated with electricity). This can be offset with a green tariff grid electricity.

Fig. 1: Road to carbon net zero illustration



This figure above represents a step by step visual representation of KSCA's road to carbon net zero would the renewable technologies specified in the ECMs be adopted. The values start at 30 T a year from water, electricity and gas usage, and can eventually be offset by purchasing remaining energy needs from certified renewable energy suppliers.

2. Introduction and Information on Kinver and Surrounding Area

The Community Centre is located in the village of Kinver, South Staffordshire, and was built in the 1960s. The Community Centre provides a focal point for the local community activities including events such as acting contests, meetings such as a children café and ceremonies such as weddings, and provides extensive external outdoor activities that include a gym, football, cricket, bowling club, and a public footpath. It has suffered from the absence of much needed investment in the latest years and the building was found after a recent inspection to be in a deteriorating state. The building services are in a dilapidated condition and the boiler plant has significantly exceeded its life expectancy and will be subject to failure and expensive energy operating costs.

It is the objectives of the Kinver Sport & Community Association (KSCA) to provide a community facility fit for the 21st Century. It is proposed that grant support be sought to assist the Association's objectives. This includes a redevelopment of the Centre that will embrace sustainability best practice goals and provide a demonstrable community project. At present, Kinver has a population of 7-8,000 people.

The first traces of human settlements in Kinver are thought to be dating from the Iron Age according to a visual assessments of the region [D.M. Bills & Griffiths, 1981]. The village was overseen by a roman fort sometime in the first centuries AD, and first appeared in a written charter in 736 AD.

Similarly to the rest of Midlands, it had an industrial presence between 1850 – 1945, which gradually fell after the second World War. Kinver met with expansion and a growth in population as council and private houses were built in the second half of the 20th century. Today, it can be identified as a large village bordering on the counties of Shropshire, Hereford and Worcester, and also the Dudley Metropolitan Boroughs.

The community's aspirations and worries about achieving carbon net zero have surfaced in the light of new national and international regulations in regards to climate change, which puts the fragile area that the village of Kinver and its community centre are situated in at risk. This area is comprised of the river Stour floodplain near Kinver Edge, the latter being home to a rare heathland habitat and place-specific houses made of soft red sandstone. It has been recognised that places of cultural and social interest such as Kinver play an important role in greenhouse gas emissions regulation and every small change in technology and consumption counts towards the national and eventually global output. Limiting global warming to under 1.5 degrees Celsius could reduce the number of people susceptible to climate-related poverty risks, such as vector-borne diseases and food security, by as much as several hundred million by 2050 [Climate NASA, 2019]. The urban heat island effect and heat-related illnesses will similarly be reduced and vulnerable habitats, such as the riparian one present in the Marsh Recreational area, would remain protected.

It is proposed that MA would provide professional services to deliver a feasibility report for the key sustainable services that can be incorporated within the Community Centre. This will include low carbon technologies, renewable generation, key energy efficiency improvements and water recycling. These objectives have been detailed in the following chapters. MA recognises that the volunteers of Kinver Sports and Community Association have played an important role in providing necessary historical building information for the creation of this report. Community-led initiatives have the power to inspire present and future generations to act as agents for positive change, where norms and attitudes would otherwise become – for better or for worse – entrenched.

This report has been carried out with the help of the Rural Community Energy Fund and the National Lottery. This has enabled the commissioning of a feasibility study at Kinver Community and Sports Centre to establish the suitability of Low or Zero Carbon Technologies (LZC) for the building's development. It shall cover the following range of energy technologies: rainwater harvesting, air-source heat pump (ASHP), solar photovoltaics (PV) and electric vehicle charging points (EVCP), as well as an assessment of current building services, electrical infrastructure and insulation. Further, the feasibility of exporting heat and electricity from its system, as well as impact of the potential specification in terms of carbon emissions and grant availability, will be discussed.

The changes at Kinver Community Centre are long-term solutions tackling energy consumption and conservation measures, a necessary step in cutting CO_2 emissions, as well as in enhancing local community wellbeing and its economy.

The findings from our review and site assessment were that the building would greatly benefit from improved thermal insulation and renewable technology systems, such as Photovoltaics and an Air Source Heat Pump.

Through the £15 million initiative funded by the Department for Environment, Food and Rural Affairs (Defra) and the Department for Business, Energy and Industrial Strategy (BEIS) called Rural Community Energy Fund (RCEF), rural communities of under 10,000 residents are supported to develop renewable energy projects which provide economic and social benefits to the community. This grant initiated by the government provides support in two stages, starting with a grant for a feasibility study for a renewable energy project, and then for business development and planning.

The National Lottery Community Fund is also helping support the refurbishment and building upgrade work at Kinver. As a public body, the organisation distributes funds raised by the National Lottery to community organisations and voluntary projects. Education, environment and energy security are areas that will definitely be impacted by the support received through this fund.

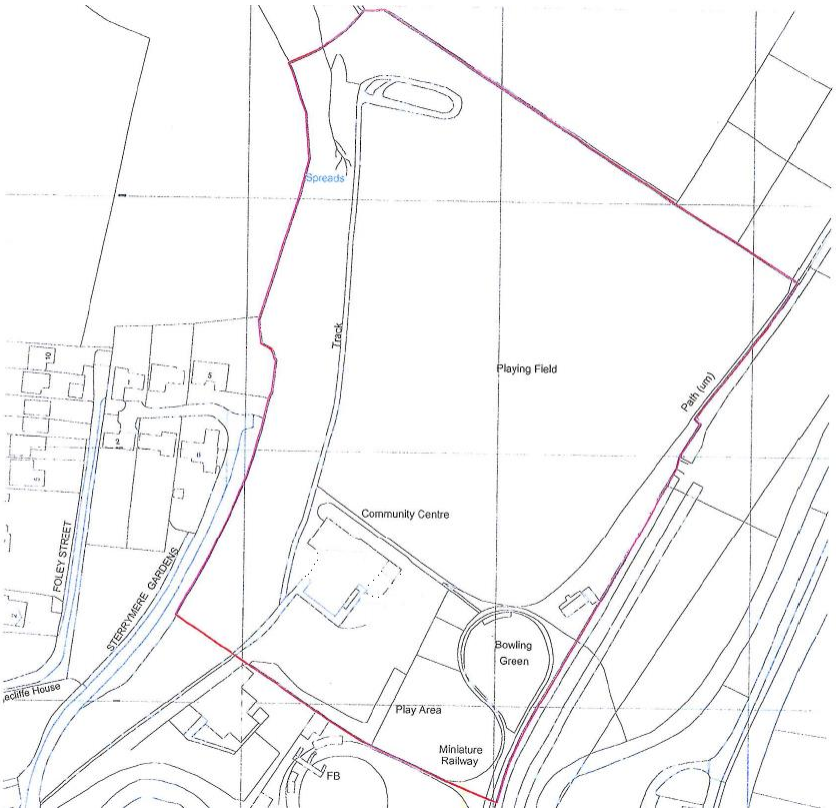
Without the aforementioned funding, this review would have not been possible.

The site lies between a Conservation Area and Flood Zone 3 (Land having a 1 in 100 or greater annual probability of river flooding). No significant landscape features exist within close proximity of the site. The closest area of conservation is Kinver Edge.

Fig. 2: Flood Map of the Kinver Sports and Community Centre area, 2020.

The KSCA building can be observed resting on raised ground in what is defined as Flood zone 1.

Fig. 3: Kinver Sports and Community Centre/Marsh Recreation Area boundaries, 2017.



The boundaries of Marsh Recreational Area can be observed marked in red, with the Sterrymere on the left-side of the map and track. In some map representations, these boundaries extended to the elongated strip visible in the bottom-left corner to the right side of the Sterrymere Gardens.

3. Background on Maloney Associates Ltd

Maloney Associates are Energy and Carbon Management Consultants with a wealth of experience and expertise in delivering Energy Management Reduction Programmes.

We have delivered major energy and carbon saving programmes, which have included behavioural change strategies for major blue-chip clients. Many of these programmes have been recognised with national awards, including five within the last three years.

Prior to creating Maloney Associates in 2007, our Managing Director, Keith Maloney, was responsible for delivering an energy saving strategy for the Co-Operative Group. This resulted in energy savings of over £20million across 2,500+ sites. The behavioural change programme for the United Co-Operatives helped to deliver a 12% energy consumption reduction within the first year of launch and increased the Co-operatives profit levels by 8% for that financial year.

This valuable experience has not only continued to help the Cooperatives but furthermore, Maloney Associates have delivered and supported energy saving projects across many sectors including on-going clients such as Manchester United FC, NHS, Knowsley Housing Trust, Belton Farm and Arla Dairies.

A recent project commissioned by Maloney Associates for Knowsley Housing Trust resulted in the delivery of the low carbon refurbishment for the King George V Community Centre, a community-focused project supported with grant funding. MA received the **'Supply Partner Of The Year Award'** in 2018 for the energy saving programme they deployed for Knowsley Housing Trust.

In addition to providing tailored energy reduction plans, we provide a wide range of Energy and Carbon Management Specialist Services. We have extensive knowledge and experience with energy analysis work and provide a Bureau Service to many of our clients. We also have a highly specialised Independent Measurement and Verification Service and of the handful of specialists in the UK, MA actually have two leading Certified Professionals within the company.

Our staff are highly qualified and experienced and additionally include Accredited CIBSE ISO 50001 Consultants, Accredited ESOS Lead Assessors and Accredited Low Carbon Consultants in Building Operation and Design.

Keith is also a Regional Representative and Officer for the Chartered Institution of Building Services Engineers (CIBSE) and has received the Institution's Bronze Medal for services to the Industry. He has actively assisted advisory panels on compliance and statutory papers that have included the Carbon Reduction Commitment Scheme and Building Regulations.

4. Aims & Objectives

The objective of this feasibility report is to help the association with the Community Centre appraisal and fulfilment of their carbon net zero targets.

It is recognised that the aspiration of the KSCA is to be carbo net zero, but part of the road map to achieve that is to include cost-effective measures in accordance with the support received from the funding scheme which may include the renewal of existing heating systems as a backup plan.

This report considers the measures indicated to be deployed within the wider development scheme that the association is looking at with the designer.

The feasibility report will include the following key elements and wider objectives:

- Present an overview of the KSCA and sustainability objectives.
- Holistic operational assessment of the KSCA.
- Methods to reduce energy usage and environmental impact.
- Solar PV electricity generation and potential energy storage.
- Solar thermal and air source heat pump hot water production.
- Air source heat pump generation for Low Temperature Hot Water (LTHW) heating.
- Review of the building envelope and feasibility for thermal insulation improvement and assessment.
- Rainwater recovery and harvesting.
- Internal and external lighting review.
- Electric vehicle charging points.
- Energy use (and renewable generation) monitoring system and community display.
- Review of the site electricity network connection capability and availability.

The feasibility report will include detailed appraisal report and the inclusion of financial costing, business case and benefits, which include financial savings and carbon emission reductions. The feasibility report will include a fully detailed appraisal that will support and can be included with potential grant funding applications.

It will also provide a risk register within the project viability plan. This will include a risk review of each of the identifies measures recommended within the report and mitigation actions required to manage such risks.

5. Methodology

A review of the energy use and subsequent savings report and action plan has been conducted and developed for Kinver Community and Sports Centre. A combination of desk-based and site-based review methods were employed in order to successfully complete the review. These include the following:

- Site visit, assessment and appraisal.
- Collection and analysis of data in cooperation with the KSCA volunteers and committee members.
- Desk-based modelling and data collection from wider sources.
- Improved recommendations produced after understanding the aspirations and thoughts of the client, with consideration of a broad range of technologies, viability and production of a business case for the technologies.
- Profile & determine total energy consumption of the site.
- Establish an action plan of cost-effective energy saving opportunities.
- Produce a carbon footprint and net zero carbon map.

6. Site Energy and Carbon Assessment

Maloney Associates undertook detailed energy audits of the Kinver Village Sports and Community Centre, based in South Staffordshire, in 2020 and early 2021.

The purpose of the review was to identify cost effective energy conservation measures that would deliver reduced operational cost savings and increase the energy performance of the community centre. The review has identified significant energy saving opportunities and areas fit for improvement, at both a low cost and through future investment, often at times congruent with the new building refurbishment plans. This comes in support of KSCA volunteers' aspirations to carry out activities in a centre that is up to current and future sustainability target regulations, and continue the legacy of Kinver's Sports and Community Association.

First and foremost, areas of significant energy saving can be created through investment into appropriate technology, through the adoption of low-carbon technologies and building thermal insulation. Secondly, there are a number of cost-effective solutions that can be followed through for long-term savings, and it includes elements such as current internal and external lamp replacement with light-emitting diodes (LEDs), where the more costly version would be to include photocells for ambient light detection, and insulation of cooled or heated ducting and trunking to reduce energy loss.

In addition, the audit has been undertaken to the required standards of an Investment Grade Audit (IGA). This includes detailed energy appraisal, calculations, and investment payback calculations.

Renewable energy systems were carefully considered and listed as an important part of the refurbishment and plans to bring the centre close to national and international net zero carbon standards.

Therefore a net zero roadmap has been produced and included in section 1 to underline the current and future needs of the community centre and encourage behavioural changes.

7. Summary of Potential Energy and Carbon Savings.

TABLE 1: SUMMARY OF POTENTIAL ENERGY SAVINGS

Energy Saving (kWh)	Emissions Saving ($kgCO_2e$)	Energy Cost Saving	Capital Costs	Simple Payback
127,193	25,777	11,171	134,210	12.0

The energy savings identified equate to a cost saving of **£11,171** and would require a **134,210-capital** expenditure. This would provide **12-year** payback.

An action plan of the energy saving measures have been included within the report.

Figure 1 and figure 2 shown below allow for the visualisation of the expected energy and emission savings following the implementation of the recommended energy conservation measures (ECMs) outlined in section 12.1 of the action plan.

FIGURE 4: SUMMARY OF POTENTIAL ENERGY SAVINGS

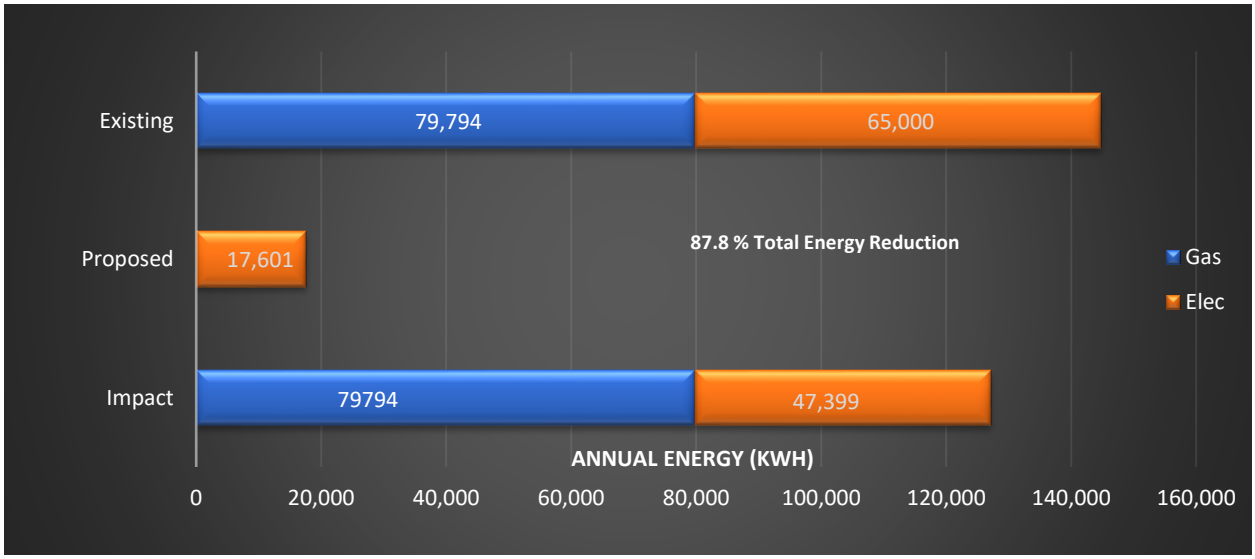
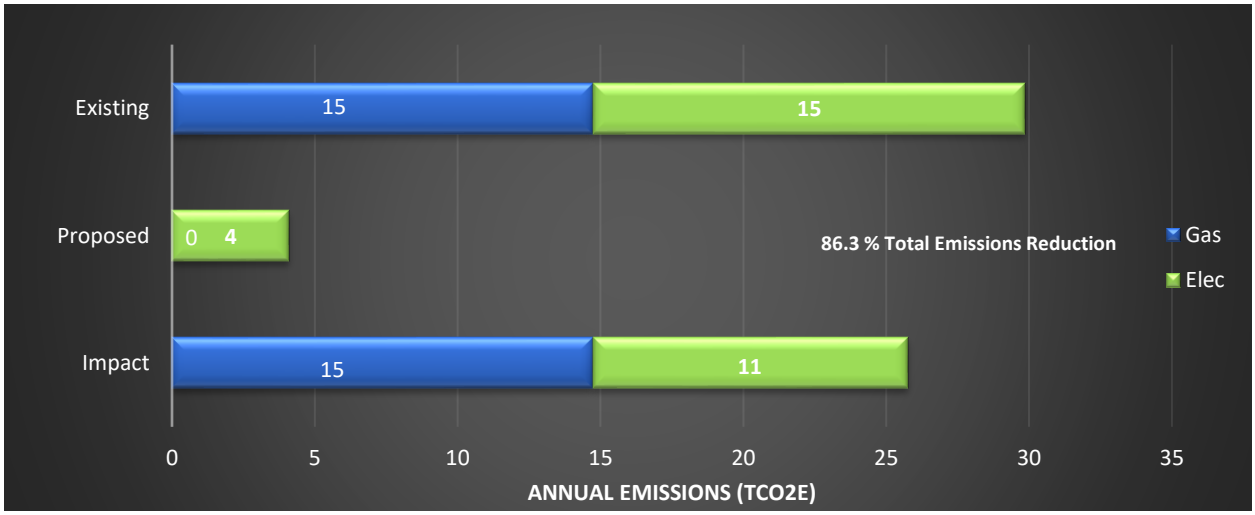


FIGURE 5: SUMMARY OF POTENTIAL EMISSIONS SAVINGS



The graphs illustrate the impact of the energy saving opportunities compared to the current energy consumption at the KSCA. The identified savings represent an annual reduction of **79,794 kWh (100%)** in gas consumption and **47,399 kWh** in electricity consumption (this includeds the calculated electricity consumption needed for the operation of the ASHP). This equates to a carbon emission reduction of **15 t** for gas, and **11 t** for electricity. This totals an **88% reduction** in energy consumption, and a **86% reduction** in associated carbon emissions.

8. Site Energy Consumption and Performance

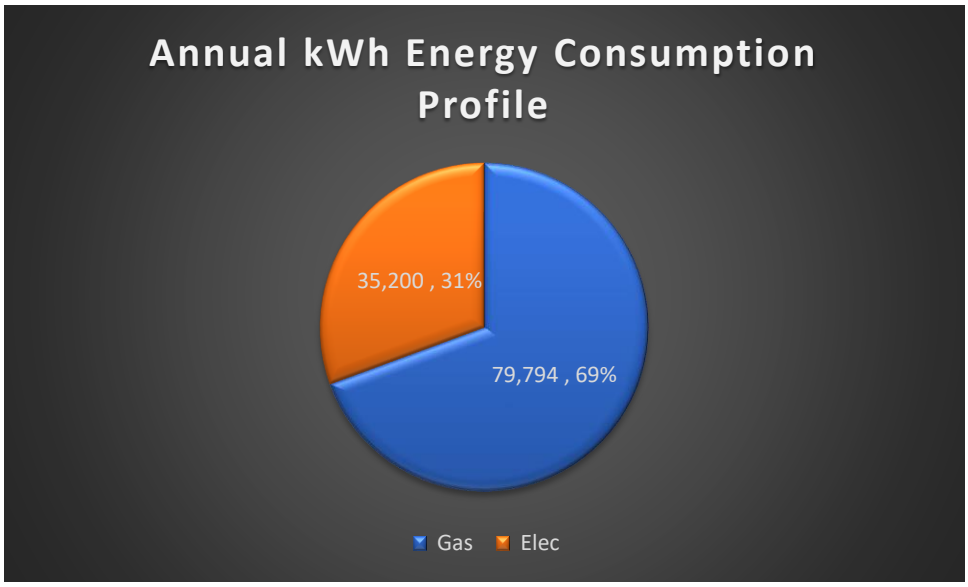
Table 2: Existing Annual Energy Consumption totals kWh/m^2

Elec kWh	Gas kWh	Total kWh	Gas kWh/m^2	Elec kWh/m^2	Total kWh/m^2
35,200	79,794	114,994	107.3	47	155

Table 3: Existing Annual Emissions Overview kgCO2e/m^2

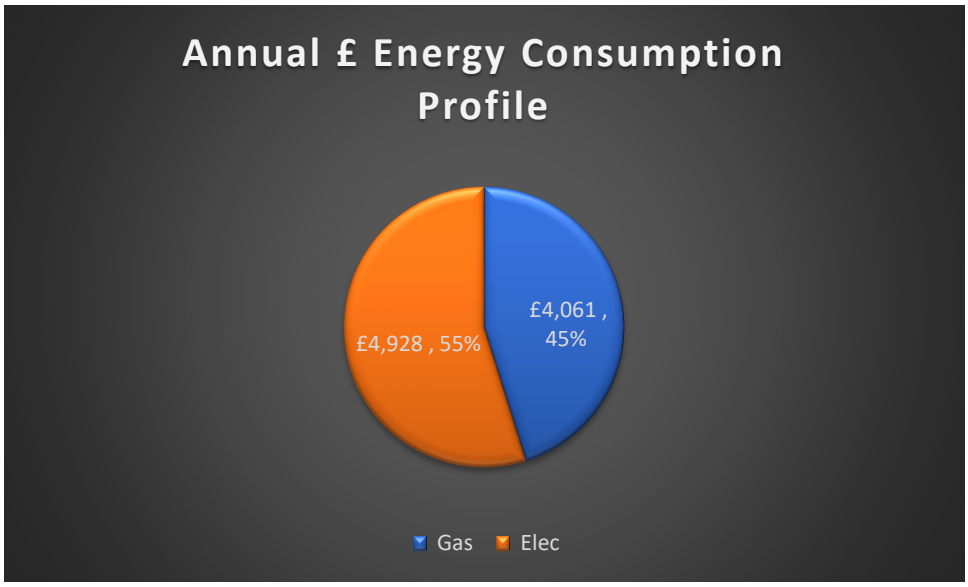
Elec TCO_2e	Gas TCO_2e	Total TCO_2e	Gas $kgCO_2e/m^2$	Elec $kgCO_2e/m^2$	Total $kgCO_2e/m^2$
15	15	30	20	20	40

Fig. 6: Annual Energy Consumption Profile for the period March 2019 – March 2020



This profile indicates that gas usage at the centre is more energy intensive than electricity on an annual basis.

Fig. 7: Annual kWh Energy Costs Profile for the period March 2019 – March 2020



This Profile indicates that electricity usage at the centre is less cost-effective than gas on an annual basis.

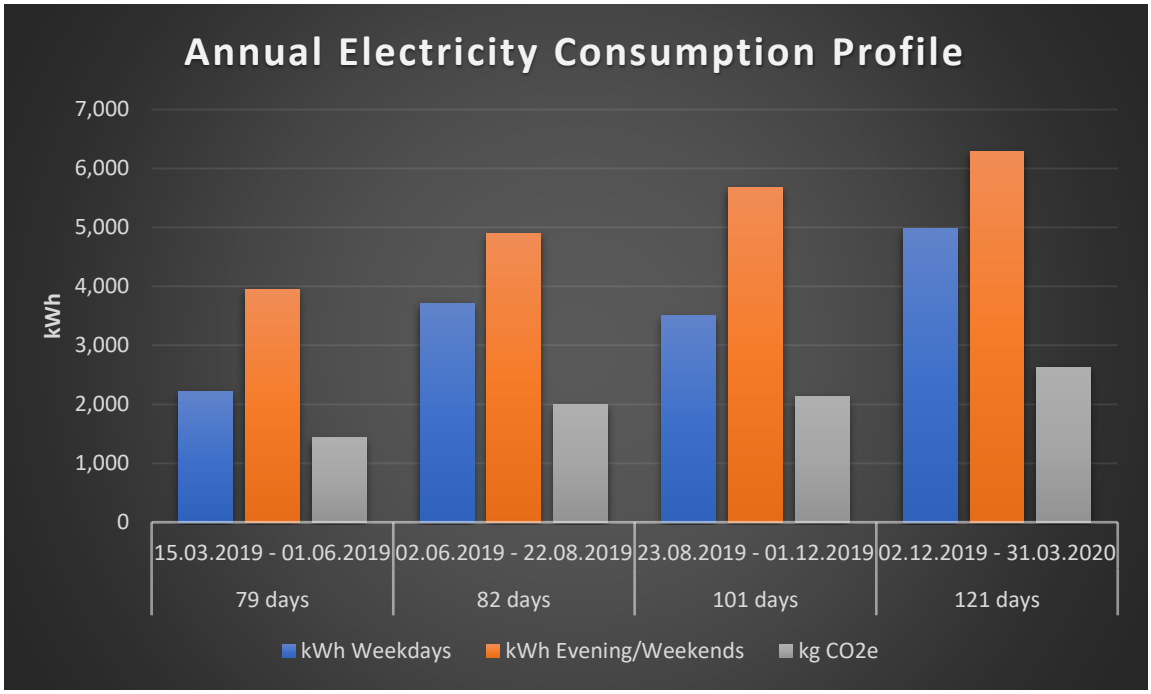
8.1 Annual Electricity Usage at Kinver

Grid electricity is typically measured in kilowatts per hour (kWh) for uniformity. Great improvements have been brought to grid electricity generation, and as of 2020, renewable production generated 40.2% of total electricity produced in the UK. Most appliances nowadays run on electric energy and thus require a kW source. The Kinver community building uses most of its electricity supply for water and space heating, closely followed by lighting needs. Electric and electronic appliances present at the Centre include internet access and data processing, hand drying, space heating, dish washing,

refrigeration, chilling and cooking, etc. These usually have a wattage rating indicated on a plate on the appliance itself. The longer they are used and in combination with a high wattage rating, the more electricity they will consume. Energy loss also occurs with appliances left on stand-by or just plugged in, although to a smaller rate, and it is called a vampire load or a standby power consumption. As such, it is advised that they are turned off from the switch on their respective electrical outlets.

Electricity at Kinver Sports and Community Centre is provided by Npower Ltd., and the centre's annual expenditure totalled £4,928 inclusive of VAT. Consideration ought to be given with the installation of a renewable energy system such as an ASHP, as it would have an impact on electricity expenditure. An ASHP unit would replace current water heating systems and heating fans, and would allow the cooling unit to function at an optimal temperature with the removal of the neighbouring boiler from the cellar.

Fig. 8: Annual Electricity Consumption Profile



This graph shows the annual electricity consumption profile at the centre between March 2019 and March 2020, where energy use and equivalent carbon footprint are directly proportional with the number of days attributed to each billing period. It can be noticed however that evening and weekend usage predominates and that in all cases, the Centre is less active during the week. 15 days of March 2019 and the whole month of March 2020 were considered to account for lack of energy usage following the lockdown announcement on the 16th of March 2020. This trend is consistent with HVAC items operating during the weekend. There does not seem to be seasonal variability in electricity usage trends.

Table 4: Summary of Annual Electricity

Energy Electricity Consumption (kWh)	Emissions (kg CO_2e)	Energy Cost £
35,200	8,207	4,928

Current electricity consumption was calculated from readings taken directly from the centre's bills, in quarterly format (every three months), for the period March 2019 – March 2020. The lockdown began on the 16th of March 2020, and thus the month of March was taken in its totality as the nearest tertiary bill would have ended on the 6th of March. Each period's corresponding CO_2e emissions were marked in grey.

According to the visual representation for electricity consumption from the above profile, the usage meets with a gradual increase throughout the year, consistent with higher heating requirements during the cold months, when building heat loss is also higher. The resulting annual electricity consumption for the period 15th March 2019 to 31st March 2020 is **35,200 kWh.**

8.2 Annual Gas Use at Kinver

Of all the electricity generated in 2019, natural gas accounted for 40.9 per cent according to the Department for Business, Energy and Industrial Strategy. Gas is seen as a bridge to GHG emissions reduction, but may ultimately have to be replaced if GHG emissions are to be reduced by more than 80% compared to 1990 levels, unless efficient carbon capture and storage/use technologies are used [Scharf H. et al, 2021]. As part of UK's strategy, gas heating for domestic and commercial places will be banned in new houses built from 2025 onwards.

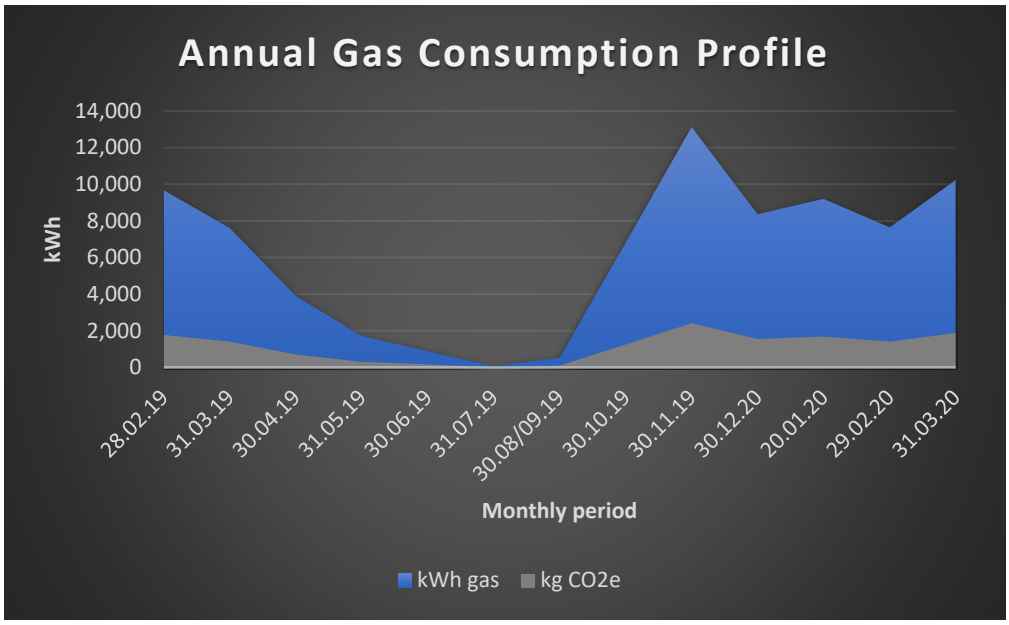
Understanding the community centre's natural gas consumption patterns and their influencing factors can help implement specific energy consumption policies and improve energy efficiency. Gas at Kinver is provided by Contract Natural Gas Ltd. and the annual gas expenditure at the centre was **£4,061** inclusive of VAT. Details can be observed below.

Table 5: Summary of Annual Gas

Energy Consumption Gas (kWh)	Emissions (kg CO_2e)	Energy Cost £
79,794	14,726	4,061

Annual gas consumption was calculated for the building (internal) supply from readings taken during the pre-lockdown period 01.04.19-31.03.20, which equates to a full UK financial year. The monthly corresponding CO_2e emissions are illustrated in grey.

Fig. 9: Annual Gas Consumption Profile



The information was obtained directly from the centre's bills, in monthly format. The above profile shows a relative seasonal variation. The gas consumption from April 2019 to August 2020 is minimal due to no space heating being required and is consistent with hot water production only. However, the highest values are achieved in November 2019, which then do not show a decline by the end of March. While declining values are gradual, increase in consumption is steep, which can indicate that the old gas boilers are left running all day and do not have timers. The annual gas consumption totals **79,794 kWh**.

8.3 Annual Water Use at Kinver

Table 6: Water consumption – overview table

Water supplied (m^3)	Emissions ($kgCO_2e$)	Energy Cost £
340	117	470

This table is purely for water consumption, and in addition to the above the drainage and used water have been added below.

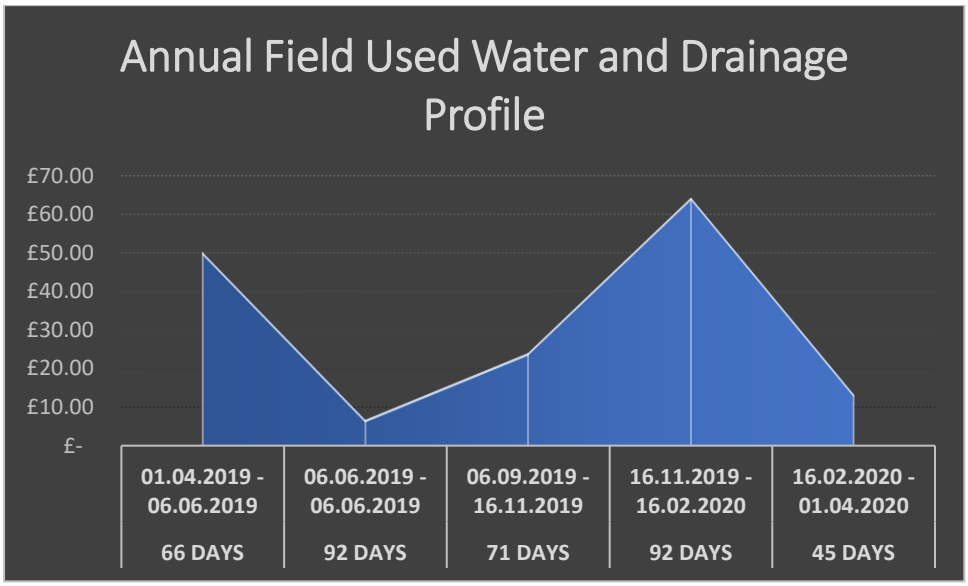
According to the government publications, public water supply in England was the biggest source of water abstraction needs in 2017. Energy is technically consumed at most stages of a building water supply, including treatment, use through faucets and toilets or other appliances, and disposal. This is a negligible aspect of kWh/m^3 consumption in the case of Kinver Sports and Community Centre due to low aggregated annual usage, but makes for an interesting point of study should the need arise. It has been noted that water pressure from at least the Hall's bar use and from the showers is low, which can indicate low water pressure or excessive scaling of the pipes.

The centre's water supplier is South Staffordshire Water Business and Water Plus for used water and drainage. Combined annual expenditure equalled **£1,226**, inclusive of VAT and other charges.

Current water consumption was calculated for both the building (internal) and its playing field (external) from readings taken during the period April 2019 – April 2020.

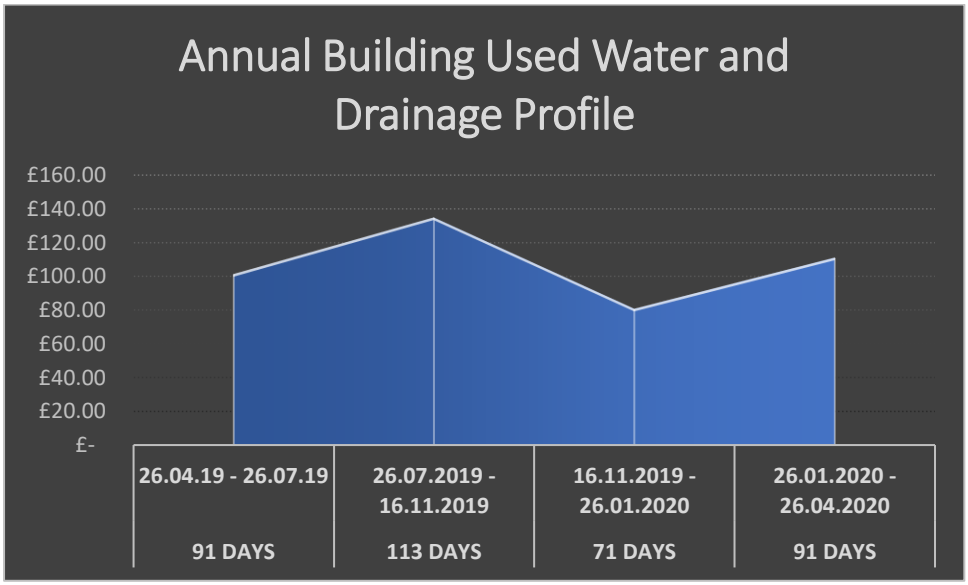
The information was obtained directly from the centre's bills, in quarterly format.

Fig. 10: External (Playing Field) Used Water and Drainage



Total costs for the period above equal £158.19.

Fig. 11: Internal (Building) Used Water and Drainage



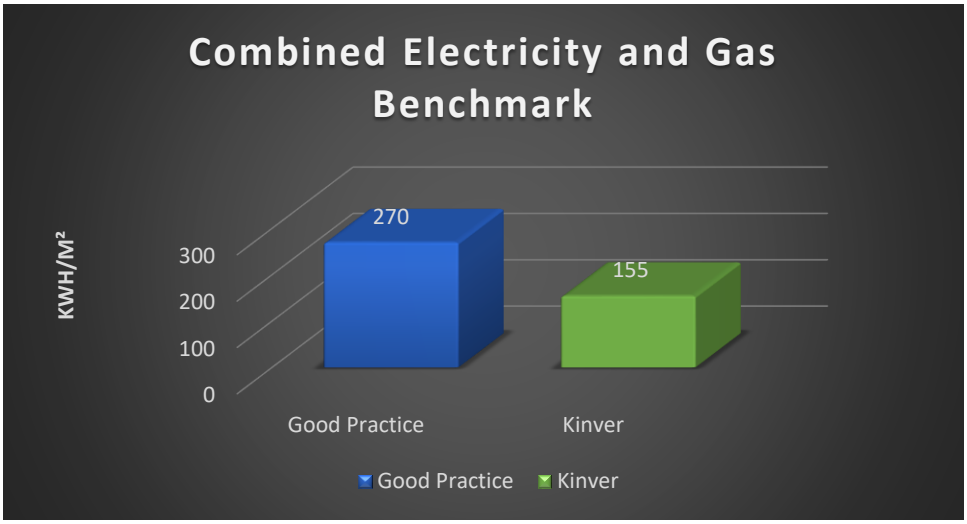
Total costs for the period above equal £427.37. Trends showed by bill values are relatively consistent regardless of season.

8.4 Energy and Carbon Benchmarks

Kinver has been benchmarked for the performance of the site's energy usage and associated emissions using national industry standards provided by the Chartered Institution of Building Services Engineers (CIBSE). Figure 11 and figure 12 allow for a visualisation of how Kinver is performing against national industry standards for energy usage and associated emissions within a similar type of building.

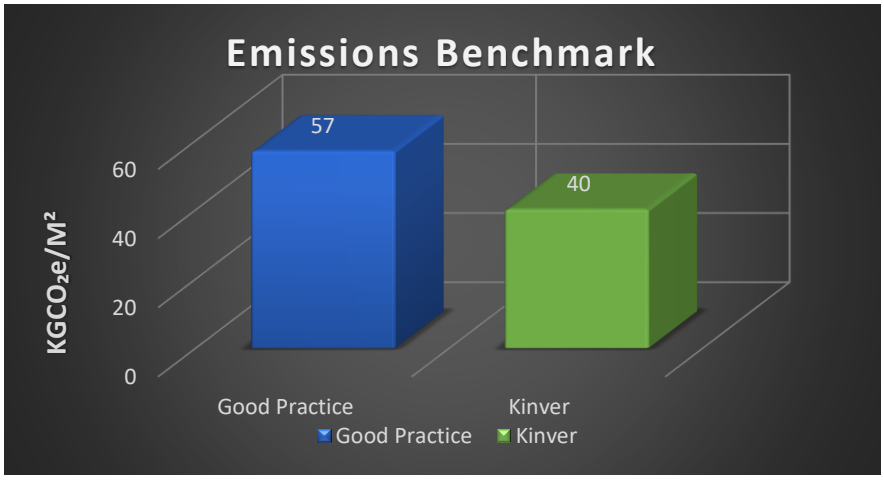
The CIBSE benchmark for good practice shown in figure 11 and figure 12 have been based on Licenced Community Centre/Building. This is currently the closest benchmark available for a similar building type to KInver and may not be a true reflection of the operation of the building.

Fig. 12: Existing Combined Gas and Electricity Benchmarks.



This above benchmark indicates that the KSCA building is operating at 43% below the good practice benchmark for energy usage. Note, this period includes the current "lock-down" guidelines when the Centre has not been used fully.

Fig. 13: Existing Combined Gas and Electricity Benchmarks. For emissions



This above benchmark indicates that the KSCA building is operating at 43% below the good practice benchmark for greenhouse gas emissions.

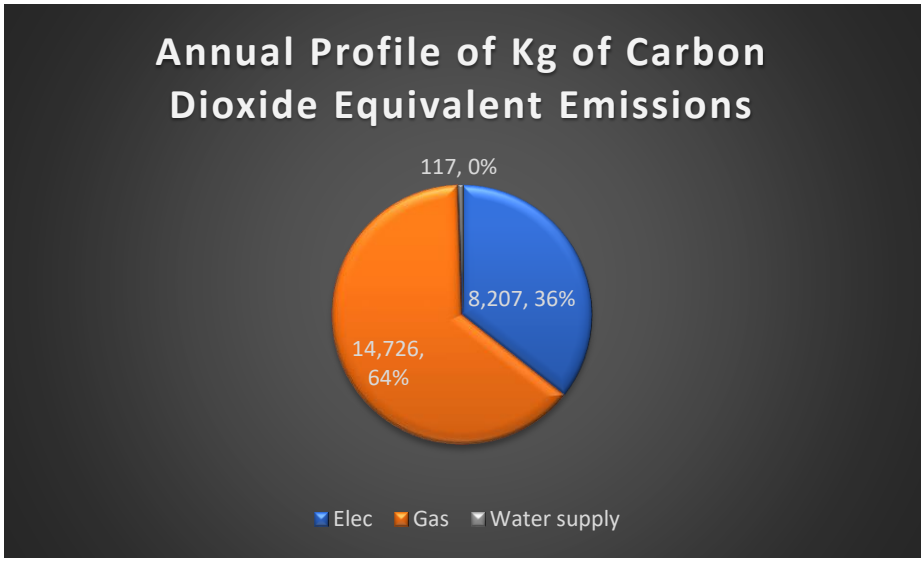
9. Greenhouse Gas Emissions Calculation

The annual energy consumption values have been converted to an annual carbon equivalent output using the greenhouse gas conversion factors from the Government Conversion Factors 2020.

The appropriate values used to calculate emissions for the three energy sources mentioned (water, electricity and natural gas) have been specified in the Assumption table, section 17.

Total standard emissions value at Kinver in the period March 2019 – March 2020 was **23,050 kgCO_2e (23 tonnes).**

Fig. 14: Annual Breakdown of kgCO_2e Emissions at Kinver



The above graph shows an annual breakdown of CO2e emissions at the KSCA building, where gas has a higher carbon footprint than electricity. Emissions associated with water supply are negligible.

10. Wider Strategic Drivers for Sustainability Improvement

The energy security concerns over the recent years have resulted in policies that subsidize and encourage the use of "clean" technologies, in line with the Paris Agreement's targets of limiting global warming to below 1.5°C. Climate change has been identified as the biggest health threat of the 21st century, and biodiversity along with valuable natural resources are declining despite rapid technological advancements. These effects combined are putting the lives and wellbeing of billions of people as well as other species at increased risk, and will continue to do so over the next decades.

The first formal, global-scale discussions around climate change began as early as 1973, with the UN Conference on the Human Environment, held in Sweden. In 1992, the United Nations' (UN) Earth Summit produced a climate change framework, which today has near-universal membership. The United Nations Framework Convention on Climate Change (UNFCCC), together with the legally binding treaties established at Kyoto and Paris in subsequent years, have been adopted and ratified by around 192 countries. The Intergovernmental Panel on Climate Change (IPCC), responsible for regular scientific assessment and research on topics of climate change, was also established under UN governance in 1988, and has played a critical role in shaping policy outcomes with publications issued roughly every six years.

10.1 Impact on Community Health and Social Values

There is a definite need to use the current knowledge of environmental and especially air pollution and greenhouse gas emissions to steer policy decision-makers. Old, outdated technologies can be replaced with newer systems where output falls behind consumption needs, and when equipped with readers and manual programming or sensors, can provide a significant and traceable reduction in fuel emissions and total consumption.

Specifically, investment in the 60 year old community building is perceived as an empowerment of local life and activities. In times of social isolation imposed by worldwide measures, the community centre has managed to adhere to strict regulations and provide a safe space for people of all ages to meet and socialise where possible.

The road to net zero carbon has become a governmental focus and it has been recognised that the community at Kinver also has the aspiration to achieve net zero targets by refurbishing their most important community building.

Data from most countries is pointing towards air pollution as the leading cause of death worldwide by type of environmental pollution [WHO, 2020]. This is important as both an ASHP and solar PV system would replace the Centre's need for natural gas, which in the UK has a higher carbon footprint than electricity in buildings of this kind.

The Kinver Community and Sports Centre further provides necessary amenities for a healthy lifestyle, through the public footpath, playing field, and sport programmes and events organised within the building which helps bring people together. Recent studies have shown that £2.1 billion per year could be saved in health costs if everyone in England had good access to greenspace and physical activity [PHE 2020 review], due to factors such as lowering the cardiovascular disease burden, better mental health, immune system or metabolism boost, as underlined by NHS guidelines.

Although at this stage the centre may not be able to achieve complete net zero carbon, limited by grants and funding, the desire is to limit greenhouse gas emissions and energy consumption by as much as possible.

For these reasons mentioned, there are a number of options which the volunteers at Kinver have chosen to go with. They include: significant carbon reduction, landscape improvement, Sterrymere desilting, appropriate policies and operational investment, which will be detailed below.

10.2 Impact on biodiversity

The Association managing the community building recognises the importance of green/blue corridors in providing green spaces and amenities, important ecological support and pivotal flood management and water filtering functions. Wetland restoration is underway within the Marsh Recreation Area, and the historical canal flowing into the bigger Stour river, the Sterrymere, has recently been desilted. The river Stour has suffered wide environmental pollution in the 19th and early 20th centuries, but nowadays wildlife is making a comeback.

The Community Centre is located near Kinver Edge, with historical soft red sandstone houses that attract tourists annually and an outstanding natural beauty. According to the Worcestershire Biodiversity Action Plan 2018, Kinver Edge is owned by the National Trust and the site lies on the boundary between two counties on a ridge of Permian sandstone. The acidic soils support lowland

heathland, acid grassland and oak-birch woodland. The area has species of interest such as the adder, slow-worm and smooth cat's-ear (a type of dandelion).

Taken from the Sterrymere Environmental Enhancement review 2020, a habitat and species survey was commissioned and carried out by David Haslam of SES Staffordshire Ecological Services Ltd in 2011. The report states that the habitats on site currently have a low conservation value. An update Phase 1 habitat survey was carried in the 29th of May 2020 by Martyn Owen of BiOME Consulting, which identified 33 protected species within a 1km radius of the site, proving that this can be an important area for conservation. One of the main objectives of projects at the community building in Kinver remains to improve the nature conservation value of the site and of Kinver as a whole. As a result, renewable technologies with minimum impact and without hazardous by-products or intrusive landscaping requirements were given a great deal of consideration.

The Kinver Community Centre and Marsh Recreation area also provides a learning environment for young people and adults and recreational sessions on conservation and sustainability are to be carried both inside and outside the building once it is safe for social activities to be resumed at the Centre.

10.3 Legislation and Directives

Since the Paris Agreement entered into force in 2016, over 125 countries have ratified it and taken on the responsibility to keep global warming below the set threshold of 1.5°C for the following decades.

The UK Government is also looking at future legislation. With the Climate Change Act of 2008, it has been established that the final UK carbon emission target for the year 2050 has to be at least 100% lower than the 1990 baseline in greenhouse gases for that year, as established by the Kyoto Protocol. This means, a net zero carbon target by 2050.

In July 2019, the Staffordshire County declared a climate change emergency to demonstrate a commitment to reducing climate change impacts across every aspect of their service provision and estate. The five key focused areas to achieve net zero carbon emissions are organisation carbon reduction, air quality, natural environment, waste and behaviour change.

The Net Zero Emissions by 2050 initiative has been explained on the government's official website as meaning any emissions that would be balanced by schemes to offset an equivalent amount of greenhouse gases from the atmosphere, such as planting trees or using technology like carbon capture and storage (CCS).

All these necessary climate change adaptation and mitigation measures are starting to be felt in a variety of sectors, including transportation, healthcare and the building sector.

Part of this is the natural gas and oil boiler ban from 2025, where the installation of fossil fuelled boilers, which make up over 85% of the national domestic heating stock, is phased out from 2025. Instead, hydrogen-fuelled appliances are currently being studied and tested to be released on the market.

The UK Government is also looking to phase out the selling of new petrol, diesel and hybrid cars and vans by 2030 in the upcoming UN summit of 2021 in Glasgow. This changed from the original deadline, which was 2040, owing in part to technological advancements. Criteria for ultra-low emission vehicles (ULEVs) will be changed in 2021 to include emissions of under 50g of CO2/km from

the tailpipe, from the previous 75g. EU fleet-wide average emission target for new cars will be 95 g CO_2/km from 2021, and car manufacturers will risk penalties if going above the threshold [EU 2019].

With the Energy Performance on Building Directives, consumers and businesses should be able to make more informed choices to save energy and money. A highly energy efficient and decarbonised building stock is desired by 2050, and new cost-optimal minimum energy performance requirements will be implemented. These strategies will only be achievable through smart and renewable energy systems. The Energy Efficiency Good Practice Benchmarks we have used in our reports will become more stringent, according to estimations, in as little as two years from now or even sooner in order to meet these targets. The ultimate aim is to create a stable environment for decision-making and regulation.

Last, but not least, the national grid is being upgraded constantly to allow for bigger electric loads with the phasing out of natural gas and fossil fuels.

11. Calculated Building Performance Post ECMs

Table 7: Predicted Annual Energy Consumption totals kWh/m2 after implementing all ECMS included in the Energy Conservation Measurers' Section

Elec kWh	Gas kWh	Total kWh	Gas kWh/m²	Elec kWh/m²	Total kWh/m²
17,601	0	17,601	0	24	24

Table 8: Predicted Annual Emissions Overview kgCO2e/m2 after implementing all ECMS included in the Energy Conservation Measurers' Section

Elec TCO_2e	Gas TCO_2e	Total TCO_2e	Gas kg CO_2e/m^2	Elec kg CO_2e/m^2	Total kg CO_2e/m^2
4	0	4	0	6	6

Fig. 15: Predicted Electricity Benchmarks.

Utilising the same CIBSE benchmark category as for the existing energy consumption (licenced community centre/building), Kinver benchmarks have been recalculated to show the building performance post ECM installation.

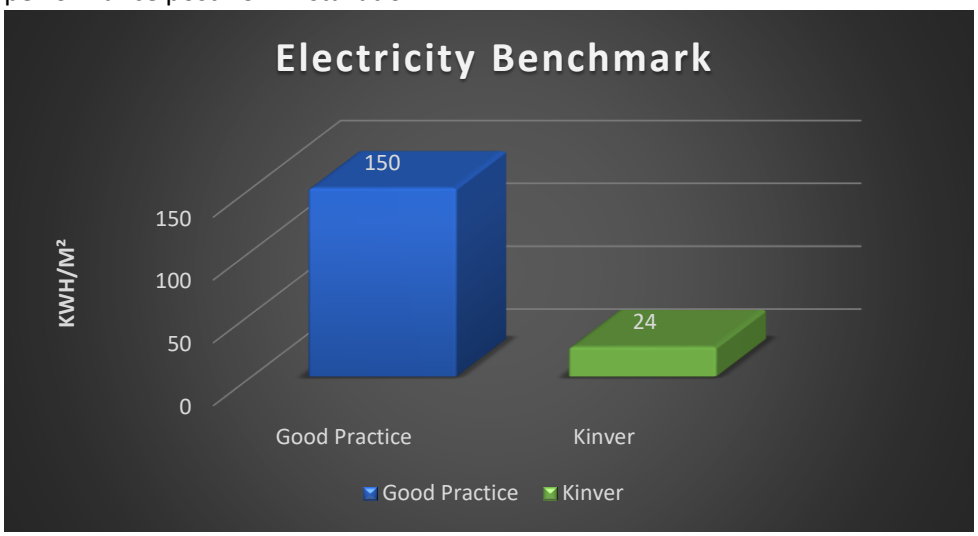
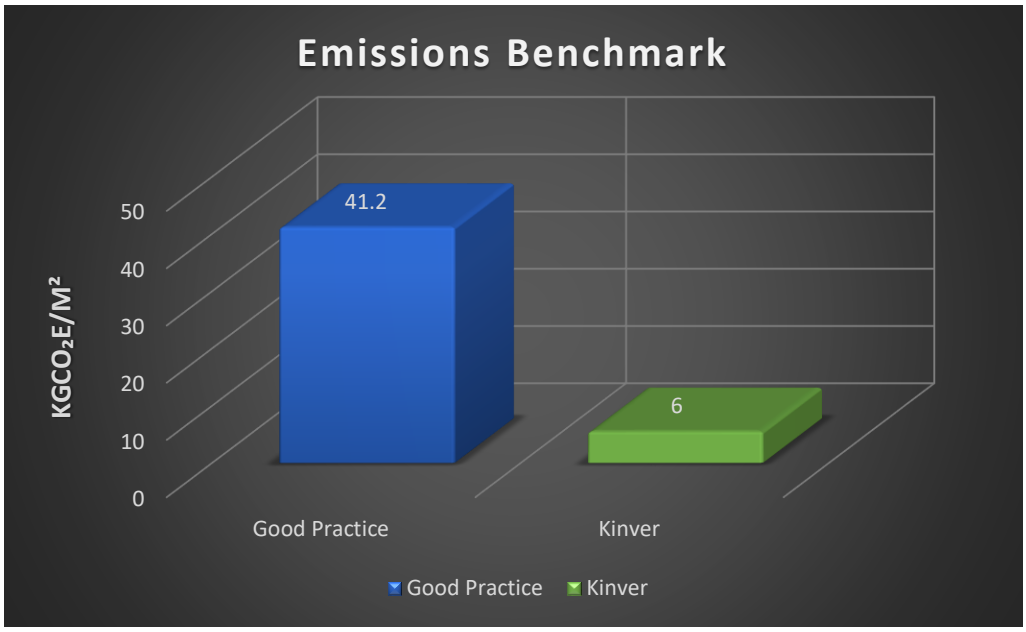


Fig. 16: Predicted Emissions Benchmarks.



Both above benchmarks provide a visual representation of the predicted building performance for both energy and emissions. This has been further improved to approx. 85% below the CIBSE "good practice" guidelines.

12. Energy Conservation Measures

Following the desktop energy analysis, the site audits conducted at Kinver and the development of energy profiling and benchmarking of the site, a number of energy reduction opportunities have been identified. This action plan covers all aspects of energy reduction in correlation with their cost effectiveness and payback efficiencies with the wider view of developing a net zero carbon solution. This has included a review of the heating and hot water demands, and the introduction of energy saving technologies such as:

- Air Source Heat Pumps.
- Solar Photo Voltaic (Solar PV).
- LED Lighting Replacement.
- Solar Thermal.
- Rainwater Harvesting.
- Behavioural Changes.
- Building Thermal Insulation.

12.1 Energy Saving Summary

The following energy conservation measures (ECMs) have been categorised by payback criteria by the following methodology:

Short or Instant	**0 to 3 Years**
Medium	**3 to 5 Years**
Long	**Over 5 Years**

Category	Service	Area	Finding	Action	Potential Annual Savings			Return on Investment (ROI)			
					Energy Saving (kWh)	Emissions Saving (kgCO2e)	Energy Cost Saving (£)	Capital Cost (£)	Simple Payback	Annual Maintenance Savings (£)	Payback Category (yrs)
ECM-1	Lighting	Internal	A comprehensive lighting survey has been undertaken at Kinver. The review has identified that the majority of communal area lighting has been replaced with energy efficient LED lighting. The remaining inefficient existing lighting is made up of inefficient Linear Fluorescent, compact Fluorescent and domestic style halogen lamps. The purpose of the lighting survey was to assess potential energy savings that could be achieved by low energy LED lighting and integrated lighting controls. The results and subsequent financial assessment reveal significant opportunity for both energy and maintenance savings.	The lighting survey has comprehensively assessed all future opportunity for energy and maintenance savings. A full schedule of lighting replacement has been identified in targeted areas throughout the Centre. This could deliver significant energy savings in a cost-effective manner with numerous cases of short returns on upfront capital investment. Identified energy and maintenance savings equate to over £1,500 p.a. These savings could be achieved within a simple payback period of 3.5 years based purely on energy savings and 2.3 years including energy and maintenance savings.	6,834	1,593	£1,025	£3,540	3.5	£540	2.3

ECM 2	Heating and Hot Water Replacement With (ASHP)	Kinver	A comprehensive appraisal of Kinver's heating and hot water systems has been completed with a view to replacing the site's systems with an 'A' rated low energy and carbon friendly Air Source Heat Pump. This will provide 100% of the sites heating and hot water demand. This option will eradicate the need for gas, along with the introduction of Solar PV (ECM-3) will help deliver a 'carbon zero' plan for Kinver. A full detailed appraisal of the existing heating and hot water systems along with a proposed ASHP solution; has been undertaken and is included within this report	It is recommended that: a) Kinver install an ASHP to provide the sites heating and hot water demand. This is a solution that would future proof Kinver for a carbon zero outcome and also provide a full turnkey solution to the internal environment b) Further consideration should be given to installing two heat recovery as an add on to the main ASHP installation. This will provide ventilation in-line with current building regulations. For budgetary purposes £10,000 should be included to provide this. Note: If any heating improvement work is carried out to the main hall the mechanical ventilation will have to be aligned to the current building regulations. c) The current ASHP review does not include for additional heating within the changing rooms or for any mechanical ventilation. A further budgetary cost of £5,000 should be included if additional heating is required. Note: If any heating improvement work is carried out to the Changing Rooms, the mechanical ventilation will have to be aligned to the current building regulations	GAS 79,794	GAS 14,726	£4811	£89,420	19	£500	17
			Electric		5,000	1,166					

Category	Service	Area	Finding	Action	Potential Annual Savings			Return on Investment (ROI)			
					Energy Saving (kWh)	Emissions Saving (kgCO2e)	Energy Cost Saving (£)	Capital Cost (£)	Simple Payback	Annual Maintenance Savings (£)	Payback Category (yrs)
ECM 3	Solar Photo Voltaic (PV)	Kinver	A comprehensive Solar PV assessment including a site visit has been completed for Kinver. This has identified the great potential to install Solar PV to the available roof spaces at the Health Centre. This would greatly assist the site becoming "carbon neutral".	It is recommended that the site is fitted with the maximum solar PV array that is possible for the building. The initial assessment has identified the potential electricity generation of over 34,000 kWh equal to over £5,100. The ROI for this site is 8 years, however, over the 20 years life cycle, the Health Centre would achieve over £61,000 of profit.	34,000	7,927	£5,100	£41,000	8.0	£0	8.0
ECM 4	Hot Water For Amenities	Kitchen	The 3kW instant hot water heater within the staff kitchen is operating 24/7. This is unnecessary out of hours energy wastage.	It is recommended that a digital 7-day time clock is installed and aligned and optimised for the Centre's core occupancy times. A capital cost of £250 has been included for this ECM to install the "hard wired" digital time clock.	1,565	365	£235	£250	1.1	£0	1.1

Category	Service	Area	Finding	Action	Potential Annual Savings			Return on Investment (ROI)			
					Energy Saving (kWh)	Emissions Saving (kgCO2e)	Energy Cost Saving (£)	Capital Cost (£)	Simple Payback	Annual Maintenance Savings (£)	Payback Category (yrs)
ECM 5	Thermal Insulation	Building	An overall dominating type of thermal insulation was identified for walls (empty cavity), floor (concrete slabs) and roof (suggested to be a thin layer of cork). These are considered minimal and are contributing to significant heat loss in the building. We have also identified that comprehensive thermal insulation plans have been made for the extension area mainly. This has not been included in the in the report. It is recommended that this is undertaken as part of the future refurbishment plans.	It is recommended that the thermal properties are extended beyond current building regulations and to the other key areas of the building on top of the extension area. This would also greatly improve the efficiency of the ASHP suggested in ECM 2.	TBC	TBC	TBC	TBC	TBC	TBC	TBC
ECM 6	EVCP	Carpark	EVCPs have been included and we are awaiting further information on official quotations. That will include a survey of the electrical infrastructure. The viability of this ECM will depend on the OLEV grants.	Two 7.4kWp single wall mounted EV charging units have been suggested for the current building load capacity, placed strategically on an easily accessible side of the building for both drivers and high-voltage specialists. These are to be remotely monitored and controlled through a wireless application usable by both drivers and charger owners, called EVBox.	TBC	TBC	TBC	TBC	TBC	TBC	TBC

Category	Service	Area	Finding	Action	Potential Annual Savings			Return on Investment (ROI)			
					Energy Saving (kWh)	Emissions Saving (kgCO2e)	Energy Cost Saving (£)	Capital Cost (£)	Simple Payback	Annual Maintenance Savings (£)	Payback Category (yrs)
ECM 7	Rain Water Harvesting		There are no water harvesting technologies present at the Centre, however, significant potential has been identified due to total roof catchment area (>700 m^2), annual precipitations (>700 mm/yr), and the very close proximity of the floodplain.	A budgetary cost was sourced for water harvesting; however, it was found that this would be substantial, up to £15,000 to replace water consumption on site with a filter included in the quote. This can lead to a payback period of up to 40 years. However, rainwater harvesting benefitting from a tank of smaller capacity than 20.000L can certainly be taken into consideration during building reconstruction or refurbishment.	TBC	TBC	TBC	TBC	TBC	TBC	TBC
					TBC	TBC	TBC	TBC	TBC	TBC	TBC
Totals					**127,193**	**25,777**	**£11,171**	**£134,210**	**12.0**	**1,040**	**11.0**

13. Review of Existing heating system

The existing heating at Kinver is provided by 2x gas fired hot air heaters. One supplies the lounges, and one supplies the main hall. The hot air heating is delivered to the lounges and main halls through underfloor concrete channels emitted through vents in the floor. The existing heaters are over 20 years old and were rated at 70% seasonal efficiencies when new. With the current condition it has been calculated that the operating efficiencies would be approx. 60%. The heater that supplies the lounges is located within the cellar that is also fitted with a refrigeration unit. This has a detrimental effect on the cellar cooling, causing the cellar refrigeration unit to operate excessively when the heating is in operation.

The method of delivering hot air through concrete channels is inefficient as concreate absorbs heat causing heat/energy wastage. It has been reiterated by the building manager that the heating for the lounges does not reach the lounge furthest from the heating unit.

The aspiration to replace the current system with low carbon technologies will be assessed in the following chapters of the report.

Main Hall Heater	Lounge's Heater
	
Hot Air Vent located under large UPVC doors in lounge next to	Cellar Refrigeration Unit located with heater above

13.1 Replacing Heating System “like for like”

Should an upgrade to renewable technologies not be possible because of cost restraints, the alternative solution is equipping the existing gas-fired units with a new gas-fired plant and improved controls.

A budgetary cost of £8,000 has been estimated for the replacement of the two gas burners only, not including insulated heating duct work. This would include an insulated compartment for the lounge heater (located in the cellar). The new gas heaters would have an operational seasonal efficiency of 90%.

Table 9: Budgetary Costs and Payback

Capital Cost	Annual Energy Consumption	Estimated Energy Saving (kWh)	Estimated Cost Saving (£)	Simple Payback (years)
£8,000	79,794	15,959	638	13

It should be noted that the above option does not allow for a carbon zero output.

13.2 Replacing Heating System with Air Source Heat Pump (ASHP)

A comprehensive appraisal of Kinver's heating and hot water systems has been completed with a view to replacing the sites systems with an 'A' rated low energy and carbon friendly Air Source Heat Pump.

This will provide 100% of the sites heating and hot water demand. This option will eradicate the need for gas, along with the introduction of Solar PV (ECM-3) will help deliver a 'carbon zero' plan for Kinver. A comprehensive appraisal of the suitability for providing ASHP at Kinver has been undertaken and included within this report. For the necessary background information, please refer to section 14.4.1 and the Appendices.

Lounges

Ceiling mounted heat pump cassettes have been proposed for the lounge/meeting rooms. This will give individual control for each for each lounge/meeting room. The existing heating system does not adequately reach the meeting room furthest from the source and is not fit for purpose. The ventilation for these areas is natural ventilation through open windows and ceiling mounted ventilation grilles.

Note: It was identified during the site visit that the ceiling mounted ventilation needs attention and is in disrepair.

Main Hall

Wall mounted cassettes have been proposed for the hall again with individual unit control. Due to the hall being occupied by a large number of people, mechanical ventilation has been considered. However, the existing “mechanical ventilation” is considered to be inadequate and not fit for purpose.

Review of hot water services

A comprehensive appraisal of Kinver's heating and hot water systems has been completed with a view to replacing the sites systems with an 'A' rated low energy and carbon friendly Air Source Heat Pump. This will provide 100% of the sites heating and hot water demand. This option will eradicate the need for natural gas, along with the introduction of Solar PV (ECM-3) will help deliver a 'carbon zero' plan for Kinver.

The existing hot water demand at Kinver consist of 2 x 300 Litre electric immersion heaters for the home and away changing rooms and a domestic hot water heater located in the Kitchen.

The ASHP has been ‘sized’ and calculated to supply for this demand. The use of small electric water heaters in the toilets have not been included within the proposed ASHP assessment.

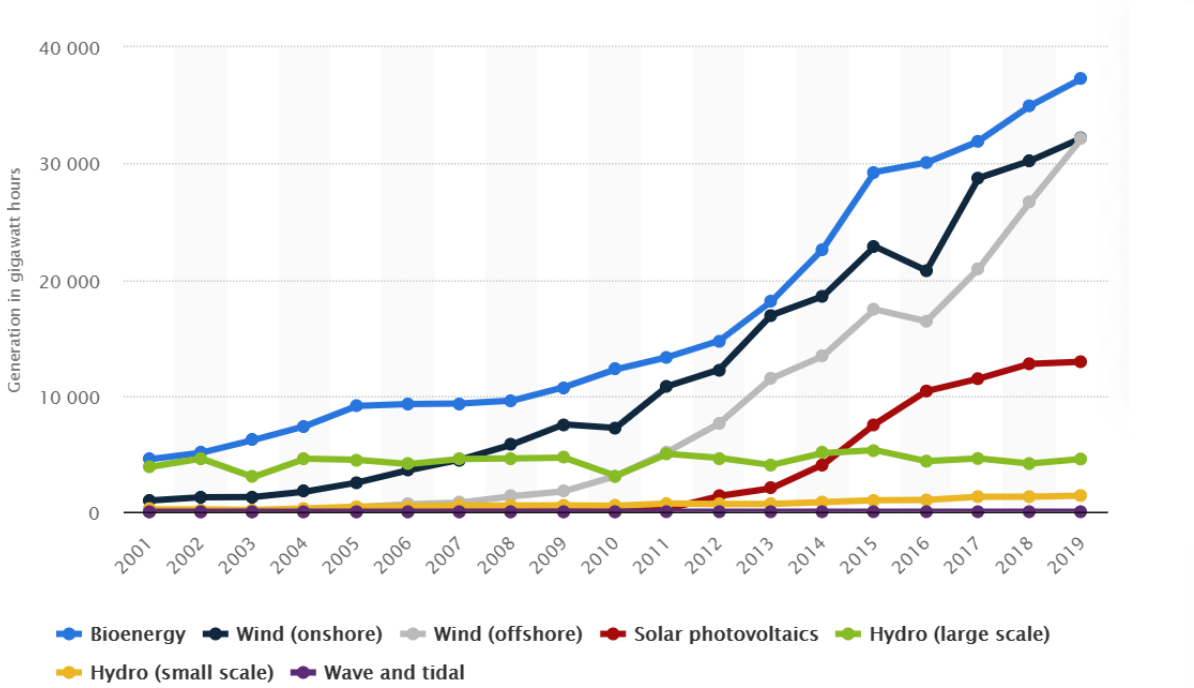
Additional heat source will be provided by electric immersion heaters.

14. Renewable energy solutions

A good system combination at Kinver is key to achieving overall good performance as well as individual component performance. The proposed renewable energy technologies complement each other in providing a predictable constant of energy performance when needed, and ensure that the centre can become truly carbon neutral in the years to come.

Nation-wide, renewable energy generation has met with continued increase over the years, which has also driven down the costs for renewable technologies. The Smart Export Guarantee (SEG) was launched in January 2020 following the closure of Feed-in-Tariffs, and enables small-scale exporters to choose the highest bidder for the renewable energy they put into the grid, although beneficiaries are subject to eligibility criteria.

Fig. 17: Generation of Renewable Energy and Heat in the UK, 2020 [Statista.com]



The above figure suggests a significant increase in Aeolian (wind) and bioenergy technologies. Solar PV follows closely and seems to have stabilised, whereas the wave and tidal power sector still needs significant research and investment to create cost-effective technologies.

14.1 Wind energy

Wind regeneration, also known as aeolian energy generation, became the second largest source of electricity in the UK, providing 64 TWh; almost one fifth of the total national generation, through both onshore and offshore technology [government assets, 2020]. There is a definite possibility for the Kinver Sports and Community Centre to tap into local wind resources. This would however require significant investment into a tall windmill as the average needed wind speed of 5m/s is only achieved at 30m or more above ground level [Kinver Energy Survey 2014]. It has been noted that a tall windmill may meet with disagreement from local residents.

14.2 Solar

Solar energy has the advantages of low utilisation costs, ease of access, low maintenance & health and safety risks and longer-term availability of structural materials when compared to fossil fuels, making them more sustainable at present. While there are greenhouse gas emissions associated with the mining, refining, production and shipping stages, as well as end of life recycling, the proposed monocrystalline solar panels for the centre bring on average 30 years of linear power output and, like most solar PVs, do not create hazardous by-products during functioning. Material refinery and texturing taking place inside factories tends to be the stage responsible for most hazardous by-products. From a commercial perspective, adding solar-powered systems can increase a property's value.

Solar radiation intensity and ambient temperature both influence the energy efficiency of connection methods for the proposed solar-powered systems. The overall system size and annual climatic and environmental conditions (dust, bird droppings, etc.) will influence final power output. Solar thermal tends to be more efficient during summer months for water heating specifically, but falls in output during cloudy days and cold months.

The intermittent nature of solar energy may make both thermal and PV systems work at full capacity mainly during the summer, after which the kWh output experiences a gradual decline, reaching minimum values in December in the Northern Hemisphere. With the closure of Feed-in-Tariffs in 2019, it is advised that storage measures such as batteries or a backup system is used to compensate for the energy necessities of the centre during months with low solar radiation or after dusk, and sell back to the grid when more than the centre can utilise is being produced.

14.2.1 Solar thermal

Solar thermal energy (STE) is a technology that harnesses solar energy and converts it to thermal energy (heat). Solar thermal collectors are classified as Low-, medium- or High-temperature collectors. Low temperature collectors are flat-plates generally used to heat swimming pools. Medium-temperature collectors are also usually flat-plates but are used for heating water or air for residential and commercial use.

This technology uses collectors to absorb heat commonly for use to produce low grade energy to assist the production of hot water or preheat a buffer vessel for under floor heating. Due to local weather conditions, there is no reliance on the sun's energy being available. Supplementary systems are required e.g. electric heaters or the main heating system etc.

Solar thermal can work alongside the ASHP to provide heated water to the boiler, therefore reducing the electricity consumption of an ASHP. Solar thermal only supplements the heating demand from the boiler, and it does not replace it. Government's RHI (Renewable Heat Incentive) is still open to application for solar thermal technologies until the 31st of March 2021, subject to eligibility criteria, however, the technology

As this is was a less cost-effective solution for heating demands at the Kinver Community Centre, due to not being able to heat water as efficiently during cloudy days and colds months when compared to the low carbon heat source provided by the ASHP, a quotation was not obtained. If the centre was to go for a "like for like" replacement of the gas boilers with newer system using the same type of fuel, the measure to replace the gas boilers with solar thermal would have been a consideration to ease the hot thermal load.

14.2.2 Solar PV

In this section, we describe the assessment that has been completed for the KSCA building alongside electrical specialists.

Fig. 18: Projection - Aerial view of roof solar panel arrangement at Kinver

The figure above is showing an ideal maximum number of solar panels that would be capable of providing the centre with enough kWh for at least half the consumption needs during sunny months and exporting purposes to the Grid. The amount of pictured solar panels is only able to provide a minimum quantity of energy during the cold, cloudy days and months between November and February each year.

The photovoltaic (PV) system is a technology that has been designed to capture energy from the sun and transform it into electricity by using photovoltaics, also known as solar panels. Although research for more types of materials is underway, most panels start off as quartz, a form of silica, which are refined into polysilicon of different quality grades.

We believe that solar PV plays an essential part of the current carbon reduction strategy, and we've undertaken a solar PV modelling and engaged a specialist to provide a proposal. The needs to be covered by the system are comprised of heating for space, hot water, and electricity.

It has been calculated following the survey that both the building and the new flat roof are deemed structurally-sound to bear the added weight of the panels. The **100A** three phase supply is sufficient for the proposed system and the project falls under the permitted developments category. However, future installation of PV is still subject to DNO approval.

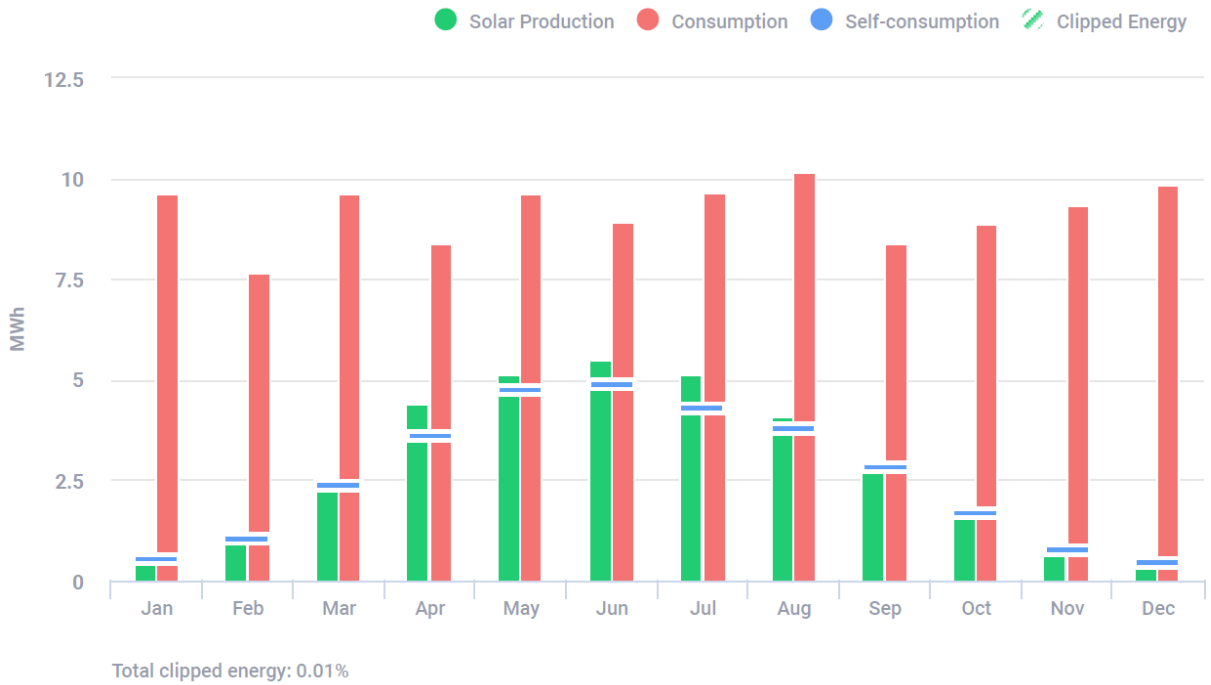
Proposed System and Modules: 102 solar panels, with 1 inverter and 51 optimisers.

<u>Simulation output power</u>

The proposed solar PV system would have an energy generation output of **41.82 kWp.** This would generate the equivalent of **34,300 kWh** (34.33 MWh) annual energy production. The equivalent CO_2 emissions saved when compared to traditional fossil fuel sources is **9.65 Tonnes** per year.

Fig. 19: Simulation results

Fig. 20: Estimated monthly energy production



The above graphs shows maximum decreased solar energy output from PVs during the cold, shaded months from November until February.

14.3 Water recycling

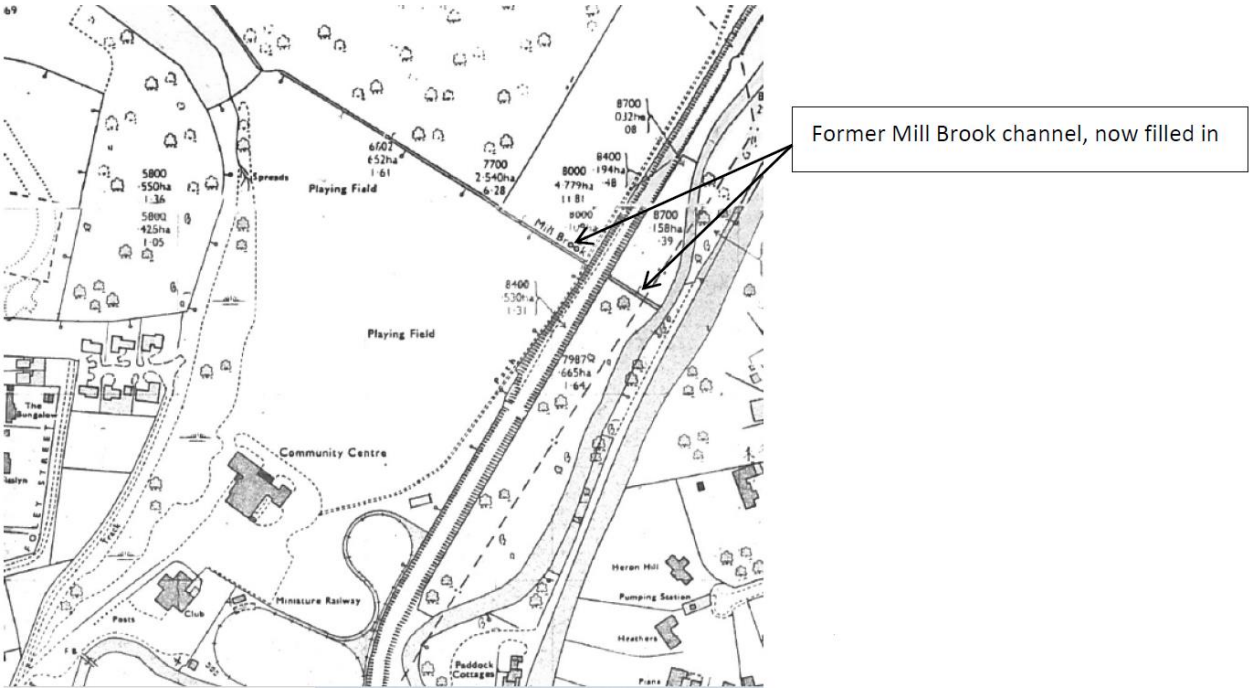
Water bills can be positively impacted by water recycling systems. This usually refers to waste/greywater coming from sinks, baths, showers, washing machines, dishwashers, etc. as well as rainwater, which can be reused without filtering in areas such as cistern filling where it does not pose a direct health and environmental hazard. Based on annual rainfall patterns in Stourbridge and nearby areas (over 700mm p.a. inclusive of snowfall and hail, and before reduction by evaporation is taken into account) and approximate roof area of the Kinver Sports and Community Association (770 m^2), rainwater collection is a viable source of water. Proper floodwater management and drainage further ensure that energy is correctly used at KSCA.

14.3.1 Flood Management and Drainage

On the first on-site visit undertaken by Maloney Associates, the field around the building was extensively flooded, close to the building level. After discussing the matter, it has been established that there are still existing worries related to the potential flooding danger at the Kinver Sports and Community Centre, especially in the light of new uncertainties brought by climate change.

In order to improve water catchment management and water quality through the planting of aquatic plants with filtering function, as well as biodiversity enhancement through wetland restoration, the Sterrymere has recently been desilted. A channel which aided with water management was historically located at the northern boundary of the playing fields, but it was filled in a number of years ago (Sterrymere Environmental Enhancement report, 2019).

Fig. 21: Former Mill Brook channel, Sterrymere Environmental Enhancement report 2019.



A 2020 analysis of the flood map, provided for through the government online tools by Margaret Kodz, showed that the KSCA building itself lies within Flood Zone 1, on raised ground. During the site visit, it was confirmed that the building's basement also tends to flood, although the water doesn't overflow into the main Hall to which the basement is connected.

Drainage

Two surface water sewers conveying surface water runoff from the Potters Cross area of Kinver discharge into the Mill Brook. A combined sewer overflow spills excess flow from the foul/combined sewer system into one of the surface water sewers. (Sterrymere Environmental Enhancement report, 2019). It has been reported that some greywater from the centre's showers currently soaks into the ground or discharges into the closest waterways.

However, according to McHale 2017, there are no records of any current discharge agreements to the canal from the site. Any new drainage methods of new developments can have significant impacts on the structural integrity, water quality and the biodiversity of waterways. It is important to ensure that no contaminants enter the canal from surface water drainage and full details should be submitted and agreed. The details should include details of interceptors, maintenance, and pollution control measures in flood conditions. This need comes perhaps as a result of historical surface and ground water abstraction for public, as well as industrial and agricultural use in the bigger Stour valley. Four NVZs (Nitrate Vulnerable Zones) alongside its main course had been identified in 1998: Tom Hill, Hinksford, Kinver and Wildmoor.

It is recommended that more efficient drainage for the changing rooms' greywater is considered in future refurbishments.

14.3.2 Rainwater Collection Systems

Tanks up to 20,000 litres or more can be installed and filled to provide water when needed, both below and above ground. A rainwater collection system can be especially useful in an area like Kinver with high annual rainfall pattern (over 800mm p.a. inclusive of snowfall and hail, and before reduction by evaporation is taken into account) and approximate roof area of the Kinver Sports and Community Association (approx. 770 m^2).

Details such as base model, cost, and ground use have been included at the end of the report in section 17. As the payback for a rainwater harvesting system of significant size was over a long time span (up to 40 years depending on final decision on model, size, etc.), this option was not included. Please refer to the Summary of Key Assumptions.

14.4 Heat Pumps

Heat pumps can provide high-efficiency, low-carbon heat for dwellings. Their performance is optimised if low-temperature heat emitters (eg. radiators, underfloor etc.) are used for heat distribution in the house.

Heat pumps use refrigerant gasses in an electrically powered unit to take and provide heated air to a system. They can be separated into those which use air as the source - called Air Source Heat Pumps (ASHP), and another form that uses the more stable temperatures from below the ground - called Ground Source Heat Pumps (GSHP).

In line with MCS guidelines, a temperature star rating was used to indicate how efficient the proposed system is likely to be. More efficient systems are given a higher number of stars, 6 stars being the maximum. More stars are given when lower heat emitter temperatures are used because

the heat pump is able to operate more efficiently. In order to operate at a lower temperature the heat emitter must be oversized compared to those normally used with Gas/LPG/ Oil.

Table 10: Global Energy Solutions (GES) Star rating

No. of Star	Flow Temperature
6 STARS	35°C
5 STARS	40°C
4 STARS	45°C
3 STARS	50°C
2 STARS	55°C
1 STAR	60°C
0 STARS	>60°C

14.4.1 Air-Source Heat Pump

An air-source heat pump typically extracts heat from the surrounding ambient, or even from recirculated air. Heat engines that work in reverse mode as a heat pumps seem to have originated from refrigeration techniques.

For an air-source heat pump, the lower ambient temperature is, the less effective it will be, due to the system requirements to bring the flow temperature to at least 50°C. Nevertheless, ASHP units have a functioning temperature range of -20/+35°C, where the optimal range is achieved somewhere in the middle, from -3 to +18°C. These specifications apply to the proposed Lincoln unit, with the annual average temperature at Kinver between -3 to 10°C. This heat pump can provide partial space heating services, the rest being ideally covered by PV or an electric element in the cylinder. This model has been considered more efficient than other fossil-fuel based heating systems or than the ground-source HP. A room by room design appraisal has been undertaken and included in the appendix, inclusive of thermal losses and internal temperatures.

Base model

Based upon information supplied and data gathered, the use of 1 x Global Energy Systems 80kW Lincoln Eco Air Boiler was suggested, with a 1000 litres DHW Store. This is based on people in the property and a 54 minute reheat time. This solution takes into account the heat demand of 32.2kW that the company estimates is needed at the agreed design temperature of -3.4°C.

Energy usage and Efficiency

Table 11: Heating types and corresponding efficiencies

Heating Type	Heating Efficiency
ASHP	286%
Gas	70%
Oil	70%
LPG	70%
Electric	100%

In the above table, the proposed ASHP model is compared to other types of heating. These figures are derived from the rapport between space heating requirements which the system can provide for (84,383 kWh/yr) and actual consumption (29,500 kWh/yr).

14.4.2 Ground-source Heat Pump

A ground-source heat pump was considered for the Centre; however, pipe work would have been necessary under the playing field, an area which floods every year. It has been recognised that for Kinver, an air-source heat pump would be a more cost-effective option. The GSHP remains a solution that can be considered in future plans.

14.5 Electric Vehicle Charging Points

Conventional diesel and petroleum engines have bigger emissions of nitrogen oxides (NOx), particulate matter (PM), carbon dioxide and monoxide (CO_2 and CO) and of hydrocarbons (HC) when compared to electric systems [DFT 2018]. This is important as air pollution contributes to most worldwide deaths by type of environmental pollution [WHO 2020]. Moreover, road transport accounted for 21% of all the GHG emissions in the UK [ONS 2017]. Globally, it is responsible for 24% of the total CO2 emissions [Bobeth et al., 2020]. The EV industry has been constantly changing and developing. The Government's 2018 Road to Zero strategy outlined how road transport is going to be "decarbonized", and includes car sale strategies and incentives for ultra-low emissions vehicles. From 2030 onwards, the selling of new petrol, diesel and hybrid cars and vans will be phased out.

The Kinver Parish Council intends to deliver electric charging points (EVCPs) in the village to welcome these industry-wide changes, and the KSCA building parking has been identified as a suitable spot for 2 EVCPs.

An EV specialist has been to the site and recommended that EV charging points are possible. Based on the key requirements they have produced a proposal, part of which has been included in the Appendix as a sample.

They allowed in their projections for 7 kW units to be used for the whole community. They could allow a much bigger infrastructure to serve a bigger demand for the whole of the Kinver area.

Phone-based app for both drivers and station owners

EVbox

EVCP scope of work

2 x 7.4kWp single wall mounted EV charging units
-supply and install a new 4-way TP & N distribution board from existing DB in the boiler room.
EVCP model

-EV Box Elvi charging units, single phase 7.4KW EV charging
Fig. 22: Elvi EV Charger 7.2kW Wifi + UMTS Untethered Black (White also available)

Location
Fig. 23: Positioning of EV charging points

The above photograph illustrates proposed position of 2 EV charging points in an easily accessible area of the car parking and near the disabled spaces. It is readily accessible to electrical services

Online Monitoring Platform

Provision of the EV box advanced monitoring software is provided at a cost of £65.00 per year per socket, which enables remote self-service functionality, support, and firmware updates, as well as station, card, and user management. Provided through start and stop charging via RFID card or online portal. This enables the following:

- Review and download transaction data for stations and cards (PDF/CSV)
- Smart charging
- Load balancing, setting max power and charging profiles
- Onboarding and level 2 support (In-depth technical support with advanced troubleshooting and analysis)
- Level 1 Support (First-line technical support with remote diagnostics and solving basic issues)
- Automated reimbursement for employees charging at home
- Set charging fees for your stations and publish them online for public charging

For more information, please see section 17 at the end of the report.

15. Building Envelope

The following building parameters related to the building envelope quality were assessed room by room by Global Energy Systems and then aggregated.

The building was built in the 1960s roughly and has undergone a number of small renovations. The Building envelope is lightweight and with low thermal performance, due to cavity walls having no insulation. According to the 2014 Energy Report, the current roof is made of PVC (polyvinyl chloride) roof membrane, concrete block deck (potentially with a thin layer of screed) and wooden internal soffits. Based on made observations, it is unlikely that there is any insulation present however, if present (at all) and it will typically be a thin layer of cork. The roof is therefore poorly insulated. Roof insulation is going to receive significant improvements together with the new refurbishment plans funded by DEFRA and National Lottery Fund.

Window glazing is PVC double glazing and up to standard, although it is recommended the frames are insulated as well as currently there is some thermal loss occurring on the edges.

The building has a generally high infiltration rate through fabric, windows, roof floor, etc. A high rate of air leakage increases heat loss, demand and costs.

Other examples of heat loss occur through gaps under the doors, open holes in the ceiling, missing filters from roof light, no shutter to air vents in theatre hall, no double glazing in the changing rooms and without insulation, in direct contact with outer walls.

The KSCA have received quotations and have proposals to redevelop the building and the structure. It's recognised that in the current stage, there is a real need to improve thermal properties of the building. It is essential that the opportunity of this development maximises the thermal properties and dynamics of the building. This is essential for the correct functioning of proposed technologies,

to support the road to carbon net zero and live up to expectations, as they are a long-term investment.

Discussions with the appointed design team on the preliminary proposals have highlighted that the redevelopment is based upon statutory building regulation requirements, which include the upgrading of current building insulation.

It is recommended that the design goes well beyond the current building regulations, particularly the ones defined in Building Regulations part L: Conservation of Fuel and Power. This will future-proof the building and allow thermal properties beyond today's regulations. These regulations are currently under review and the first of several amendments will be introduced in 2022.

Key recommendation is that the new wall and floor insulation be applied to the whole of the building rather than just the extension. This opportunity needs to look at holistically improving the building envelope beyond the current regulations and requirements and put the foundation in for all the proposed technologies and map to carbon net zero.

It is also recommended that the design team consider these objectives and the low carbon consultants such as Maloney Associates are engaged independently for guidance and assessment to provide a holistic assessment beyond the minimum regulations.

Overview of proposed insulation standards (provided by the Kinver contractor) for the extension:

-100mm Insulation (floor):

-External 150mm SFS, insulated, complete with breather membrane, vapour barrier, plasterboard and skim internally

-Form Cavity, including wall ties and 50mm insulation

All these measures are going to improve the thermal insulation, but it is advised that the whole building should benefit from the new cladding if consideration is given to thermal properties.

16. Other key considerations and recommendations

Certain areas such as the kitchen heater cupboard can benefit from pipe insulation as specified in the Kinver Energy Survey 2014. The two ventilators in the main hall will further benefit from shutters to account for heat leaks.

Heating zoning arrangements (Zoning dampers/control)

We recommend all these points to be considered during the redevelopment and that the cost-effective measures will have to be identified, calculated and appraised as part of the design process with the design team.

16.1 Risk Assessment

For any ECM project identified in this report, each subsequent contractor will evaluate and complete individual risk assessments.

16.2 Summary of Key Assumptions

It is recommended than an energy management plan is laid out with the help of the KSCA committee. These simple steps can enable better energy and consumption tracking at the Centre:

1. Measure/benchmark current energy consumption.
2. Complete a greenhouse gas (GHG) emissions inventory
3. Develop an energy use profile
4. Build teams, get leadership support, assign dedicated resources.
5. Set targets/goals.
6. Develop of action plans for improvement, search for possible funding and remediating action.
7. Educate, train and praise.

17. Appendices

The final quotations and budgetary costs gained for the process report will be issued with the final issue report as separate documents. The tables and figures provided underneath that were produced for the KSCA represent a relevant example of final quotations.

Details on EVCP:

Table : Budgetary costs for EVCP installation

ITEM	SUMMARY	PRICE
Intelligence	Data, metering & back office provision for a One-year period).	£130.00
Hardware	System hardware, switchgear & cabling	£2,070.00
Administration	Installation, registration, and professional fees	£2,332.00
Network Costs	Network connection and reinforcement costs	£00.00
Access, Plant & Hire	Access provision, plant and equipment hire	£00.00
	OLEV GRANT Work Charging Place Scheme	**-£700.00**
	Total Exclusive of VAT	**£3,832,00**

Details on ASHP

Table 13: Room by room analysis of thermal loss, temperature and recommended heating type

Area measured 705 m^2

	Room Name	Current Heat Emitter Output (Watts)	Current Heat Emitter Star Rating	Recommended Heat Emitter Star Rating	Recommended Heat Emitter Output (Watts)*1	Heat Emitter Upgrade Required?	Room Heat Loss (Watts)		Room Temperature (°C)	Room Area (m^2)	Heat Emitter Type to be Installed*3
1	Gents WC		0 STAR	3 STAR	2,608	YES	1086		18	22.2222	Standard Radiator
2	Office		0 STAR	3 STAR	893	YES	372		21	7.5208	Standard Radiator
3	Hall		0 STAR	3 STAR	3,086	YES	1286		18	51.9569	Standard Radiator
4	Female WC		0 STAR	3 STAR	1,668	YES	695		18	18.75071	Standard Radiator
5	Disabled WC		0 STAR	3 STAR	1,779	YES	741		18	20.1279	Standard Radiator
6	Meeting Room 1		0 STAR	3 STAR	2,838	YES	1183		21	20.28816	Standard Radiator
7	Meeting Room 2		0 STAR	3 STAR	3,392	YES	1413		21	23.34248	Standard Radiator
8	Meeting Room 3		0 STAR	3 STAR	4,465	YES	1860		21	30.77225	Standard Radiator
9	Bar Lounge		0 STAR	3 STAR	11,036	YES	4598		21	140.2504	Standard Radiator
10	Hall		0 STAR	3 STAR	29,707	YES	12378		18	215.5428	Standard Radiator
11	Stage		0 STAR	3 STAR	4,738	YES	1974		18	32.55846	Standard Radiator
12	Corridor		0 STAR	3 STAR	517	YES	216		18	9.895786	Standard Radiator
13	Main Kitchen		0 STAR	3 STAR	2,322	YES	968		18	26.64482	Standard Radiator

14	Kitchen 2		0 STAR	3 STAR	1,072	YES	447		18	12.12963	Standard Radiator
15	Lobby		0 STAR	3 STAR	1,152	YES	480		18	17.2819	Standard Radiator
16	WC		0 STAR	3 STAR	854	YES	356		18	9.44634	Standard Radiator
17	Changing room 1		0 STAR	3 STAR	2,652	YES	1105		18	23.94532	Standard Radiator
18	Changing room 2		0 STAR	3 STAR	2,466	YES	1028		18	21.8413	Standard Radiator

*[1]- Recommended Heat Emitter Output is based on a mean air to water temperature of 50°C.

*[2]- Estimated Radiator dimensions have been estimated for a K2 (Double convector) type radiator. When selecting a radiator please use heat emitter output rather than dimensions, as the heat emitter output can vary depending on manufacturer and radiator model.

*[3]- If underfloor heating is to be installed, the underfloor design should be carried out by a qualified contractor. It should be sufficient to supply the heat loss for each room as the design flow temperature. Note: installed heat emitters do not have to be upgraded in line with this document, this has only been provided to help make an informed decision. Please contact Global Energy Systems for more information or costs on upgrading radiators.

Details on EVCPs:

Fig. 24: Detailed section from the EVCP proposal by Feed it Green

feed it green

Included in your quote:

- 1 years back office subscription
- All electrical works required
- Supply and installation of two x single 1PH Type A RCBO
- An electrical installation test certificate (Napit)
- Full registration, certification, and notification (OLEV/Back Office/DNO/Building Control)

The installation process:

Our quotation is for a complete turn-key solution. We estimate the installation will take 2-days in total. It is our aim to minimise disruption and ensure the best possible client experience. Our installations crews are clean, courteous, dressed in company uniform and always tidy up after themselves!

How to proceed
If you would like to proceed with the proposal, we require a 25% deposit and a company Purchase Order to reserve an installation appointment. Once the Purchase Order and deposit is received, we will schedule the installation (subject to the 14-day cooling-off period)

Any other queries:

If you have any further questions, please call or email quoting your project reference name detailed at the top of this document.
Payment

Our preferred method of payment is BACS electronic transfer, but we also accept all major debit and credit cards. Please note that we will pass on the fees charged for paying by credit card.

Thank you for the opportunity to quote for these works, if you require any further assistance please do not hesitate to contact me on 07946565066
Sunny regards

Mark Lee Reynolds BSc (Hons)

Fig. 25: Detailed section from the EVCP proposal by Feed it Green

feed it green

Optional extras to be considered:

Tethered lead holder - £80.00 per unit

Line marking - £400.00 per bay

Green resin painted bay
EV logo
Assuming bay is clean

Wall mounted signage - £50.00 per bay

Details on a Rainwater Harvesting System:

Fig. 26: Detailed section on product types, recommendations and prices by Stormsaver Ltd.

Estimator: Dan Sayer

Civils product selection

Product Name	Quantity	Product Code	Product Description
Stormsaver Shallow 160mm Inlet Pre Tank Filter Above Ground - Drainage Connections on Filter	1.00	1/PTF/SSD160AG	Stormsaver Shallow 160mm Inlet Pre Tank Filter Above Ground - Drainage Connections on Filter 1000 microns. For preventing leaves and debris entering the storage tank. Includes filter housing lid, 1 x 160mm inlet, 1 x 160mm outlet, 1 x 160mm drain. Invert level 20mm.
20000L Above Ground Single Piece Storage Tank	1.00	7/AG/20000	20000L capacity GRP one piece tank. Dimensions 4500mmL x 2500mmW x 2000mmH. Flat base. (N.B Client to provide flat concrete slab for installation). Includes 50mm insulation.
150mm Inlet Calmer	1.00	10/IC/150	150mm diameter inlet into storage tank with inlet diffuser.
150mm Overflow	1.00	10/OF/150	150mm diameter overflow from the underground storage tank.
160mm Non Return Valve	1.00	10/BPF/160	150mm Non Return Valve. To prevent water backflowing through the overflow. Unit is supplied fitted in the tank overflow. This item is required to meet BS8515:2009.
Service Ducts for AG Tank	1.00	10/SDHT/100	2 x 100mm service ducts for above ground tanks
Standard delivery of underground tank	1.00	30/DEL/SS/UGTANK	Standard delivery of underground tank listed in the quotation (UK mainland). This is not FORS accredited, or a timed slot, and this would incur an additional charge.

Duty Standby M40/08 Pump and Floating Suction Filter Kit - 2	1.00	11/2XM40/08/2.0	2 x M40/08 stainless steel submersible pumps with lifting rope, 2.0m floating suction extraction filter (coarse). Max Q 1.3l/s and Max H 4.8 bar per pump
eXpress 400 2P Combi - Variable Speed	1.00	15/X/2PCOMBI/VS5	eXpress 400 2P Combi - Variable Speed. Stormsaver Low cost Combi Unit provides a pressurised water supply with all the benefits of a non pressurised header tank system. Connects to duty standby submersible pumps in the main storage tank. The package combines 2 booster pumps and regulation compliant mains water top up all in one self contained unit. Dimensions 1650 (H) x 840mm (W) x 740mm (D) The unit also houses 400L back up storage, variable speed pumps, electrical processor control, system electrics, pressure set, control & sensors for a mains water top up which is compliant with the Water Supply (Water Fittings) Regulations 1999 (Optional BMS ouput). Please ensure that the mains water top up meets the demands of the outgoing water. Stormsaver cannot accept responsibility for this. Rainwater inlet 28mm. Mainswater inlet 35mm. Outlet 35mm. Booster Set - Q Max 4.0 l/s H Max 46 m
Stormsaver Delivery Costs	1.00	30/DEL/SS	Standard delivery of all equipment listed in the quotation (UK mainland). This is not FORS accredited, and this would incur an additional charge.

Services product selection

Product Name	Quantity	Product Code	Product Description
Commissioning - Green	1.00	31/COM/G1	Commissioning visit: Includes 1 day on site time to commission system on completion of the installation by others - Green area

Total Price (ex. vat)

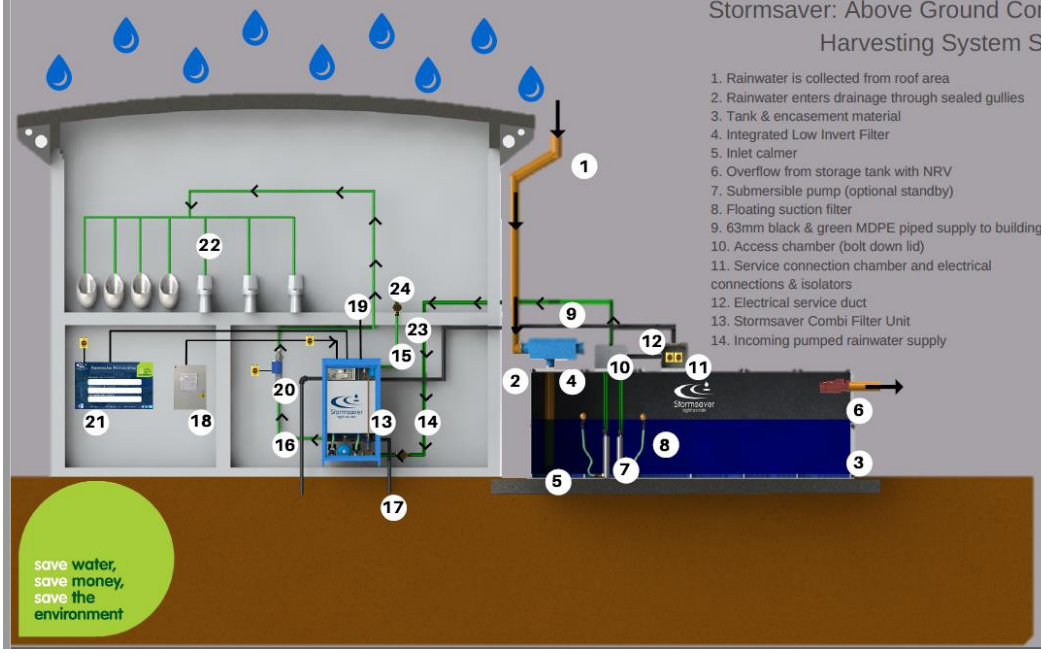
£15,307.77

Fig. 27: Details on an above ground water harvesting system with filters.

Above Ground Combi Filter Rainwater Harvesting System Schematic

Stormsaver
right as rain

The UK Market Leaders in Rainwater Harvesting Systems T 01636 815254 www.stormsaver.com



Stormsaver: Above Ground Combi FIlter Rainwater Harvesting System Schematic

1. Rainwater is collected from roof area
2. Rainwater enters drainage through sealed gullies
3. Tank & encasement material
4. Integrated Low Invert Filter
5. Inlet calmer
6. Overflow from storage tank with NRV
7. Submersible pump (optional standby)
8. Floating suction filter
9. 63mm black & green MDPE piped supply to building
10. Access chamber (bolt down lid)
11. Service connection chamber and electrical connections & isolators
12. Electrical service duct
13. Stormsaver Combi Filter Unit
14. Incoming pumped rainwater supply
15. Mains cold water supply (top up)
16. Boosted rainwater supply
17. Connection to drain
18. Mains power supply
19. Optional BMS (by others)
20. Optional UV disinfection unit
21. Optional- monitoring unit supplied with rainwater and mains water meters
22. Points of use
23. Mains water solenoid
24. Mains water flow meter

Disclaimer:
This schematic is to be used as a general overview of a typical Stormsaver rainwater harvesting system layout. It is not site specific and should not be relied upon for technical submittals or installation guidance.

Assumption	Source/Reference
Energy data has been taken from the following sources: Electricity & Gas – Bills, scanned format	KSCA committee
This report has been completed using methodologies and guidance as detailed within; - BS EN 16247 - Technical Memorandum (TM) 41 & 46 - The EU Energy Performance of Buildings Directive (EPBD) - The Energy Savings Opportunity Scheme Regulations 2017	Chartered Institution of Building Services Engineers (CIBSE) British Standards Institute (BSI)
The energy benchmark for 'Good Practice' has been taken from Chartered Institution of Building Services Engineers (CIBSE) Guide for Energy Benchmarks.	CIBSE TM46:2008
All estimated capital costs stated within the report have been calculated using published cost data such as SPONS etc., cost data from previous projects with similar technologies and experience and knowledge of the auditors. Prior to the implementation of the ECMs it is recommended that fixed price quotations are sought for all measures.	
All capital costs contained within this report are exclusive of VAT	
Degree- day correction has not been applied to the data contained within this report	
Power capacities of some items of plant have been estimated where not readily available	Where required assessment made using engineers experience
Emissions factors used for calculations: Electricity:- 0.23314 kg CO_2e Gas:- 0.18455 kg CO_2e Water supply:- 0.344 kg CO_2e	DEFRA (2020)
The following energy unit rates have been used within the ECM calculations: Electricity- £0.15/kWh Gas-£0.04/kWh	Scanned energy bills
Community Centre operating hours are as follows: **Mon-Sun: 09:00 – 17:00**	

18. List of Abbreviations and Glossary

The following table has been included in the beginning for lecture flow for the reader and familiarisation with the terms contained within the report.

ASHP	Air Source Heat Pump
GSHP	Ground Source Heat Pump
Abstraction (of water)	the process of taking water from any source, either temporarily or permanently for irrigation, industry, recreation, flood control or treatment to produce drinking water.
PV	Photovoltaic
GHG	Greenhouse Gases (as specified in the Kyoto protocol)
Aeolian	Wind
EVCP	Electric vehicle charging point

kWp	Kilowatts peak – energy generated at peak performance (for example at noon on a sunny day)
CO_2e	Carbon dioxide equivalent – the amount of global warming caused by a quantity of GHG at a specific point in time, expressed in terms of the amount of CO2 which would have the same instantaneous warming effect. It is used to evaluate the releasing (or avoiding releasing) of different greenhouse gases against a common basis.
Carbon Assessment	A type of assessment used to determine the total carbon footprint (expressed as carbon dioxide equivalent) for a particular development project.
KSCA	Kinver Sports and Community Association
LED	Light-emitting diode
Northern Hemisphere	Top half of Earth that is North of Equator
Natural Gas	Naturally occurring flammable gas, consisting largely of methane and other hydrocarbons, found underground (often in association with petroleum) and used as fuel. To be differentiated from biogas.
IPCC	Intergovernmental Panel on Climate Change – International body of climate change scientists, having the role of assessing the scientific, technical and socio-economic information relevant to the understanding of the risk of human-induced climate change.
Kyoto gases	The gases covered by the Kyoto Protocol – Carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydroflurocarbons (HFCs), perflurocarbons (PFCs), and sulphur hexafluoride (SF6).
Kyoto Protocol	A protocol to the United Nations Framework Convention on Climate Change (UNFCCC or FCCC). The Kyoto Protocol establishes legally binding commitments for the reduction of the Kyoto gases which came into force in 2005 and committed signatories to a reduction in greenhouse gas (GHG) emissions to between 20-24 billion tonnes by 2050 (about 50-60% below 1990 global levels).
Offset	Offsets are discrete GHG reductions, in the form of carbon credits, used to compensate for (i.e. offset) specific and accurately measured GHG emissions elsewhere, for example to meet a voluntary GHG target or cap. Carbon credits

	must represent a genuine, additional carbon saving, and are calculated relative to a baseline that represents a hypothetical scenario for what emissions would have been in the absence of the mitigation project that generates the credits. To avoid double counting, the reduction giving rise to the credit must occur at sources or sinks not included in the target or cap for which it is used.
Renewable energy	Sources of energy that can be replenished through natural resources within a needed timeframe, from timber to tidal power.
Renewable energy technologies	Technologies that generate energy from renewable natural resources. These technologies are not always in line by default with sustainability targets or sustainable energy production, for example, where water use in hydroelectricity generation disrupts natural river ecosystems, though preventing the flow of nutrient-rich alluvial deposits or blocking the migration of fish and crustaceans.
Scope	Operational boundaries
Climate change emergency	A situation in which urgent action is required to reduce or halt climate change and avoid potentially irreversible environmental damage resulting from it.
Significant landscape features	Noticeable characteristics encompassing topography, vegetation patterns, human culture, etc.
AD	Anno Domini – Latin for "*in the year of the lord*," refers to the birth of Jesus Christ in what is the "year 0" of reference in this paper.
Floodplain	The relatively flat lands adjacent to a body of water, such as a river or stream, that become flooded (inundated with water) when channel capacity is exceeded and overtopping occurs.
DEFRA	The Department for Environment, Food and Rural Affairs – the government department responsible for environmental protection, food production and standards, agriculture, fisheries and rural communities in the United Kingdom of Great Britain and Northern Ireland.
RCEF	The Rural Community Energy Fund (RCEF) – a £10 million programme which supports rural communities in England to develop renewable energy projects, which provide economic and social benefits to the community.

BEIS	The Department for Business, Energy and Industrial Strategy – a department of the government of the replaced the Department for Business, Innovation and Skills (BIS) and the Department of Energy and Climate Change (DECC) in July 2016.
Climate change	Observed warming trend as a result of changes in levels of gases with greenhouse effect in the troposphere due to human activity (including fossil fuel usage, deforestation, etc.) since at least the mid-20th century and proceeding at an unprecedented rate over millennia. Global warming trends comprise of elements such as ocean acidification, extreme weather events, glacial and ice cap retreat, changes in rainfall patterns, sea level rise, global temperatures rise and species extinction.
Paris Agreement	A legally binding international treaty on climate change. It was adopted by 196 Parties at COP 21 in Paris, on 12 December 2015 and entered into force on 4 November 2016. Its goal is to limit global warming to well below 2, preferably to 1.5 degrees Celsius, compared to pre-industrial levels.
UNFCCC	A legally binding international treaty on climate change. It was adopted by 196 Parties at COP 21 in Paris, on 12 December 2015 and entered into force on 4 November 2016. Its goal is to limit global warming to well below 2, preferably to 1.5 degrees Celsius, compared to pre-industrial levels.
UN	United Nations
WHO	World Health Organisation
LTHW	Low Temperature Hot Water – the supply temperature of low temperature heating anywhere between 35 °C and 55 °C, as opposed to central heating water in a traditional heating system which is anywhere between 75 °C and 85 °C.
CCS	Carbon capture and storage – the process of capturing and storing carbon dioxide (CO2) before it is released into the atmosphere.
LZC	Low and zero carbon technologies that can provide a source of energy generation from renewable energy sources or from a low carbon source such as combined heat and power (CHP) or ground source heat pumps (GSHP).

Carbon footprint	The total greenhouse gas emissions caused by an individual, event, organization, service, or product, expressed as carbon dioxide equivalent.
Pollution	Or polluting – refers to the introduction of chemicals in nature that alter biogeochemical processes and cause adverse changes.
Permian	In geologic time, the last period of the Paleozoic Era, lasting from 298.9 million to 252.2 million years ago.
Heathland	Shrubland habitat found mainly on free-draining infertile, acidic soils and characterised by open, low-growing woody vegetation. The landscapes are open and dominated by plants such as Heathers, Gorse and heathland grasses and punctuated by scattered trees such as Silver Birch. Considered a rare habitat in Europe.
ULEV	Ultra-Low-Emission-Vehicles are currently defined as having less than 75 grams of CO2 per kilometre (g/km) from the tail pipe. Recognising advances in technology, it is expected that from 2021 the definition of ULEV as a car or van will apply to those that emit less than 50g/km CO2.
IGA	Investment Grade Audit - An Investment Grade Audit and project proposal contract direct an Energy Service Company to identify, evaluate, and present a recommended package of measures with associated efficiency savings and projected costs.
CIBSE	The Chartered Institution of Building Services Engineers is an international professional engineering association based in London that represents building services engineers.
Used water	Water returned to sewers after use (e.g. toilet flush, baths and showers) and charges are levied for the cost of removing, treating and disposing of this used water. Charges are calculated based on how much clean water has been used.
Drainage	Rainwater that drain from somebody's property into the sewer. A water company will collect and treat this surface water, and issue charges accordingly.
Bioenergy	In this paper, it refers to electricity and gas that is generated from organic matter, known as biomass. This can be anything from plants and

	timber to agricultural and food waste – and even sewage. The term bioenergy also covers transport fuels produced from organic matter.
OLEV (grant)	A grant to support the wider use of electric and hybrid vehicles, offered by the Office for Low Emission Vehicles
A	Amp or ampere – the base unit of electric current in the International System of Units (SI).
L	Litre – a metric unit of volume.
T/t	Tonne – a metric unit of mass equal to 1,000 kilograms.

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