Pro Enviro

Report

Renewable Energy Feasibility Study - Report

Lutterworth RFC

13 May 2022

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Introduction

This review was undertaken at the premises of Lutterworth RFC located at Ashby Lane, Bitteswell, LE17 4LW on 08 January 2022.

Lutterworth RFC is a sports and social club that provides sports and space facilities for the local community. Annual site working hours are:

- Tuesday 18:00 – 21:00
- Wednesday 18:00 – 21:00
- Thursday 18:00 – 21:00
- Saturday 09:00 – 20:00
- Sunday 09:00 – 15:00 (Can sometimes run later to 20:00)

The occupancy hours of the club have been estimated at 1,000 hours based on 50 occupied weeks of the year. The business operates from a single-story brick-built building which consist of a bar/function area, changing rooms, offices and storage covering 830 m^2.

Growth Plans

The club has plans to introduce a 215m^2 single-story extension to connect the main building to the Storage Shed. The extension will contain four changing rooms each containing 8 shower points and a WC (two toilets and two sinks). There is no heating load required for the changing rooms, just hot water generation for the additional 32 shower points and 8 sinks. The extension is likely to be completed by August 2022.

There are also plans to purchase four acres surrounding the current site for additional pitch space although this is yet to be confirmed.

There are further tentative plans for adding a floor above the current recreational area and changing rooms 4 – 6 covering an area of 600m^2. If this were to happen it would occur in 15 – 20 years' time and contain additional recreational/social space, including bar, function space and viewing area over the pitches.

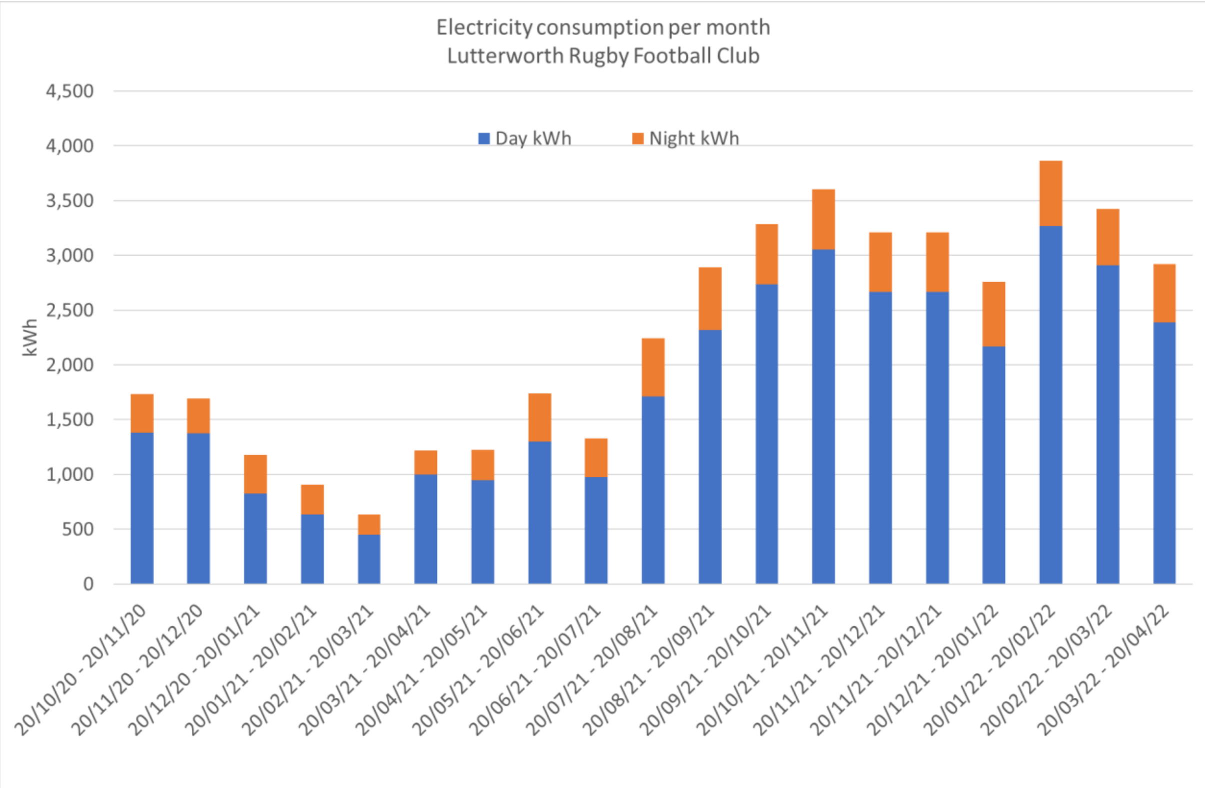
Energy Data

Electricity

Electricity bills were provided and have been summarised below for the 12-month period 20/05/21 – 20/04/22. The effective rate for this period which includes all charges except VAT was 15.53 p/kWh.

Period	20/05/21 - 20/04/22
Day kWh	28,157
Night kWh	6,319
total kWh	**34,476**
total cost	**£5,003**
Days	**365**
Std chg	**£93**
CCL cost	**£267**
Total cost	**£5,363**
Total cost + VAT	**£6,435**

It has been highlighted since the site survey that the energy contracts unit price has increased to 35p/kWh which will used for the purposes of this report, this increased price will increase the annual consumption cost to an estimated £12,110. The following chart shows the profile of electricity consumption per month, with a colour difference denoting the day or night portions of usage.



The electricity consumption was higher during the last months of 2021and early 2022 compared with 2020 and early 202 due to the COVID restrictions in place at that time. The lower consumption during the summer months is suggestive of electricity used mainly for lighting during the darker and shorter days. This would include the use of the floodlights in the winter months being used more extensively.

Oil

Oil delivery receipts were not provided however it has been calculated from the boilers and hours of occupancy that the estimated oil consumption per annum is 20,500 kWh which equates to 5.67 CO_2e tonnes and a cost of £1,640. This is based on an estimated oil cost of 86p/Litre (8p/kWh), should the cost of oil increase then the payback period would be reduced.

Space Heating

Currently the heating to the recreational area (Bar, Back Room and Kitchen) is supplied by an oil-fired Grant Vortex 15-26-S boiler. The heating is controlled in two zones, Bar and Backroom / Kitchen, during the review it was noted that the Bar thermostat was set at 25 degrees in an attempt to heat up the area quickly. It was explained that setting the thermostat at a higher temperature will not speed up the heating process but will overshoot the target temperature and create wasted energy. The thermostat should be set between 18-21 degrees to ensure appropriate levels of comfort. The setting should be reviewed regularly until the lowest acceptable setting is established. Additionally, the Bar thermostat was located next to the entrance door so that when the doors are opened a false representation of the room temperature will be created close to the thermostat, therefore increasing the load factor of the heating system. It is advised the thermostat should be moved to a more suitable location that avoids changes in temperatures that are not representative of the room as a whole.

The hot water for the showers is generated by "Big Bertha" an oil-fired Ideal Harrier GT 5 105-140kW boiler. The boiler supplies hot water via two tanks to the current 47 shower points and 16 sinks. The boiler is manually controlled so that it heats up the water from 30 degrees to the desired 65 degrees in one hour.

The club have been considering the installation of a ground source heat pump using vertical boreholes to replace both boilers. This was discussed and it was suggested that air source heat pumps might be a better option as it will be a cheaper install cost, be less invasive and easier to maintain. The new system is required to supply the central heating system in the recreational area and provide hot water to the future total 79 shower points and 24 sinks.

Heat pump systems use the ambient temperature of either the air or ground to provide domestic heating and hot water. Air source heat pumps absorb low temperature heat from the air into a refrigerant fluid. This fluid then runs through a compressor, which increases its temperature. The heated fluid runs in a coil through water that is used in the heating and hot water circuits in the building. Ground source heat pumps work in a very similar manner but instead, they absorb heat from the ground through fluid-containing loops that are buried either horizontally or vertically in bore holes, depending on the space available.

Once the water is heated by the heat pump systems it is stored in a tank ready for use. This tank needs to be well insulated to prevent heat loss. With a conventional boiler, domestic hot water is usually stored at 60-65°C, however heat pumps can normally only heat water to about 45-50°C, so it is also likely that occasional temperature boost will be needed. The water tank used with ground and air source heat pumps will usually contain a heating element. If solar panels were installed it would be possible to use the power generated for the additional heating elements required.

The maximum temperature of the hot water depends on a number of factors, such as the type of refrigerant used in the heat pump, the size of the coil in the hot water tank, the usage, etc. Changing the refrigerant can cause the heat pump to operate at higher temperatures and heat water up to 65°C, however heat pump systems are less efficient at higher temperatures. The size of the coil within the tank is very important: if the coil is too small, hot water will not reach the required temperature. When using a heat source or ground source heat pump it is necessary to have a large heat-exchanger coil.

It is suggested that an Air Source, Air to Water system be considered to replace the existing boilers. A heat pump rated at 33kW input and 120 kWh heat output with high temperature capability has been estimated to provide sufficient capacity to replace the current systems. This would need to be verified by a and MCS qualified supplier/installer. It is estimated that such a technology would consume 5,940 kWh which would provide a saving of 14,563 kWh/ 4.41 CO_2e tonnes per annum however due to the significant price increases of electricity there would be an increased running cost of £439. The unit will cover an area of 1.27 m^2 at a height of 1.9m and can be installed inside or outside.

The estimated cost of installing an Air to Water system with the associated ancillary equipment including the tank and controls is £50,000. Even if the electricity unit prices fell to the prevouse contracts levels the payback period would be relatively longer (69.64 years) than normally experienced with systems of this nature due to the short hours of use of the heating system per annum.

A 120/140 kW biomass boiler with hopper and feeder would cost between £60,000 and £70,000 and would have similar issues as the air source pump solution in terms of investment required for the level of usage of the heating system. The savings would be lower than using an air source heat pumps when the cost of pellets is considered against the potentially "free" operation of the heat source pumps when combined with solar panels and batteries.

Lighting

Most of the building fittings have been converted to LED with motion sensors being utilised extensively. However, the floodlights used to illuminate the pitches have not been replaced, the club looked at changing them 2 years ago but said it was not cost effective at that time.

The current lighting system is summarised below:

Light Fitting	Power (W)	Qty	Total Power (kW)	Hours	Total Consumption (kWh)
Metal Halide Floodlight	2,000	16	26	315	8,190

The current system is calculated to consume approximately 8,190 kWh per annum with a CO2e footprint of 1.74 tonnes, costing £2,867 per annum.

The following table shows the recommended light fittings to replace the existing floodlights.

Light Fitting	Power (W)	Qty	Total Power (kW)	Hours	Total Consumption (kWh)
LED Floodlight (Tamlite Stadia)	600	16	8.64	315	2,722

The LED lamps should have a life span of a minimum 30,000 hours in comparison to the current lighting systems life span of 15,000 hours, therefore also reducing the maintenance costs.

The recommended lighting system is estimated to save 5,468 kWh per annum with a CO2e saving of 1.16 tonne and a cost saving of £1,914.

The estimated cost of supply and installation is ~£17,000 which gives a payback period of 8.88 years. It is recommended that a lighting design is conducted to ensure that the new LED system provides the required minimum of 100 lux illuminance levels.

Solar PV Generation

Due to most of the energy demand coming later in the day when solar generation is diminished and the use of the 13 x 2kW floodlights being a big consumer, a battery storage system to support the solar pv generation would be required to supply the site during the evenings.

Initial estimates indicate that a 30.18 kWp solar array could be installed on the flat roof of the planned building. Although the performance of any solar system cannot be guaranteed with certainty due to the variability of the amount of sunlight from year to year, the calculation of estimated generation is based on industry standard methodologies.

The following assumptions have been utilised for the available system for both sections of the roof:

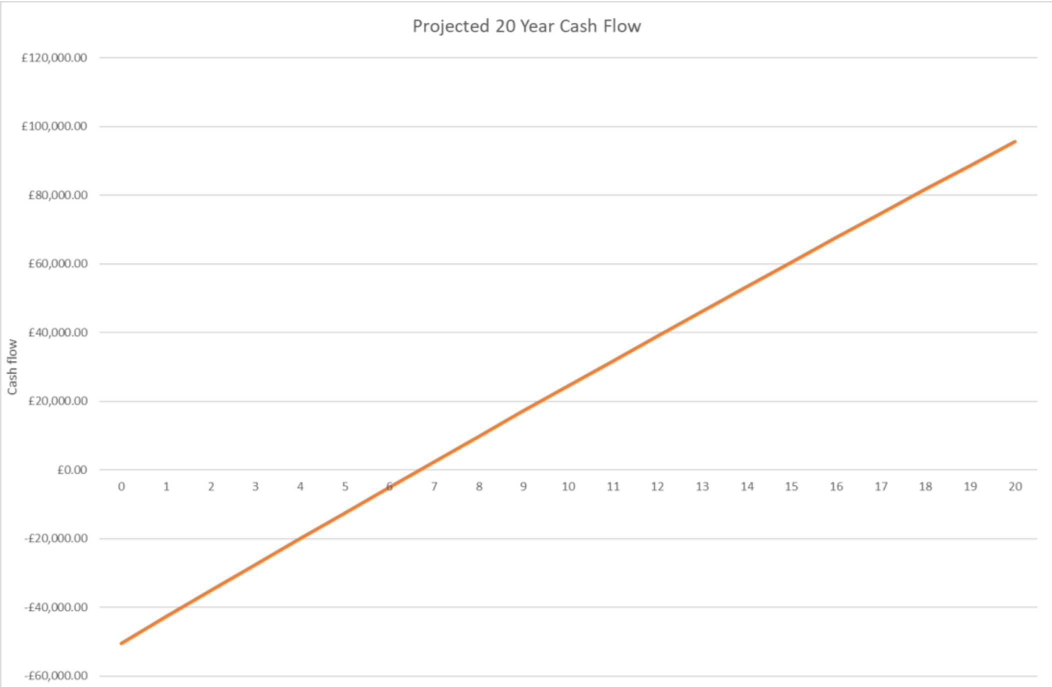
Solar Assumptions	
Region	Zone 1
Panel Width	1.9m
Panel Length	0.9m
Panel Area	1.71m^2
Total number of solar panels	126
Angle (from horizontal)	45°
Direction (Angle from South)	35°

The estimated quantity of energy generated by the recommended array is 24,333 kWh per annum.

It is estimated that the site will use 90% of the energy generated if installed with a battery storage system. The following assumptions have been used in calculating the returns associated with the recommended installation:

Estimated output (kWh/yr.)	24,333
Unit Rate (p/kWh)	35
% Of energy used on site	90.00%
% Increase of energy costs	0.00%
Capital Cost	£50,390

A degradation factor of 0.5% per year has been applied to the panel performance.



The anticipated savings from the generation of energy used on site in the first year is £7,665 and 21,900 kWh with a payback of 6.7 years and a total positive cash flow of £95,629 by year 20. It is worth noting that an increase in potential unit rates has been excluded from this calculation and if unit rates were to increase over the lifetime of the solar panels the payback would shorten. It is suggested that 3 x 10kW storage batteries be installed to ensure the generated power can be used when highest load occurs, when the floodlights turn on. These batteries would cover an area of 14.19 m^2 at a height of 1.5 m and can be stored either indoors or outdoors.

If the LED floodlights and heat pump were both installed, the electricity demand would generally stay the same as the added electricity consumption from the heat pump system would match the savings from the installation of the LED floodlights. It is recommended that any solar PV system is installed after the other energy reduction measures or technologies have been installed to ensure that the solar pv system be correctly sized to meet the needs of the club after the energy reduction activities have been implemented.

Solar PV – Diversion to Hot Water System

It may be possible to install a control device that will divert any excess energy generated by the solar panels to support the heating of the hot water. The cost of providing a system capable of doing this is estimated at approximately £2,000 including the electronic control device, immersion coil and wiring.

Given the large differential between the cost per kWh of oil and electric heating (8p v 35p) it is not sensible to displace the potential solar benefits away from electricity consumption, leaving only the 10% not consumed on site available for water heating, i.e., 2,433 kWh which would reduce the oil consumption costs by £194 resulting in a payback period of 10.3 years.

Solar Glazing Control Technology

The club originally wanted to install glazing with solar control technology for the future second storey extension. However, it has been highlighted that the new glazed area would be north facing, therefore it was advised that standard double glazing would be suitable as there would be limited solar gain from these windows.

Non-Productive Load

The club management have instigated strict end of day shut down procedures have made sure that everything is turned off, however when using a submeter it was established that a small load still existed. A baseload consumption level should be expected from equipment such as drink chillers and kitchen fridges / freezers.

A full-scale energy monitoring system would not be appropriate for the club but a simple clamp on logger on the main incoming energy supply could be used to identify when energy is being consumed when it would not be expected to be. For approximately £100 a monitor could be obtained that would provide data on the main meter and up to 8 individual pieces of equipment or circuits. The data can made available via wireless internet connection and then be accessed in real time via an app on a smart phone.

The Emporia Smart Home Energy Monitor is an example of such a system. This is not a specific recommendation for this system as there are many other systems available, but it is listed here as an example of the type of systems that could be used by the club management to monitor energy consumption.

Electric Vehicles

The introduction of electric vehicles and the provision of at least one charging point in the area would provide a benefit to people traveling to or close to the location of the charger. It will also raise awareness of the potential use of electric vehicles and encourage individuals to consider the use of an electric vehicle, sooner than they may have done had they not seen a positive action within the community to install at least one charging unit.

Demand for charging points will grow as electric cars become ‘normal’ and community charging points would incentivise the community towards electrification. It may be possible to establish an electric vehicle car share club within the local community making use of a centrally located charging point from which the sharing can be managed. Car clubs allow individuals and communities to access a personal vehicle without being tied to ownership. They are usually membership-based schemes operated by community groups or private organisations where vehicles are available for short term hire. Car club vehicles are often available for collection in public spaces rather than “conventional” car hire hubs.

Financial Support

Several different potential funding options have been found that may provide support for the implementation of the technologies discussed within the report. These encompass either the project as a whole or individual aspects such as electric vehicle charging. The potential support, what it covers, and value of financial aid is listed below.

Boiler Upgrade Scheme
The UK government has recently introduced the Boiler Upgrade Scheme (BUS). This is a funding opportunity mainly targeted at domestic properties but includes small non-domestics as well. The scheme covers installation capacities of up to 45kWth. Under this programme the government will provide grants to encourage property owners to install low carbon heating systems, including heat pumps. These grants are designed to help property owners overcome the upfront cost of low carbon heating technologies.

Accredited installers will apply for the grant on behalf of the property and the value of the grant will be discounted off the price you pay. The maximum funding available is outlined below.

- £5,000 off the cost and installation of an air source heat pump
- £5,000 off the cost and installation of a biomass boiler
- £6,000 off the cost and installation of a ground source heat pump

The grant will only cover biomass boilers in rural locations and in properties that are not connected to the gas grid. The property needs to have a valid Energy Performance Certificate (EPC) with no outstanding recommendations to be eligible for this scheme. Further information can be found at: https://www.gov.uk/guidance/check-if-you-may-be-eligible-for-the-boiler-upgrade-scheme-from-april-2022

Workplace Charging Scheme
This is one of four government led schemes under the Office for Zero Emission Vehicles (OZEV). This scheme covers business and public sector organisations with assistance available of £350 per socket installed. The Workplace Charging Scheme (WCS) is a voucher-based scheme that provides support towards the up-front costs of the purchase and installation of electric vehicle charge-points, for eligible businesses, charities and public sector organisations. Further information can be found at: https://www.gov.uk/guidance/workplace-charging-scheme-guidance-for-applicants.

Planning Permission

Solar PV

In April 2008, solar panels were designated as 'Permitted Development', meaning that planning permission is no longer necessary for systems below 50 kWp. The only exceptions to this are listed buildings and conservation areas.

Aside from this, solar panels are subject to normal building regulations, which involves checking that the roof can support the extra load – your MCS-certified installer will this check for you.

The Distribution Network Operator (DNO) must be notified about any potential installation of solar PV. Planned solar pv systems with a Declared Net Capacity (the estimated output of the installation after any losses through inverters and wiring etc) larger than 3.68kW must be approved by the DNO through a G59 notification before any installation work begins. The DNO must give permission for these larger systems to be installed.

The normal process is for the MCS contractor to notify the DNO and seek approval prior to the start of any installation. An MCS approved contractor will also confirm that your solar setup meets all the aforementioned requirements before the installation commences.

Heat Pump

Air source heat pumps have now joined other technologies including biomass boilers and thermal panels as Permitted Developments in England, Wales, Scotland, and Northern Ireland, providing certain requirements are met.

If the planned heat pump installation complies with the following Permitted Developments criteria, there is no requirement to apply for planning permission.

1. The heat pump is only used for heating (space heating and hot water).
2. The installation complies with the Microgeneration Certification Scheme Planning Standards (MCS 020). It is the responsibility of the installer to ensure that your heat pump installation is compliant with MCS standards.
3. Only the first air source heat pump falls under Permitted Development rights – adding a second would require planning permission.
4. Similarly, an air source heat pump is a Permitted Development on the condition that there is not a wind turbine on your property. If there is, there is a requirement to apply for planning permission. This is not the case in this instance.
5. The heat pump must be sited in a way that minimises its effect on the appearance of the building and the amenity of the area. This may involve siting the external unit at the back of the property, out of view from the road, or if you're fixing it to a wall, it must be below the first storey. This should not be an issue for the club given its remote location.
6. The air source heat pump must be installed on flat surfaces.

7. If the building is listed building or scheduled monument, a listed building consent prior to the installation is required.
8. If property is situated within a conservation area or World Heritage Site, there is a requirement to check with local planning authority whether air source heat pumps are deemed Permitted Developments. This is not an issue for this site.
9. Size of external compressor: in England, the outdoor unit and housing is not larger than $0.6m^3$, ok if installed internally with ducting to external.
10. Distance from boundary / nearest house: the air source heat pump must be at least 1 metre from the property's boundary.
11. The external unit cannot protrude more than 1 metre from the outer wall, roof or chimney of the building

If the unit was installed in the current boiler room, there would be should no conflict with the rules above.

LED Floodlights

There is no need for planning permission for the replacement of the metal halide floodlight for LED fittings as this will be a straight swap, as long as the fittings are not significantly brighter than the existing units there should be no issue.

Community Benefits

The rural location of the club means that it has a limited number of near neighbours and any proposed changes at the club will have no negative impact on the neighbouring community.

The planned changes, both in terms of growth and the potential installation of renewable energy sources will have a positive impact on the local community. The club will be able to offer facilities that can be used by local community groups in the extended building. The club has the benefit of significant parking available for visitors to use and this makes it an attractive venue for groups and events.

The clubs' members are drawn from a large geographical community although the majority can be considered to be local. The extension of the facilities and the playing spaces will improve the quality of the services the club can offer and will also enable the club to grow its membership and offer the opportunity of playing at the club to a wider group of people including local school children playing mini rugby on a weekend.

Conclusion

The opportunity for the introduction of renewable energy sources to the club do exist but are hampered economically by the scale of the club and its "normal" hours of operation.

Heat Pumps
The installation of heat pump heating systems works best in well insulated buildings with a consistent requirement. The relatively low levels of heat generated by heat pumps mean that they work best when working all the time and building up a "heat store" with the buildings they are heating.

The rugby club does not operate as a rugby club all year round although the facilities are open out of season. The hot water requirement is focused on playing and training days and is intense for a short period of time. this means that a heat pump system would need to be sized larger than if it was covering a consistent requirement. It may also be necessary to support the water heating system with and electric heating element. If a solar pv is installed, the electric heating element energy requirement could be met by the renewable energy generated by the solar panels.

Solar PV
Solar PV is a good option for the club but again, because the main demand for energy relates to the external floodlights and the clubhouse which are both used outside of solar pv generation period, there is a need for battery storage which whilst not impacting on the carbon savings does impact on the payback period.

The installation of solar pv could be considered as a good long-term investment and will provide protection from rising electrical energy costs.

External Flood Lights
Based on the current electrical energy costs the payback period for replacing the floodlights with LED equivalents is less than 9 years. The switch to LED lamps should also extend the life of the lamps and therefore reduce the replacement periods and the need to incur costs in the replacement. This saving has not been taken into account as it is not possible to calculate with any degree of accuracy and it is expected that any lamps that do fail would be replaced with LED at that time.