ESOS-ENERGY
Energy efficient solutions

Heat Decarbonisation Plan

Leicester College

Leicester College

Author	Reviewer	Date	Version
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1. Executive Summary

This Heat Decarbonisation Plan (HDP) for the College's estate was prepared by ESOS Energy Ltd to support the drive to reduce carbon emissions across the organisation (Leicester College) and to support with compliance to the grant conditions of the Public Sector Decarbonisation Scheme (PSDS).

The UK Government has set a target for the whole of the UK to be Net Zero Carbon (NZC) by 2050 and many scientists, organisations and activists are highlighting the need to act now and more quickly that this target to prevent the worst effects of the climate crisis. The public sector has a role to play in demonstrating how this can be achieved and influencing its local communities by being a positive exemplar.

Every year Leicester College uses £1,501,844 of energy and emits 1,477 tonnes of CO_2e into the atmosphere contributing to the current climate crisis. Our review has found that the energy usage could be reduced by 59.5%, saving £572,258 and 838.8 tonnes of emissions per year. If the residual energy usage is then purchased from a 100% renewable source (ideally REGO or GoO backed) then Leicester College would be Net Zero Carbon. Many of the measures have quick paybacks and therefore saving energy and responding to the climate crisis is also good business.

One of the key steps to achieve Net Zero Carbon is to stop using fossil fuels (gas, oil and LPG) to heat our buildings. Electricity is rapidly becoming a near zero carbon fuel with the increase of renewable and other zero carbon energy generation across the grid. This HDP therefore focuses on the actions which can be taken to move away from using gas and oil for the heating and hot water requirements of the building and estate. To be able to heat buildings effectively with decarbonised heat sources it is important that the building wastes as little heat as possible therefore insulation and building fabric measures are an important feature. As the UK increasingly relies upon clean electricity to support its move to Net Zero Carbon the demand for electricity will increase, not only from buildings heat demands but also from the electrification of transport. The plan therefore, also includes measures that can be implemented that reduce the overall electricity demand and generates electricity needs on site. Not only do these help to balance the overall electricity demands of the UK but they also help to provide the electrical capacity needed for heat decarbonisation measures by saving this from other areas.

1.1 Recommended Decarbonisation Measures

Our key findings and recommendations have been summarised in the table below (sorted by payback) and are described within the body of this report. ESOS Energy would be pleased to support the implementation of any or all of these measures.

Decarbonisation recommendation	Estimated Annual Energy Saving (kWh)	Estimated Annual Cost Saving (£)	Energy Reduction (%)	Estimated capital cost (£)	Simple Payback (years)	CO_2 savings (tCO_2e/yr)
Remove filters from extract ductwork	2,808	£864	0.0%	Nil	Immediate	0.59
Repair leaks to air ductwork	3,510	£1,080	0.0%	Nil	Immediate	0.74
Install low loss air filters	9,042	£2,783	0.1%	£220	0.08	1.91
Optimise control system settings	279,417	£29,529	3.7%	£3,960	0.13	50.30
Insulate exposed pipework and fittings in plantrooms	87,469	£9,244	1.1%	£5,335	0.58	15.74
Install clean power supply unit to vending machines	4,380	£1,348	0.1%	£1,100	0.82	0.92
Install SavaWatt devices on fridges and freezers	20,840	£6,414	0.3%	£6,985	1.09	4.40
Replace centralised hot water tank for a packaged air source heat pump HWS tank	773,637	£92,508	10.2%	£107,250	1.16	151.22
Install Circosense on Hot Water System	85,075	£8,991	1.1%	£12,320	1.37	15.31
Fit timed fused spurs to hot water heaters	590	£182	0.0%	£396	2.18	0.12
Change existing lighting for low energy lamps/fittings	647,469	£199,259	8.5%	£537,774	2.70	136.66
Fit 270mm of insulation into the uninsulated roof space	15,128	£1,599	0.2%	£4,950	3.10	2.72
Install PIR motion sensors on selected lighting circuits	12,868	£3,960	0.2%	£12,779	3.23	2.72
Install a Solar PV array to roof of building	383,350	£117,976	5.0%	£541,761	4.59	80.91
Adjust settings on existing PIRs	763	£235	0.0%	£1,100	4.68	0.00
Install Variable Speed Drives (VSD) to fan motor / pumps	914	£281	0.0%	£1,870	6.65	0.19
Inject cavity wall insulation into walls	1,739	£184	0.0%	£3,300	17.95	0.31
Install an Air-to-Air Source Heat Pump	1,691,775	£81,113	22.2%	£1,705,275	21.02	289.50
Install an Air-to-Water Source Heat Pump	46,656	£1,159	0.6%	£78,540	67.74	7.82
Replace single glazed windows and doors for double glazed units	147,418	£15,579	1.9%	£1,131,090	72.60	26.54
Install a High Temperature Air-to-Water Source Heat Pump	308,239	-£2,029	4.1%	£627,000	N/A	50.16
Contingency (10%)				£478,301		
OHP (12%)				£631,357		

Design Fees (8%)				£471,413		
TOTAL		**£572,258**		**£6,364,076**	**11.12**	**838.80**

Based on current market prices of 32p/kWh for electricity, 10p/kWh for mains gas. Carbon savings are based on the current DEFRA carbon emissions factors for 2022.

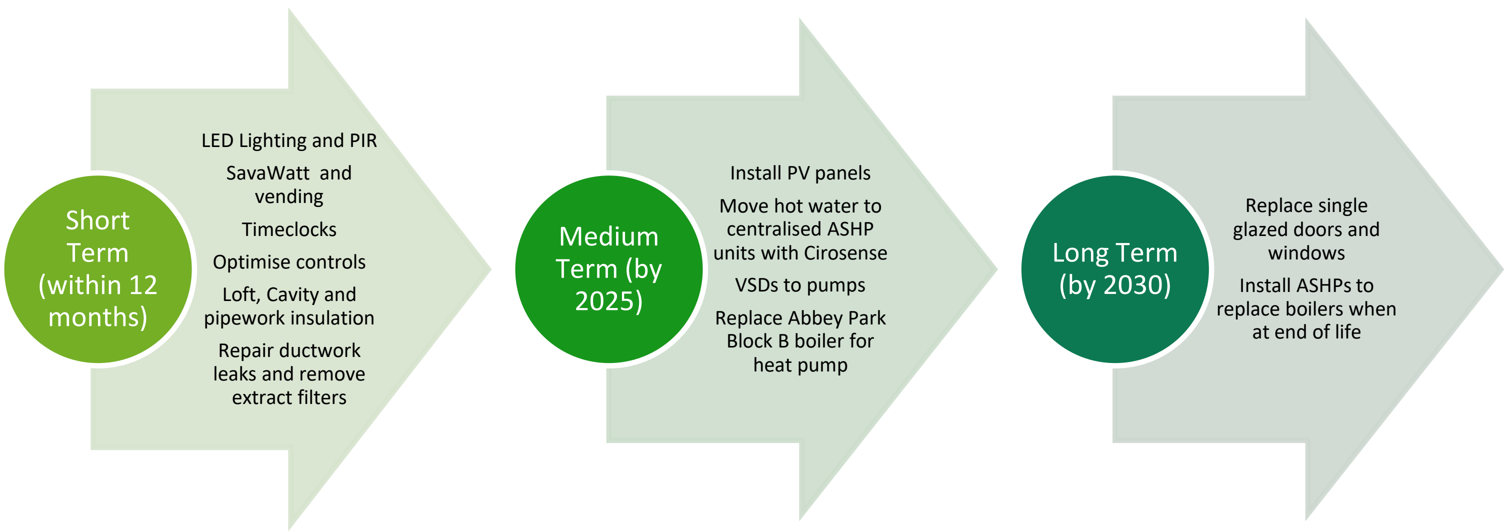
1.2 The Route to Net Zero Carbon

In June 2019 the UK is legally committed to be Net Zero Carbon by 2050. Following on from this many local authorities and other organisations have declared Climate Emergencies and committed to achieve Net Zero by much earlier dates typically ranging from 2030 to 2045.

Leicester College has committed to the Race to Zero initiative with the aim of reaching net zero by 2030 and are working to the Climate Action Roadmap for FE. Sustainability is one of the core values in the Colleges strategic plan. The college purchases 100% renewable electricity and has undertaken many transport, waste and food procurement initiatives.

The local authority in the area is Leicester City Council who in February 2019 declared a climate emergency and set a target for the authority region to be carbon neutral by 2030[1].

This site has a clear route to become net zero by 2030 by undertaking the following steps, which revolves around ensuring building fabric is well insulated, switching to localised electric water heaters and switching fossil fuel boilers to electrically driven air source heat pumps:



[1] https://www.leicester.gov.uk/your-council/policies-plans-and-strategies/environment-and-sustainability/climate-emergency/

2. Introduction

This report is provided to Leicester College to outline the actions and solutions required to deliver a net zero carbon estate and to identify the energy saving opportunities available. The report has been commissioned and prepared as a condition of the Public Sector Decarbonisation Scheme.

Leicester College is based across three main campuses, all in the centre of Leicester.

The College provides further and higher education courses to over 9,500 students, both full and part time, in a range of mainly vocational courses.

Leicester College has an estate which comprises of three distinct campuses which are:

- **Abbey Park Campus** – Comprises of 5 blocks (A to E) provide a large range of further education facilities including motor workshops, a large modern teaching block and smaller teaching blocks some in historic canal buildings
- **Freemans Park Campus** – Comprising of 4 blocks (A to D) including construction skills
- **St Margaret's Campus** – One large block containing departments such a the arts

A decarbonisation audit of all of the above sites within the Leicester College estate was completed in November 2022 by David Legge and Matt Fulford.

Matt is a highly experienced energy auditor with over 15 years' experience in sustainability and energy matters in the built environment. He is a chartered surveyor with RICS, a Certified Measurement and Verification Professional (CMVP) for energy savings measures and a CIBSE Low Carbon Energy Assessor. He has audited hundreds of buildings of varying types

David is an experienced energy auditor with over 10 years' experience in sustainability and energy matters in the built environment. David is a fully qualified ESOS lead assessor with CIBSE and a CIBSE Low Carbon Consultant, a fully qualified ISO50001 lead auditor.

2.1 Carbon Reduction Plans and Heat Network Potential

The College has advised that it has plans to deliver further energy saving and decarbonisation works as follows:

- Continue with LED lighting replacements at all sites as necessary

The heat network resources for the area have been reviewed. Leicester does have an existing 7kW District Heating system which is mainly powered from gas CHP units. A major part of this does run very close to the Freemans Park campus and there is good potential to connect onto this system in the future however the nature of the existing system being from gas CHP means that this may not provide a full net zero carbon solution that is sought.

2.2 Internal Resources and Funding

The two most significant barriers to an organisation implementing a Net Zero Carbon programme are having enough **time** and **skills** to be able to put together the plan and implement it with appropriate leadership and governance and having the financial resources in place to be able to fund the works.

The organisation should appoint a named individual to lead the work on heat decarbonisation and the move to Net Zero Carbon and this should be a defined part of their roles and job description. In this organisation that named individual is yet to be appointed.

Leicester College does not have in house resource with the required time, skills or experience to develop and deliver a heat decarbonisation programme. The organisation typically uses resources from its consultant surveyors and the like, to be able to deliver capital programmes. ESOS Energy is currently supporting Leicester College to develop this HDP and would be happy to continue to support the organisation in the future delivery of this plan.

In terms of financial resources, the organisation only has limited funds which it can invest in the improvement and up-keep of its buildings and estate therefore it only has the means to fund low cost, quick win, energy saving measures. Larger measures will require additional funding sources which may include private finance solutions such as Power Purchase Agreements (PPA's) and grant funding for energy saving and decarbonisation works such as potential future rounds of the Public Sector Decarbonisation Scheme (PSDS).

The potential funding routes for each measure have been detailed in the table below

Decarbonisation recommendation	Estimated capital cost (£)	Simple Payback (years)	CO_2 savings (tCO_2e/yr)	Most likely funding source
Remove filters from extract ductwork	Nil	Immediate	0.59	N/A
Repair leaks to air ductwork	Nil	Immediate	0.74	Maintenance
Install low loss air filters	£220	0.08	1.91	Maintenance
Optimise control system settings	£3,960	0.13	50.30	Own Funds – In Year Payback
Insulate exposed pipework and fittings in plantrooms	£5,335	0.58	15.74	Own Funds – In Year Payback
Install clean power supply unit to vending machines	£1,100	0.82	0.92	Own Funds – In Year Payback
Install SavaWatt devices on fridges and freezers	£6,985	1.09	4.40	Own Funds
Replace centralised hot water tank for a packaged air source heat pump HWS tank	£107,250	1.16	151.22	PSDS
Install Circosense on Hot Water System	£12,320	1.37	15.31	Own Funds
Fit timed fused spurs to hot water heaters	£396	2.18	0.12	Own Funds
Change existing lighting for low energy lamps/fittings	£537,774	2.70	136.66	Own Funds
Fit 270mm of insulation into the uninsulated roof space	£4,950	3.10	2.72	PSDS
Install PIR motion sensors on selected lighting circuits	£12,779	3.23	2.72	Own Funds
Install a Solar PV array to roof of building	£541,761	4.59	80.91	PPA
Adjust settings on existing PIRs	£1,100	4.68	0.00	Own Funds
Install Variable Speed Drives (VSD) to fan motor / pumps	£1,870	6.65	0.19	Own Funds
Inject cavity wall insulation into walls	£3,300	17.95	0.31	PSDS
Install an Air-to-Air Source Heat Pump	£1,705,275	21.02	289.50	PSDS
Install an Air-to-Water Source Heat Pump	£78,540	67.74	7.82	PSDS
Replace single glazed windows and doors for double glazed units	£1,131,090	72.60	26.54	Condition Improvement Funds
Install a High Temperature Air-to-Water Source Heat Pump	£627,000	N/A	50.16	PSDS

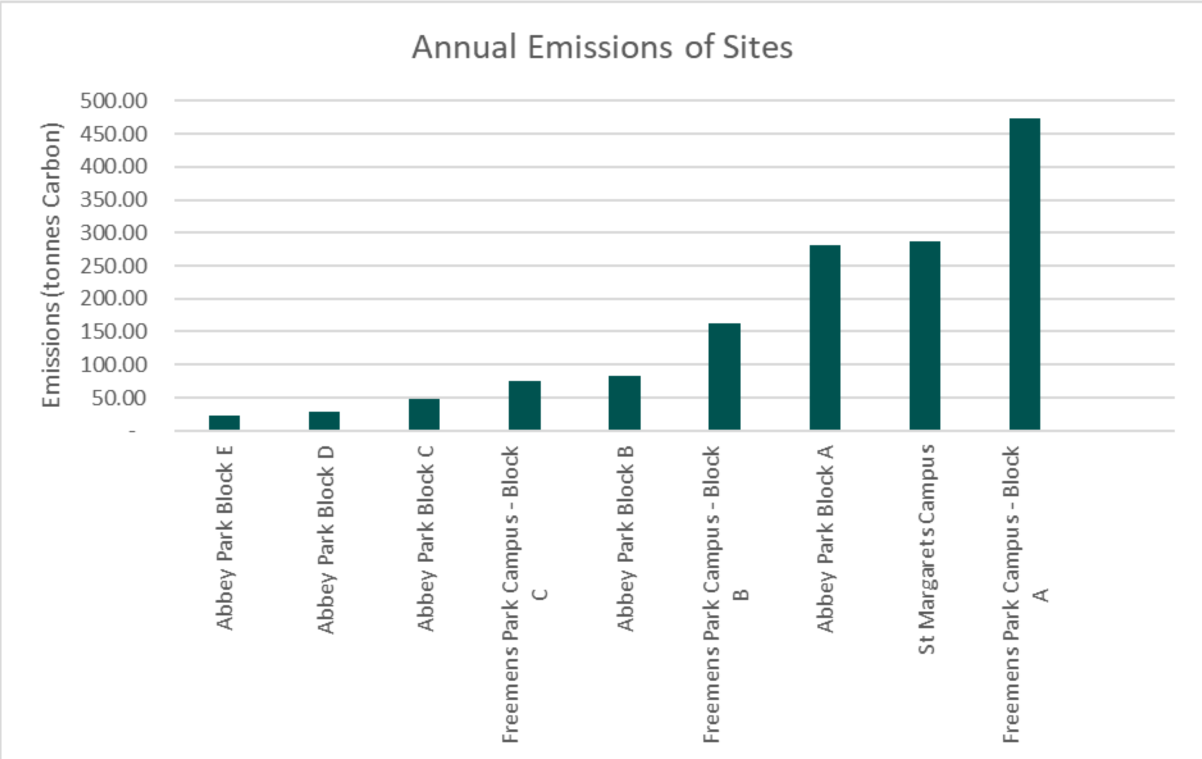
3. Current Energy, Carbon Emissions and Capacity

Leicester College uses 3,453,549 kWh/year of electricity and 4,154,181 kWh/year of mains gas.

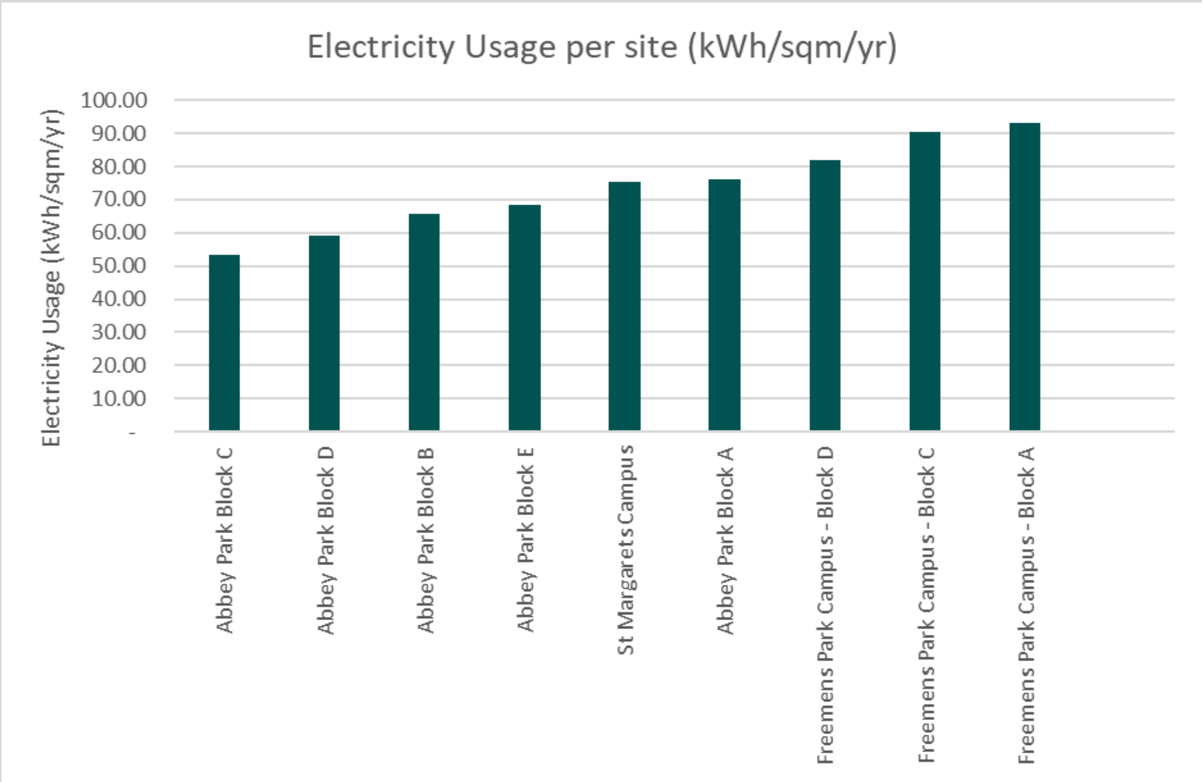
Leicester College currently emits 1,477 tonnes of carbon dioxide (equivalent) into the atmosphere each year which contributes to the climate crisis.

3.1 Energy Benchmarking

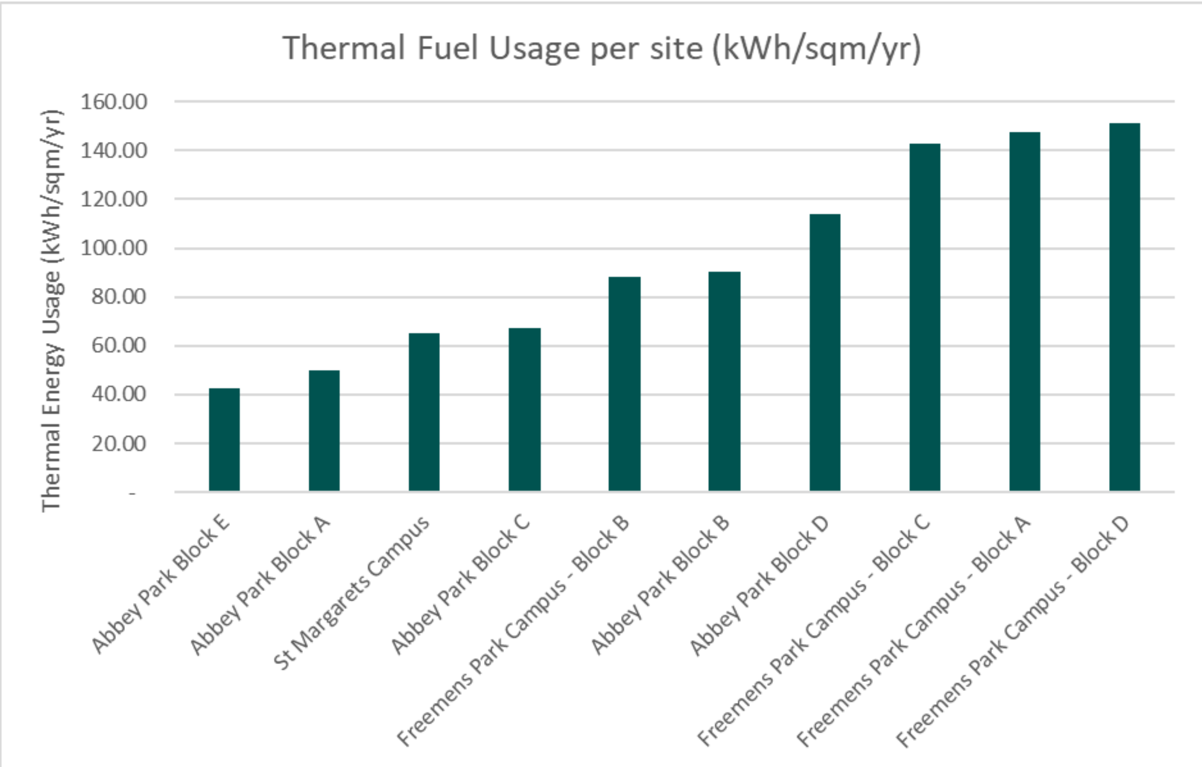
As can be seen from the charts below, there is a broad variation of carbon emissions across the Leicester College estate. The chart below accounts for current absolute carbon emissions and therefore highlights that the Freemans Block A uses the most energy despite not being the largest in terms of treated floor areas (both Abbey Block A and St Margaret's are slightly larger). The older buildings and heating systems are resulting in this campus having higher carbon intensities.



When reviewing the sites electricity and thermal fuel consumption on a per square metre basis, the view changes and highlights a variety of reasons for apparent efficiency at some sites. The College estate is diverse and has a range of end uses, making comparisons more challenging. However, the electricity usage across most of the sites is relatively consistent at between 60 to 90 kWh/sqm/year. The exceptions are Block A Freemans which is again the highest electricity users per m2.



In terms of thermal usage, Abbey Park is the generally the lowest consumer as it is a series of modern and well insulated buildings. Freemans Park is generally more poorly insulated with ageing gas boilers thar results in this being the highest thermal energy user.



3.2 Electrical Capacity

Each site currently has main electricity incomers which are detailed within the individual site reports.

The available capacity for each site would need to be reviewed following the decarbonisation strategy. Any future heat decarbonisation measures may need to be supported by an increase in the existing electrical capacity. Increases in supply capacity can be reviewed and quoted for by the local electricity District Network Operator (DNO) in the area and an increase would apply to the majority of the eight sites with fossil fuelled heating if a move towards fully electric heating is made.

The DNO in your area is Western Power Distribution - www.westernpower.co.uk; 0800 0963080 (East Midlands, West Midlands, South Wales & South West England)

4. Decarbonisation Approach

4.1 Fabric First Approach

In order to most efficiently decarbonise the site, a fabric first approach should be taken to ensure that the buildings are well insulated and as thermally efficient as possible within reasonable financial and technical boundaries. The individual site reports include recommendations to improve the thermal efficiency of the buildings. These measures should save 251,754 kWh/yr and £26,605/yr with a capital cost of £1,144,675 which is predominantly associated with the replacement of single glazed windows. This applies to mainly Freemans Block A and B and also to Abbey Park Block C with minor elements also to Block B. The benefits of insulating the buildings will mean that any future move to heat pumps will require less capital investment as well as reduced operational costs and of course reduced carbon emissions.

4.2 Solar PV

To support the move to electrified heating, it is recommended that solar photovoltaics are considered wherever possible to provide on-site electrical generation. The potential for solar PV has been identified at seven buildings, as detailed in the table below. Arrays at these seven properties are estimated to save £118,000 per annum of displaced energy costs whilst generating 383,350 kWh/yr. This would be for a capital cost of £542,000 giving a payback of around 5 years. If capital from the College is not available to undertake this measure, there are various financing schemes available which would include good Power Purchase Agreement (PPA), which should be considered by the organisation to ensure this measure is still able to be installed.

Site Name	Estimated Annual Energy Saving (kWh)	Estimated Annual Cost Saving (£)	Estimated Capital Cost	Simple Payback (years)	CO2 saving (tonnes of CO2e/year)
Abbey Park Block A	124,700	£38,376	£166,100	4.33	26.32
Abbey Park Block B	27,820	£8,562	£37,037	4.33	5.87
Abbey Park Block E	20,110	£6,189	£26,862	4.34	4.24
Freemens Park Campus - Block A	40,870	£12,578	£55,352	4.40	8.63
Freemens Park Campus - Block B	69,760	£21,469	£89,947	4.19	14.72
Freemens Park Campus - Block C	11,130	£3,425	£15,466	4.52	2.35
St Margaret's Campus	88,960	£27,377	£150,997	5.52	18.78
TOTAL	**4,523,087**	**£572,258**	**£4,783,005**	**8.36**	**838.80**

4.3 Existing and Proposed Heating Systems

The Leicester College estate has mains gas supplied to all of its sites. There are a variety of boiler ages and conditions and the following table details all of the key boiler details including lifetime. The estate is composed of 19 heat generators with a total heating output of 3,076 kW. Only one boiler is nearing the end of its serviceable life and the boiler dates from 2007. Eight further boilers date from 2008/9 and are starting to become eligible for PSDS funded replacements. The others are more modern boilers that do not need to be considered for replacement.

Site / Area	Existing Fuel	Boiler Make	Boiler Model	Year of install	Expected life cycle / condition	No. of Boilers	Existing Output (kW)
Abbey Park Block B	Gas	Remeha	Quinta 85	2007	5 years	2	84
Abbey Park Block A	Gas	Hamworthy	Wessex Modumax 250	2009	10 years	4	250
Abbey Park Block D	Gas	Remeha	Quinta 85	2009	10 years	1	84
Freemens Park Campus - Blocks A to D	Gas	Hoval	Cosmo 1450	2008	15 years	3	2300
Abbey Park Block C	Gas	Strebel	S-CB 80	2017	15 years	2	78
Abbey Park Block E	Gas	Ideal	Evomax 2	2019	20 years	1	80
St Margaret's Campus	Gas	Remeha	Gas 210 Eco Pro 200	2021	20 years	6	200

It is considered that whilst gas boilers remain serviceable, they should be correctly maintained and utilised until they have reached the end of their serviceable life. Therefore, the decarbonisation of these boilers should cascade based on the life of the boiler and is based on a 20 year lifecycle.

When the existing boilers reach the end of their life, the advice of this report is that they should be replaced with an air source heat pump (as detailed within the individual site reports). This may require the replacement of the existing heating distribution pipework and radiators if an air to water system is proposed or may require a new system if an air to air source heat pump is recommended.

Therefore, the phased programme to decarbonise the primary heating source should be as follows:

Replacement Period	Number of Boilers	Location
2022-2025	1	Abbey Park Block B
2025-2030	8	Freemans Park, Abbey Park Blocks A and D
2030-2035	2	Abbey Park Blocks C and E
2035-2040	1	St Margaret’s

Where gas appliances remain on site after 2030, if a Net Zero Carbon ambition is necessitated, then carbon offsets and/or the procurement of green gas will be necessary to facilitate this approach.

Where hot water is currently heated centrally from the boiler or via direct gas fired water heaters, it is a recommendation that the hot water is changed to an electric point of use system so that the hot water is heated locally to the tap/outlet and there is no centralised store of hot water and distribution system and pumps which will reduce servicing and legionella management requirements in addition to providing a decarbonised hot water system that does not need to have a boiler or heat pump to raise the temperature to 60 degrees.

4.4 Lighting

There are still a significant number of inefficient lights across the estate. These could all be replaced with LED and there is a considerable package of works that is recommended which includes £199,259 of LED lighting replacements and £13,632 of installation or adjustment of lighting controls. This would offer a simple payback of 2.8 years.

5. Next Steps

The focus should now be on reviewing those boilers which have reached end of life and fully or partially decarbonising these sites by 2030. It is possible that PSDS funding could be secured to enable some of the works required but further work will be necessary by the College to ensure sufficient detail for a successful PSDS application.

Work following on from this HDP to make a successful application will require:

- Heat loss calculations for the current buildings
- Heat loss calculations following the install of any fabric measures (i.e. windows)
- Quotation for the like for like fossil fuel replacement
- Quotations for all recommendations that are required for the proposed decarbonised heating approaches
- Mechanical and Electrical schematics and outline design demonstrating how the proposed system will work within the building(s)
- Site specific programme of works
- Site specific risk register
- Internal and external resource requirements
- Specification, data sheets and outline design scope for the proposed decarbonised solutions

Once a PSDS application has been made for Abbey Park Block B, replacement options should be developed for all boilers/heat emitters which require replacement by 2030, which accounts for a further eight boilers at Freemans Park, and Abby Park Block A and D.

Finally, following on from this, development of designs for the replacement of fossil fuelled boilers should be carried out at the remaining sites.

Further efforts should be made to optimise controls across the estate and continue with the LED lighting programme, and consideration should be made to increasing the solar PV on site generation and how this should be funded moving forwards.