ESOS-ENERGY
Energy efficient solutions

Heat Decarbonisation Plan

Bidston Avenue Primary School

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1. Executive Summary

This Heat Decarbonisation Plan (HDP) for Bidston Avenue Primary School was prepared by ESOS Energy Ltd to support the drive to reduce carbon emissions across the organisation (Bidston Avenue Primary School) 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 Bidston Avenue Primary School uses £34,800 of energy and emits 75 tonnes of CO2e into the atmosphere contributing to the current climate crisis. Our review has found that the energy usage could be reduced by 43% saving £7,300 and 27 tonnes of emissions per year. 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 and oil) 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)
Install SavaWatt devices on fridges and freezers	2,140	£319	0.63%	£650	2.0	0.5
Insulate exposed pipework and	7,867	£390	2.32%	£1,800	4.6	1.5

fittings in plantrooms						
Change existing lighting for low energy lamps/fittings	36,169	£5,387	10.66%	£36,204	6.7	9.2
Install PIR motion sensors on selected lighting circuits	2,152	£320	0.63%	£3,823	11.9	0.5
Install Circosense on Hot Water System	4,720	£234	1.39%	£5,600	24.0	0.9
Install an Air Source Heat Pump into the building to replace existing heating system when heating system reaches end of life in around 2030/35.	93,621	£646	27.60%	£325,000	502.8	14.5

Based on current market prices of 14.89p/kWh and 4.95p/kWh for electricity and mains gas respectively. Carbon savings are based on the current DEFRA carbon emissions factors for 2020.

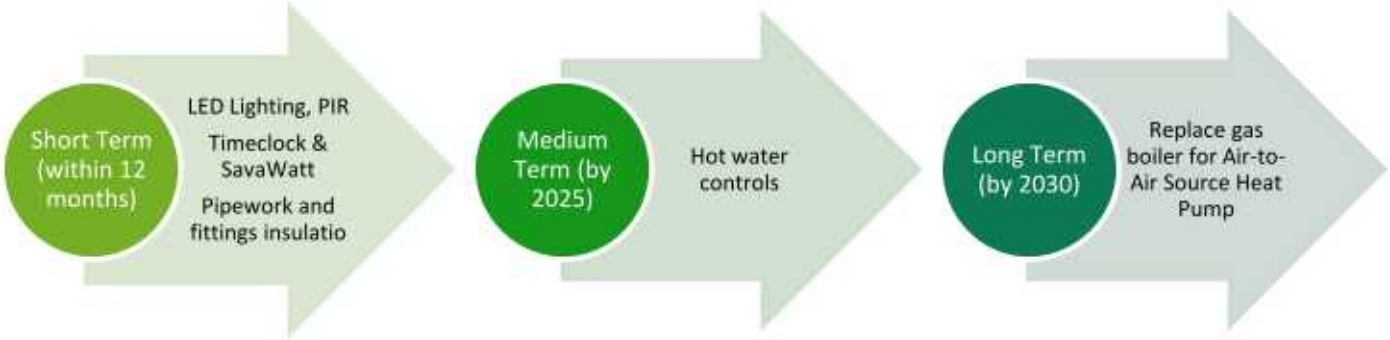
Assuming an average energy price inflation of 5% this would mean that over the next 20 years the value of implementing all these recommendations would be £241,255 (see section 4.1).

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.

Bidston Avenue Primary School has a general ambition to move toward a position of being Net Zero Carbon. The local authority in the area is Wirral council who have declared a climate emergency on 15th July 2019 and set a target for the authority to be NZC by 2030.

This site has a clear route to become net zero by 2030 by undertaking the following steps:



2. Introduction

This report is provided to Bidston Avenue Primary School 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.

Bidston Avenue Primary School consists of a single primary school site.

A decarbonisation audit of the Bidston Avenue Primary School, Tollemache Road, Birkenhead, CH41 0DQ was completed on the 2nd December 2021 by 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.

2.1 Building Details and Previous Energy Saving Projects

The building is a large suburban primary school building. It is a two-storey solid wall brick building which dates back to 1914. The roof of the school is pitched with a slate tile roof, with the windows and doors all double glazed throughout.

The lighting is mixed with some LED but it is predominantly T8, T5 and 2D fluorescent fittings. The building has the usual array of computers, projectors, and other appliances but these were noted to be used efficiently and not left on. There is a main kitchen on site serving the buildings lunches. The school has a solar PV array on the roof which generates electricity for use in the school.

There have been works undertaken in recent years which have helped to reduce the energy consumption and carbon emissions of the building which include the PV installation and the changeover to LED lighting.

Building Ownership	Leased
Location	Suburban
Gross Internal Floor Area	3,497 m^2
Listed Status	Unlisted
Energy Saving and Decarbonisation Measures already undertaken	LED Lighting – continuous programme PV installation

The building is open and operated for the following times during the week

Monday to Friday	7am to 6pm
Saturday	Closed
Sunday	Closed

There is ad hoc use outside of these time for cleaning, parents evenings and the like. These additional hours have not been included in any savings calculations.

2.2 Carbon Reduction Plans and Heat Network Potential

The site has advised that it has no current plans to deliver further energy saving and decarbonisation works.

The heat network maps for the area have been reviewed and there is currently no district heat network planned for the area.

2.3 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.

Bidston Avenue Primary School 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 local authority, to be able to deliver capital programmes. ESOS Energy is currently supporting Bidston Avenue Primary School 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 Condition Improvement Funding (CIF), School Condition Allocation (SCA), Voluntary Aided School: Capital Scheme (VASCA) funding, 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
Change existing lighting for low	£36,204	6.72	9.16	Own funds

energy lamps/fittings				
Install PIR motion sensors on selected lighting circuits	£3,823	11.93	0.54	Own funds
Install SavaWatt devices on fridges and freezers	£650	2.04	0.54	Own funds
Insulate exposed pipework and fittings in plantrooms	£1,800	4.62	1.45	Own funds / PSDS
Install Circosense on Hot Water System	£5,600	23.96	0.87	Own funds / PSDS
Install an Air Source Heat Pump into the building to replace existing heating system when heating system reaches end of life in around 2030/35.	£325,000	502.80	14.52	Own funds / CIF / SCA / PSDS

3. Current Energy, Carbon Emissions, Capacity and Heating Systems

Bidston Avenue Primary School uses 181,823 kWh/year of electricity, costing in the region of £27,000 per year, and 157,347 kWh/year of gas, costing £8,000.

Bidston Avenue Primary School current emits 75.07 tonnes of carbon dioxide (equivalent) into the atmosphere each year which contributed to the climate crisis.

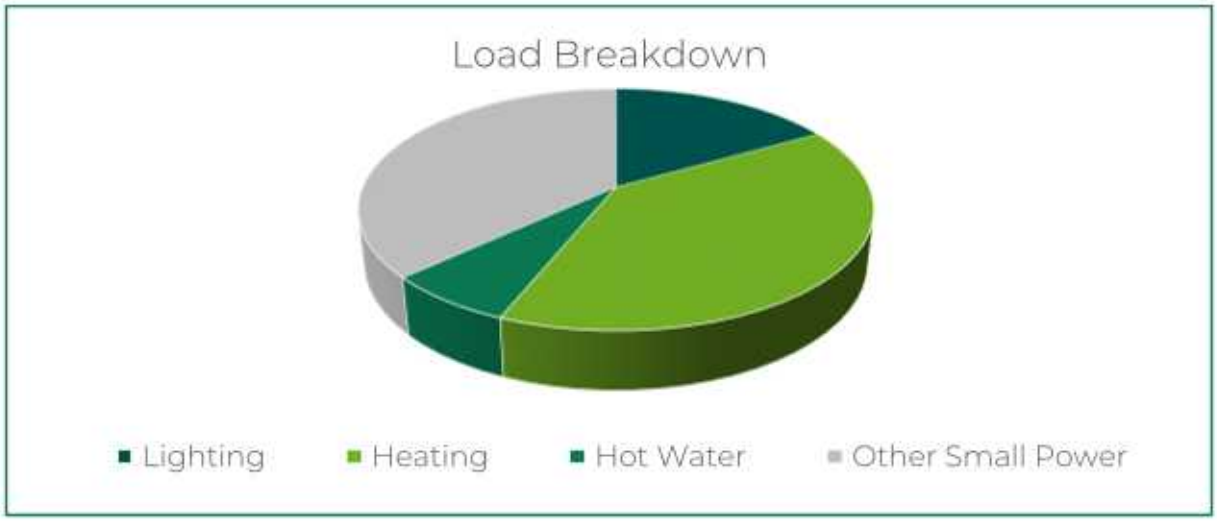
3.1 Energy Profiling

The main energy consuming plant can be summarised as follows:

Service	Description	Estimated Proportion of Usage
Lighting	Fluorescent lighting throughout - mainly T5 units.	16.7%
Heating	Gas fired heating from boilers installed in 2016/17 to aged heating distribution system	39.4%
Hot Water	Two direct fired HWS calorifiers	7.0%
Other Small Power	IT, AC, temporary heating units, kitchen and office equipment	36.9%

3.2 Significant Energy Loads

Based on the loads that were observed on site, it is estimated that the load breakdown for Bidston Avenue Primary School described above can be considered as:



As can be seen from this data, the heating makes up by far the largest proportion of the energy usage on site. The other significant loads include small power and lighting.

3.3 Energy Benchmarking

The annual energy usage has been examined against the industry benchmark for primary school (which are included under the 'Schools' category) from CIBSE TM46:2008. It should be noted that these benchmarks make use of data from 2004 and that the parameters the benchmarks are based upon, such as occupancy hours, could provide wide ranging variations.

	Size (m^2 GIA)	Annual Energy Usage (kWh)	Actual kWh/m^2	Benchmark kWh/m^2	Variance from Benchmark
Bidston Avenue Primary School (elec)	3,497	181,823	52.00	46.55	12%
Bidston Avenue Primary School (gas)	3,497	157,347	45.00	160.70	-72%
TOTAL	3,497	339,170	97.00	207.24	-53%

The benchmark is based on:

Usage times: Weekday usage for part of the year.

Building features: Teaching and community activities.

Services included: Heating, lighting and basic office equipment, teaching equipment, computers.

The Bidston Avenue Primary School has an average energy use of 97 kWh/m^2/yr.

The usage against the benchmark is very mixed, it uses considerably more electricity than expected against the benchmark (CIBSE TM46) for electricity. The gas performs much better, using 72% under the benchmark. As a combined energy benchmark, it consumes 53% less than would be expected

The gas consumption levels appear to be very efficient but it is the electrical consumption which is driving the high cost and energy inefficiencies at the site. This could be due to the use of electric temporary heaters and the use of air conditioning systems within the school. The data should continue to be reviewed as LED light gets completed.

3.4 Electrical Capacity

The site currently has one main electricity incomer which is a 200amp 3 phase supply located in the mains electrical intake cupboard under the stairs. The available capacity for the site appears to be 138kVA, (a 200A 3 phase supply has a maximum capacity of 138kVA).

The maximum demand recorded by the meter was not able to be ascertained during the site audit therefore any future heat decarbonisations measures will need obtain this information from the energy supplier to check if there is sufficiency electrical capacity on site to support any works.

Increases in supply capacity can be reviewed and quoted for by the local electricity District Network Operator (DNO) in the area.

The DNO in your area is thought to be SP Energy Networks - www.spenergynetworks.co.uk; 0300 1010 444 (Central and Southern Scotland, Merseyside, Cheshire, North Wales and North Shropshire))

3.5 Existing Heating System

The building is currently heated from gas boilers which provide hot water into the heating system. The use of fossil fuels for heating means that it will not be possible for the building to become zero carbon without changing the heating system. A boiler also has heat and other efficiency losses within it, which means that the efficiency of a boiler in converting the gas into the heat is typically around 80 to 95% (depending on the age and type of boiler). Air source heat pumps use electricity to power the heat pump which takes heat from the air and puts this into water which can then go into the heating system. An air to water heat pump can create around 3 units of heat for every one unit of electricity whereas an air to air heat pump can provide higher efficiencies, creating around 5 units of heat for every one unit of electrical input.

Boilers		
	Old Caretakers - Plant Room 1	**Main – Plant Room 3**
Make	Vaillant	Ideal
Model	Ecotec plus 837	Evomax 150
Type	Condensing	Condensing
Year of install	2017	2016
Expected life cycle / condition	10 years	10 years
Number of Boilers	1	2
Output (kW)	25	300

The existing boilers have another 10 years of serviceable life and it is therefore recommended that the replacement of the existing boilers for air source heat pumps are considered for when they require replacing.

4. Costing and Paybacks of Saving Recommendations

The costs, savings and simple paybacks for each recommendation have been detailed within the executive summary (section 1) of this report.

Please note that all capital cost figures provided are estimates and have been provided based on previous prices for similar projects, market testing or budgets from suppliers direct. They do not include any main contractor overheads if bundled together in such a way, project management internally or externally, or VAT and the like.

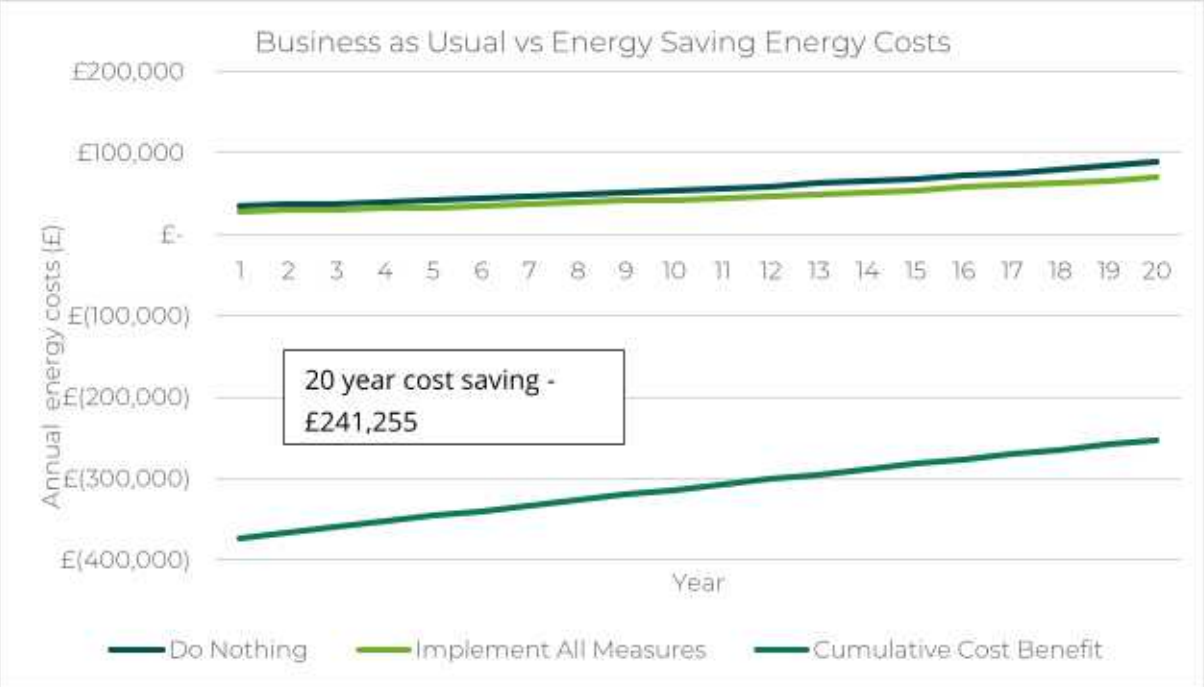
All operational energy savings are estimated using the current energy consumption data over a 12-month period as detailed in section 3.1. Any changes outside of the scope of this report may impact the estimated savings.

Savings cannot be assumed to be cumulative.

4.1 Life Cycle Costing (Portfolio)

To demonstrate the full life cycle cost benefit of undertaking the energy saving works a simply 'business as usual vs. energy saving' has been shown alongside a full cost benefit analysis for the portfolio of measures.

The cost benefit analysis uses an energy price inflation rate of 5% and a discount rate of 6%. The graph below shows the value of the whole project over 20 years which has a Net Present Value (NPV) -£252,829 and an Internal Rate of Return (IRR) of -4.2%. This clearly demonstrate the need for grant funding to be achieved for the heat pump as the finance business case to implement this carbon saving measure does not exist.



5. Energy Saving Recommendations (Electrical)

5.1 Lighting (fittings)

The lighting around the building is predominantly fluorescent lighting, of T8, T5 and 2D lamps. There are a few areas which have LED lamps, but these are still in the minority. It is recommended that all the fluorescent lighting be replaced with new LED units. A detailed list is included in Appendix 1.

Recommendation – Change all the remaining fluorescent lighting to LED

5.2 Install Lighting Controls (Internal Lighting)

Most of the lighting has no lighting control and is switched on and off using a simple light switch. There are several lights which currently remain on all the time in areas such as the staff room, circulation spaces, offices, corridors, toilet areas, staircases, and the like. Some of these areas are only used occasionally and for a short amount of time and as such, the light does not need to remain on constantly. There are also spaces which benefit from a good amount of natural daylight coming in through the windows where artificial lighting is not required for much of the year during the day.

It is recommended that a motion sensor is installed on these specific lighting circuits so that the lights come on only when movement is detected in the space and turn off approximately two to five minutes after the last movement has been detected (note that the duration of the time lag after which the light goes off needs to be considered alongside the type of light that is fitted. LED lights are much more suited to being switched off after only a short duration than some fluorescent lights). These movement sensors (commonly called PIRs) also have light sensors integrated into them so they can be used to make sure that the light does not come on if there is already sufficient daylight in the space.

Recommendation – Install lighting control in most areas except the classrooms and some offices

5.3 Refrigeration Controls

Across the site there are various domestic and commercial refrigeration units such as fridges within staff breakout areas for storage of milk and staff food, and large commercial kitchen fridges and freezers within the main kitchen. These units run 24/7 and contribute to the baseload electrical consumption of the building.

To reduce the electrical consumption of these appliances it is recommended that they are all fitted with a SavaControl unit. These units work by automatically detecting the load of the compressor and turning down the power when it is not in full load. This reduces the energy consumption of

the refrigeration unit by around 18% while maintaining the cooling of the appliance. It does this by reducing the voltage delivered to the unit when it is idling but allowing the full energy to the unit when it is required.

The installation does not cause any significant disruption to operations and can be undertaken during normal operating times.

Recommendation: Install SavaWatt SavaControl units on to all refrigeration devices

6. Energy Saving and Decarbonisation Recommendations (Heating and Hot Water)

6.1 Hot Water Pump Optimisation

The audit identified that the secondary hot water pumps were running continuously (within the set time schedules) and had the potential to be optimised to reduce the times that these pumps run. The buildings usage pattern for hot water is considered to be quite intermittent with peaks around lunch times and little use in between. This profile lends itself to good savings from not running the secondary pumps during the quieter times and will reduce electrical consumption associated with the secondary pumps as well as reducing gas consumption as there are less heat losses from continuously running hot water around the circuit.

It is recommended that the pumped hot water system is fitted with a Cirosense unit (https://circosense.com/) which learns the typical hot water profile of the building and then setbacks the pumps in periods of low demand.

A fully costed supply and installation quotation should be obtained from CircoSense prior to installation which will quantify exact costs and associated savings. Contact: 0333 320 1000, info@circosense.com.

Recommendation: Install Circosense unit to the hot water system

7. Energy Saving Recommendations (Building Fabric)

The building fabric is in good condition therefore there are no recommendations to make.

8. Saving Recommendations (Behaviours)

The behaviours noted on site were very good, therefore there are no recommendations to make.

9. Renewable Energy Potential

The potential for the generation of renewable energy on site has been reviewed and the viability noted.

Renewable Energy Type	Viable
Solar PV	Already have PV installed
Battery Storage	Review PV generation to determine export levels
Wind	No
Micro-Hydro	No
Solar Thermal	No
Ground Source Heat Pump	No
Air Source Heat Pump	Yes – see below
Biomass	No

9.1 Air Source Heat Pump

A new air to air source heat pump for the main building it could be located in the existing boiler room and around suitable locations at the school. An air to air system would require a new internal fan units to be installed but this would be considered to be easier and more robust than upgrading the wet heating system and also provides the capability to be used for cooling in summer. 3 phase electrical power will also be required to power the units, which may require some upgrade in capacity.

Good local renewable companies can be contacted for further detailed assessment of heat pumps and quotes. To enable a high quality funding application for such measures some design development work should be considered to be undertaken to work up an accurate heat loss model for the building, size and specify the internal and external units and to make initial contact with the DNO and planners over any requirements for additional power and/or planning permission.

There are currently government incentives available for installing air to water heat pumps, but these are subject to future change and adaption so should be reviewed at the time of implementation.

The design of a potential air source heat solution should also be developed to include creating an accurate heat loss model for the building, sizing and specifying the internal and external units and making relevant contact with the DNO and planners.

Recommendation: Considering replacing the existing boilers with an Air-to-Air Source Heat Pump with new internal fan units when the boilers reach the end of life in around 2030-2035

Appendix 1 – Schedule of Lighting to be Replaced or Upgraded

Rooms / Location	No of fittings	Recommended Upgrade	Saving (£)	Total Cost	Payback (years)
Old care takers ground	5	5ft Single Batten LED	£203	£429	2.11
Entrance and stairs	2	2D LED 10W	£13	£124	9.27
First floor office 1	2	5ft Single Batten LED	£26	£171	6.50
First floor office 2	1	5ft Single Batten LED	£13	£86	6.50
WC	1	2D LED 10W	£7	£62	9.27
Reception end entrance	1	2D LED 10W	£7	£62	9.27
Reception class	20	2D LED 10W	£134	£1,242	9.27
Side steps/corridor	3	2D LED 10W	£20	£186	9.27
Rainbow room	2	5ft Single College LED	£71	£224	3.17
WC	2	2D LED 10W	£13	£124	9.27
KS1 Corridor	22	NO CHANGE			
Girls and Boys WC	2	5ft Single Vapour LED	£75	£138	1.84
Accessible WC	2	2D LED 10W	£13	£124	9.27
Class 3G	5	5ft Single College LED	£177	£561	3.17
Class 3R	5	5ft Single College LED	£177	£561	3.17
F2C	10	5ft Single College LED	£354	£1,121	3.17
F2D	5	5ft Single College LED	£177	£561	3.17
KS1 Hall	8	5ft Double College LED	£283	£918	3.25
Place to Talk lobby	1	2D LED 10W	£19	£62	3.19
Place to Talk	4	NO CHANGE			
Art Store	1	5ft Single Batten LED	£38	£86	2.25
Stairs to community room	3	2D LED 10W	£24	£186	7.90
Community room	8	NO CHANGE			
Class 1B	5	5ft Single College LED	£177	£561	3.17
Class 5	5	5ft Single College LED	£177	£561	3.17
Side exit	1	600 x 600 23W Standard Panel (AG)	£18	£81	4.59
Table cupboard	1	600 x 600 23W Standard Panel (AG)	£5	£81	16.05
Office corridor	11	600 x 600 23W Standard Panel (AG)	£82	£889	10.90
Male WC	1	600 x 600 23W Standard Panel (AG)	£5	£81	16.05
Female WC	2	600 x 600 23W Standard Panel (AG)	£10	£162	16.05
Year 1 Class	10	600 x 600 23W Standard Panel (AG)	£122	£808	6.64
Staff room	9	600 x 600 23W Standard Panel (AG)	£109	£727	6.64
Heads Office	4	600 x 600 23W Standard Panel (AG)	£49	£323	6.64
Front Entrance	6	600 x 600 23W Standard Panel (AG)	£73	£485	6.64
Front Entrance	4	Downlight 8W (80-160mm)	£26	£246	9.54
Admin Office	6	600 x 600 23W Standard Panel (AG)	£73	£485	6.64
KS2	2	5ft Single Batten LED	£34	£171	5.06
KS2 Entrance	2	5ft Single Batten LED	£10	£171	17.02

Office	2	5ft Single College LED	£28	£224	7.87
Stores	4	2D LED 10W	£31	£248	7.90
Entrance lobby	1	2D LED 10W	£8	£62	7.90
KS2 Ground corridor	6	600 x 1200 45W Panel (AG)	£140	£781	5.60
Class 2M	6	5ft Single College LED	£85	£673	7.87
Link	6	5ft Single College LED	£85	£673	7.87
Class 3	6	5ft Single College LED	£85	£673	7.87
Stair lobby and electric cupboard	2	2D LED 10W	£13	£124	9.51
Side corridor x2	6	600 x 600 23W Standard Panel (AG)	£30	£485	16.05
Breakfast room	6	5ft Single College LED	£85	£673	7.87
Servery	1	5ft Single Vapour LED	£16	£69	4.23
Kitchen	6	5ft Single Vapour LED	£98	£415	4.23
Kitchen	3	600 x 600 23W Standard Panel (AG)	£51	£242	4.77
Dry Store / HWS / WC	2	2D LED 10W	£13	£124	9.51
Lockers	1	600 x 600 23W Standard Panel (AG)	£5	£81	16.05
Class 4M	6	5ft Single College LED	£85	£673	7.87
Class 4J	6	5ft Single College LED	£85	£673	7.87
Ground Hall	12	5ft Single College LED	£171	£1,345	7.87
Store, Dis, WC Lobby	3	2D LED 10W	£20	£186	9.51
Children's WC	4	5ft Single Batten LED	£81	£343	4.23
Rear steps and staff WCs	8	2D LED 10W	£52	£497	9.51
Library	6	5ft Single College LED	£183	£673	3.67
End stair lobby	1	2D LED 10W	£7	£62	9.51
Boiler room	14	5ft Single Vapour LED	£62	£967	15.57
Stairs	6	5ft Single Batten LED	£30	£514	17.02
Corridor 1st floor	11	5ft Single Batten LED	£55	£943	17.02
2BE	2	5ft Single Batten LED	£10	£171	17.02
Office	2	5ft Single Batten LED	£10	£171	17.02
Cleaners	1	2D LED 10W	£7	£62	9.51
Class 5N	6	5ft Single Vapour LED	£98	£415	4.23
Class 5S	6	5ft Single Vapour LED	£98	£415	4.23
Class	6	5ft Single Vapour LED	£98	£415	4.23
1st floor hall	8	5ft Double College LED	£283	£918	3.25
Class	6	5ft Double College LED	£69	£689	9.93
Class	6	5ft Double College LED	£69	£689	9.93
Class	6	5ft Double College LED	£69	£689	9.93
Class	6	5ft Double College LED	£69	£689	9.93
Music	6	5ft Single College LED	£85	£673	7.87
Office and sides	4	NO CHANGE			