Thinking Works
for a brighter tomorrow

Eardley Primary School Energy Audit
Commissioned by the Greener Jobs Alliance
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Thinking Works

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Thinking Works is an incorporated not-for-profit company.
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Audit Summary

Thinking Works were commissioned by the Greener Jobs Alliance (GJA) to conduct an energy audit for Eardley Primary School in Wandsworth. The GJA have a £10k pot of funding for energy saving works and wanted guidance on approaches and installations that would make the most of the available fund. This report outlines the results from an initial audit of the school and provides a list of energy saving options and the relative pros and cons of each.

Disclaimer

This report is based on an initial survey of Eardley School and it should be noted that no technical survey of the school has taken place. The report serves to provide a broad and simplistic outline of a number of energy saving options and all information should be taken as indicative only. The energy saving options proposed in this report are based on the initial survey and it is recommended that should any energy saving option be chosen to be pursued that a technical inspection is made of the school by an accredited professional from that industry.

Outline of Audit

A 2.5 hour external and internal inspection of Eardley school took place on the 29/11/12. Building fabric, windows, floors, heating systems, cooling systems, ceilings, roof and lights were inspected. Heating and lighting controls were inspected, as were gas and electric bills where provided. Although not every classroom was visited, indicative rooms, halls and hallways were inspected to provide a realistic outline of areas of heat and energy loss in the school. For the purposes of the audit the report is split into eleven sections looking at individual aspects of the school; where energy is currently being wasted and the energy saving options available for each aspect.

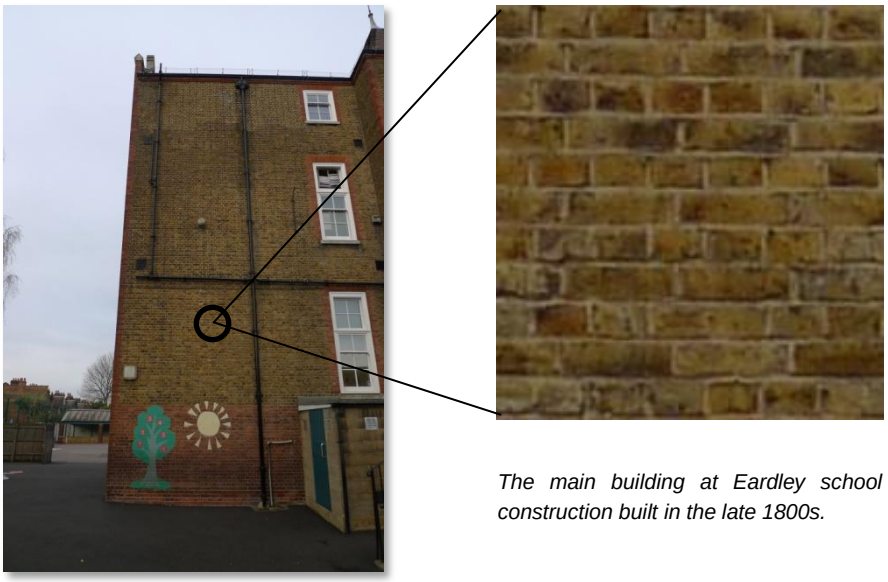
Eardley School Energy Consumption

	Annual Consumption		Annual Cost		Annual CO_2 emissions	
Utility	kWh	%	£	%	$kgCO_2$	%
Electricity	125,000	22%	15,000	48%	93,000	45%
Gas	450,000	78%	16,200	52%	114,210	55%
Total	575,000		31,200		207,210	

This table outlines the schools energy consumption, energy costs and annual CO_2 emissions. The gas use is accurate as a full 12 months of previous bills were available but the electricity consumption has been based on extrapolation from the March-May 2011 quarter bill as this was the only bill available. This extrapolation takes into account a deduction of the summer quarter June-September when the school is closed for the school holidays and there is minimal electricity use.

Bearing the school's annual energy consumption in mind, elements of the school's construction, heating, lighting and energy use patterns are evaluated below.

1. Building fabric – The main building structure is made of solid brick, built during the 1890s. The swimming pool house and grounds house are also made of solid brick and are of the same age as the school. A small extension at the front of the school is made of cavity construction and a new build extension is still under construction with completion expected early in the New Year.



The main building at Eardley school is of solid brick construction built in the late 1800s.

Possible Energy Saving Options

- External wall insulation of the school building – although this would save a lot of energy, this option has to be discounted as not only would the high cost be prohibitive (scaffolding the building alone would likely exceed £10k), but altering the external look of the school would not be acceptable as windows and the new extension have been designed in keeping with the external look at great expense.
- Internal wall insulation of the school building – this would be an excellent energy saving option although as a "whole school" retrofit it is not a viable option due to the redecoration costs, upheaval and general costs of installation. However, as a classroom-by-classroom option it should be considered.

2. Ceilings and roofs – Eardley school has, for the most part, very high ceilings of around 5m. The school has a number of pitched roofs – the sections where access was available revealed there was 100mm of fibre glass insulation. There are also several flat roofs. Apart from the new extension that is still under construction, no other flat roof has any insulation. The high internal ceilings make rooms expensive to heat and the poor insulation in most of the ceiling areas means the vast amounts of heated air can escape easily.

Eardley school has very high internal ceilings making classrooms hard to heat

Eardley school has some insulation in the pitched roofs but this requires topping up and access hatches to be cut where access is currently unavailable

Possible Energy Saving Options

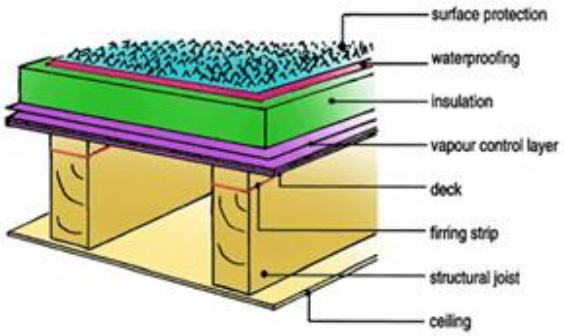
- Destratification fans for the high ceilings – these should be considered in the upper floors of the school to help keep the vast amount of hot air that rises through the school down in the rooms where heat is needed. Destratification fans work by blowing hot air downwards using minimal energy.

Destratification fans make little noise and are a cheap way of keeping heat down where it is needed.
http://www.airius.co.uk/

- Loft insulation – a top-up of 170mm is required in accessible loft spaces. Access hatches can be cut cheaply (around £150 a hatch) and all other loft spaces should be insulated to 270mm. This is basic and cheap way of keeping the school warm and would have a short pay-back period of as little as 1-2 years.

Fibreglass insulation is cheap and easy to install and can make significant energy savings.
http://www.nationalinsulationassociation.org.uk/

- Flat roof insulation – this option is more expensive but should definitely be included when a flat roof is renewed. Much like fibreglass loft insulation it provides significant heat and energy savings and is relatively cheap when installed during roof felting.



Flat roof insulation can be applied external when felting is being renewed.
www.nfrc.co.uk

3. Lighting – the school has already replaced its stock of T12 and T8 fluorescent tube lights with T5 tubes. This is excellent and apart from LED lighting (present in one or two areas) is the most cost effective way to light the school.

Starcoat T5 fluorescent tubes from the school's stock room

4. Heating and heating controls – Eardley school has two main boilers that service the heating of the main school building. Several small standalone combination boilers service individual areas where there is increased demand including the kitchen area and the swimming pool building. Heat is distributed around the school through old cast iron radiators of which there are approximately 80 throughout all the school buildings. Heat is controlled by a central thermostat in the boiler room. This is the only control over the school's heating of 21 classrooms as well as several halls and numerous hall and stairways. Due to the school's size and lack of area control over heating, at any one time south facing parts of the school are over heated whilst north facing and exposed parts of the school are too cold for comfort. During the audit, it was noticed that several external doors and windows were left open in parts of the school whilst portable electric heaters were in use in other parts of the school.

One of two floor standing boilers used for the main heating of the school

One of several standalone combi boilers used to heat areas with high energy demands

Cast iron radiators used to distribute heat throughout the school

Poor control over the school's heating is extremely expensive. One example of this was seen in the utility room where several fridges/ freezers were next to a boxed-in turned on radiator.

Whilst the fridges/freezers try to keep cool the hot radiator keeps the room almost too hot for comfort

Possible Energy Saving Options

- Thermostatic Radiator Valves – these are an excellent option at Eardley school as the vastly different temperatures in different parts of the school cause over ventilation (opening windows) or additional heating (use of expensive on-peak electric heaters).
- Room thermostats – Not a good option as thermostats in cold areas would be trying to switch the boiler on whilst thermostats in warm areas would be trying to switch the boiler off.

5. Windows – Many of the single glazed sash windows have been replaced with double glazed wooden sash versions that are professionally draught proofed. Where original

sash windows remain, they are often draughty and in some cases do not fully close causing a significant loss of heat.

Old sash windows lack draught proofing

Several of the original sash windows don't fully close

Possible Energy Saving Options

- Replace single glazed sash windows with double glazing – this would be ideal but is expensive and the ratio of energy saved to money spent is poor.
- Draught proof single glazed windows – this is an excellent interim measure and cheap to install and should definitely be considered. In one office plastic sheeting has been put up as a temporary measure to prevent draughts.

Plastic sheeting used as a temporary measure to prevent window draughts

6. Floors – Although there were no internal inspections of the schools floors and levels of insulation, it can assumed that in a building of this type and age that no floor

insulation has been added (except for in the new extension which has been insulated throughout). Up to 10% of a building's heat loss is through the floor so insulation should be considered.

Possible Energy Saving Options

- Under floor insulation – due to upheaval, this is not a viable option unless renewal works are taking place. Under floor insulation can, however, be put in classroom by classroom and if floorboards are being taken up insulation should be added as it is a cheap and effective addition.

Fibreglass laid between floor joists is a cheap and effective way to lower heat loss when done as part of planned renewal work

7. Cooling – the school as two large chest freezers and a large commercial sized refrigeration unit as well as several small fridges/freezers. The chest freezers are old and not very energy efficient although the commercial Foster fridge appears to be fairly new.

Fridges and freezers at the school use a significant amount of energy

Possible Energy Saving Options

- Allowing airflow – the two large chest freezers are too close to the wall and should be pulled out to allow sufficient airflow to help cooling of the units and improve their efficiency. As long as space allows, as this is a no cost measure it should be implemented.
- Ecubes – these optimise temperature regulation and prevent unnecessary cooling cycles saving up to 30% of cooling costs. As these are a cheap option they should be considered.

Ecubes help a refrigeration unit run cooling cycles in line with the temperature of the food in them instead of the air temperature around the food – this lowers and evens out cooling cycles and saves energy

8. Water – the school's water use is metered. Although no water bills were seen, reduction in water use is always beneficial. As the school has a small swimming pool there is increased water use.

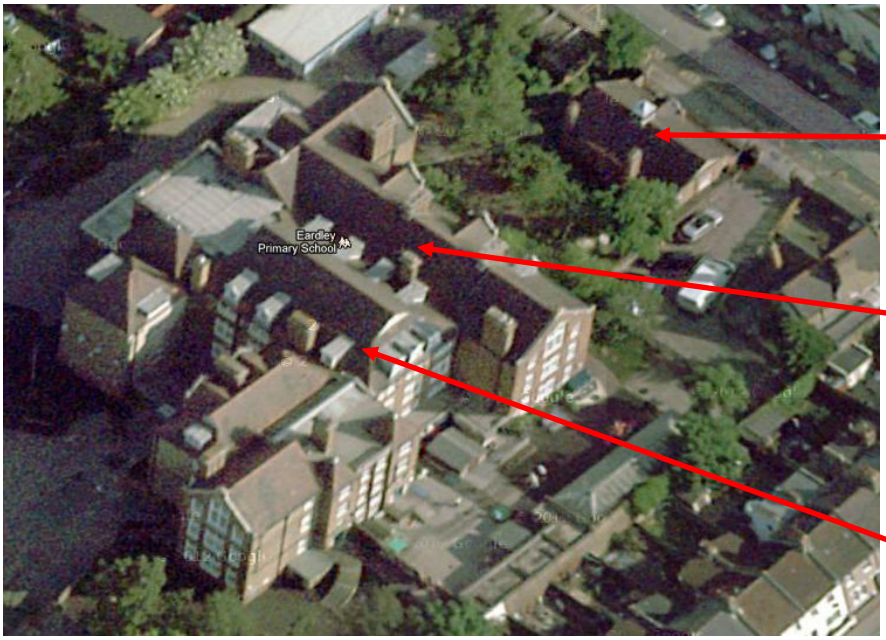
The small swimming pool at Eardley school

Possible Energy Saving Options

- Reduce flow-rate – over-all flow rate of water can be reduced to the school which would significantly reduce water wastage from running taps. The ease of changing flow rate depends from building to building and a professional plumber should be consulted to look into this option if it is to be taken forward.
- Install small water saving devices – apart from save-a-flush bags which are usually provided free from the water board and installed in the toilet cisterns, the faucets of the currently installed taps are not suitable for retrofitting with aerators due to their

shape. Save-a-flush bags should be installed throughout where access is available. This saves one litre of water each time the toilet is flushed saving thousands of litres a year per toilet.

9. Renewables – Eardley school currently has no renewable energy creating technologies installed. As Eardley school is on the mains gas and electric grid network most renewable technologies would not provide a good cost to energy saving ratio. Ground and air source heat pumps would not be viable as the poor insulation and high ceilings in the school make the background heat produced by this technology unsuitable as it would require a vast amount of additional on-peak electric top-up energy to heat the main buildings. A biomass boiler would also be unsuitable as the school is situated in a residential area where fumes from the boiler, the need to store a large amount of fuel and refuel, and the poor gains of replacing an on-grid mains system that is currently in operation make this technology unsuitable. Solar panels for either solar photovoltaics or solar thermal were considered as an option, especially solar thermal to heat the swimming pool. Solar was considered as it had the best likelihood of being a viable technology that could not only save and produce energy but also provide an income stream through a feed in tariff or through renewable heat incentive payments. Unfortunately, although the school has a south west facing roof section, it suffers from shadow cover from other roof sections and from protruding chimneys meaning that the overall area for putting panels on is too small for an efficient solar system. The front section of the school roof could be considered for an installation (see below) but access is poor and scaffold for installation and maintenance may be prohibitive and make the cost effectiveness of the installation poor.



The roof of the swimming pool roof is in the shadow of the main school building making it unsuitable for a solar system

The longest roof space suffers from shadow coverage from other roof areas and chimneys

The best roof surface for orientation and lack of covering is the front South West facing roof. Access is poor to this area however

Even where roof access is available for solar, shading covers large parts of the roof space throughout the day

10. Voltage optimisation - The average electrical supply voltage in the UK is still around 242 Volts, although can vary from around 216 to 253V within regulations. Most modern electrical equipment is designed to operate at 220V however and installing a voltage optimisation unit on site to drop the local supply voltage to a more acceptable level can yield significant energy savings.Some electrical equipment incorporating variable-speed inverter drives, high-frequency lighting ballasts and switch-mode power supplies will generally not yield significant savings from voltage optimisation as the voltage fed to the load is generated electronically and is not affected by the supply voltage. The type of load must therefore be carefully monitored before proceeding with an installation. Installers of these units should provide this service, after which they should be able to give reasonably accurate idea of expected annual savings.

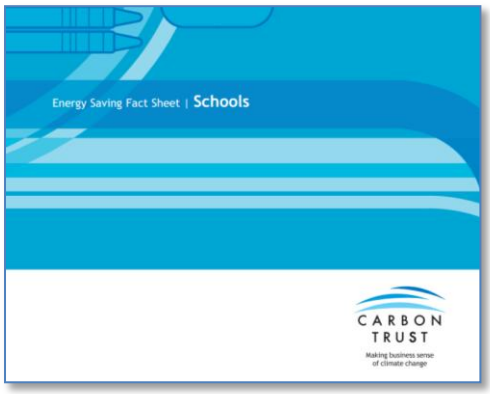
Measure	Saving [£ pa]	Cost of Measure [£]	Payback Time [years]
Voltage Optimisation	**345**	**1,587**	**5**

Table showing typical costs, savings, and payback time of installing voltage optimisation in a school

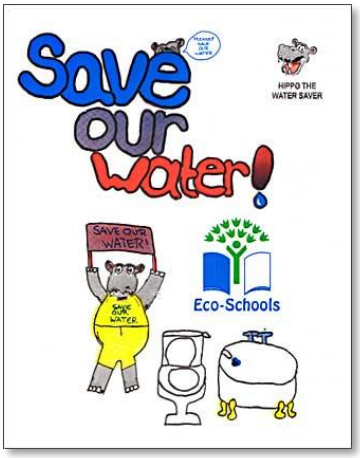
11. Behavioural change – changing pupils and teachers attitudes to energy use is essential to make lasting energy saving plans for the school. Installing individual radiator controls to regulate heat in different classrooms will only reduce energy consumption if people actually use the controls. Likewise, if people in the school leave windows and doors open and leave lights on, even with the most efficient heating and lighting systems in place vast amounts of energy will be wasted.

Possible Energy Saving Options

- Behavioural change campaign – posters, stickers, banners and assemblies should be used to promote behavioural change and lower use of heat, light and water. As this is very low cost (although time intensive) it is strongly recommended that any hard energy saving measures installed be complemented with a behavioural change campaign. The Carbon Trust have produced a handy factsheet to help schools which can be downloaded here: http://www.kingston.gov.uk/factsheet_gil147.pdf
  Below are some typical statements and tips that it is advised are promoted around the school.



The carbon trust has a handy guide to behavioural change which you can download



Posters to encourage energy and water saving can be placed in classrooms and on doors

Recommendations Summary

Bearing in mind the budget of £10k, below is summary table that summarises each of the eleven areas looked at during the audit with a review of relative pros and cons and whether a particular measure is recommended. Please note that all figures are illustrative only and that a comprehensive technical survey is required for each measure to calculate accurate costs and savings for each measure.

Measure	Illustrative Cost to Install £	Illustrative Annual Savings £	Payback time (years)	Pros	Cons	Recommended?	When?
External Solid Wall Insulation	£90,000	£3,200	29	significant energy and money savings	expensive. Not realistic as an option as would affect the external look of the school	No	NA
Internal Solid Wall Insulation	£60,000	£2,200	28	significant energy and money savings. Can be done classroom-by-classroom as renovations take place	only realistic as classroom renovations take place	Yes	As classrooms are renovated
Destratification Fans	£7,500	£2,000	4	cost effective way of saving heat	have to check with a professional installer for noise levels and exact running costs	Yes	ASAP
Loft Insulation (top up from 100mm - 270mm)	£500	£300	2	cheap way of saving heat	None	Yes	Immediate Action
Loft insulation and cut access hatch (0mm-270mm)	£1,000	£500	2	cheap way of saving heat	None	Yes	Immediate Action
Flat roof insulation	£10,000	£500	13	decent annual cost savings	expensive unless tied in with normal flat roof renewal	Yes	When flat roof is renewed
Thermostatic Radiator Valves	£5,000	£1,700	3	very cost effective way of saving heat	Only save energy if people alter the settings.	Yes	ASAP
Replace Single Glazed Sash Windows	£100,000	£1,000	100	prevents draughts. Long lasting draught proofing solution	very long payback period	Yes	When funding is abundant enough to consider this as an option
Draught proof single glazed windows	£500	£200	3	cheap way of preventing draughts	only realistically a temporary measure. Can make it hard to open and close windows	Yes	ASAP

Under floor insulation	£variable	£variable	NA	excellent way of preventing heat loss through the floor	only realistic if classroom floor renovations take place	Yes	If classroom floors are renovated
Increase air flow to freezers	£0	£50	0	no-cost measure that saves energy	only saves a very small percentage of overall energy use	Yes	Immediate Action
ecubes (fridge/freezers)	£150	£200	1	cheap way of saving energy	only saves a small percentage of overall energy use	Yes	ASAP
Reduce water flow rate	£TBC	£TBC	NA	can save thousands of litres of water and associated money savings each year	only really applies to washing up / cleaning hands water saving as the same volumes are required for cooking and drinking	Maybe	Seek professional opinions to follow up this option
Install small water saving devices (save-a-flush)	£0	£200	0	no-cost measure that saves water and should be free from the water board	None	Yes	Immediate Action
Ground Source Heat Pump	NA	NA	NA	not viable due to space required, upheaval and lack of insulation in the school	not viable due to space required, upheaval and lack of insulation in the school	No	
Air Source Heat Pump	NA	NA	NA	not viable due to space required, upheaval and lack of insulation in the school	not viable due to space required, upheaval and lack of insulation in the school	No	
Biomass boiler	NA	NA	NA	not viable due to fumes from stack, refuelling requirements and storage for fuel and poor gains replacing an on-grid mains gas system for an off-grid system	not viable due to fumes from stack, refuelling requirements and storage for fuel and poor gains replacing an on-grid mains gas system for an off-grid system	No	
Solar PV	NA	NA	NA	Not enough unshaded roof space available for an array of a viable size	Not enough unshaded roof space available for an array of a viable size		
Solar Thermal	NA	NA	NA	Not enough unshaded roof space available for an array of a viable size	Not enough unshaded roof space available for an array of a viable size		
Voltage optimisation	£1,500	£345	5	cost effective way of saving electricity	None	Yes	ASAP
Behavioural Change Programme	£100	up to £3000	1	Behavioural change is essential to any list of energy saving recommendations as it is very cost but can have huge energy and water saving effects	None	Yes	Immediate Action

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