Planet Savers Australia
P.O Box 16
Hurley Street,
Balnarring, VIC. 3926

Energy Efficiency Opportunities For Killara Primary School.

Reducing your energy consumption footprint

School	Killara Primary School
Address	Phillip Dr Sunbury, VIC, 3429.
Auditing firm	Planet Savers Australia, EMG Carbon Pty. Ltd.
Firm contact details	Mark Smith: 0425 734 904
Authors	Mark Smith and Eric Bottomley
Audit commencement date	21/10/2013

Contents

Tables

Figures

Photographs

1 Audit overview and objectives

Planet Savers Australia (PSA) have been working closely with schools for many years delivering their school sustainability programs aligned and accredited under Australian Sustainable Schools Initiative (AuSSI) around Australia.

Killara Primary School has successfully applied for funding as part of the energy efficiency grants program for Victorian schools provide by DEECD and supported by Sustainability Victoria. This audit is the first step in identifying energy waste and will provide a list of costed recommendations that could see Killara Primary School reduce energy waste by over 25%

1.1 Acknowledgements

Thank-you to Robyn Smith and the student leadership/ green team for their time and effort gathering appliance data and usage practice information.

1.2 Getting the most out of this report

First step is to read this report thoroughly. Second Step is to act on it. We at Planet Savers can produce the best report or summary in the world but it is useless unless you act on it. These next key steps are crucial in achieving your emissions reduction strategy.

- Involve the key stakeholders and decision makers. These include, Staff, business manager, maintenance manager, I.T manager and any party with a keen interest in the outcome.
- Involve the whole student population in your switch off strategy. Changing the culture can literally double your savings outcome.
- Set a budget
- Set a target and a time line for implementation.
- Measure your success. (SETS) or internally monitor
- Tell everyone of your success. (Newsletters, websites, etc.)

We sometimes see the best of intentions flounder due to a lack of funding, time constraints or just indecision as to how to move forward. If you encounter these problems Planet Savers can also provide advice, project management and or installation services. Action on climate change is now an imperative. Energy Efficiency is the most cost effective first step.

Photograph 1: Waiting for action.

2 Executive Summary

Two key factors have a significant impact on energy consumption within any school.

1. **The quality and energy saving potential of existing school electrical, gas appliances and infrastructure.**
2. **The way in which staff and students use that equipment and infrastructure and the level of control that staff and students have over that infrastructure.**

2.1 Audit Methodology

This energy audit is the first step in what we envisage will be a successful auditing outcome. Implementation of audit findings is key to achieving the bulk of reductions. Full quotes are advised before any commitments are made.

This is a level 2 to AS3598: Energy Audit.

- Site visits were conducted on 21st of October 2013.
- Estimates of hours of operation, duty cycles and central cooling plants have been arrived at through questioning of teaching and maintenance staff.
- Estimated loads have then been balanced against billing information provided by Killara Primary School.
  - Victorian benchmark data.
- We have underestimated potential savings and overestimated costs (+ or – 10%).
  - Example 1. We have estimated 8 hours lighting use for delamping and other lighting recommendations. We know through questioning of staff and our own observations that this figure is between 8 to 10 hours.
  - Example 2. Individual split systems and packaged air-conditioners (APACs) have different loads according to temperature range settings.
- Our best efforts and care have gone into estimating electrical loads based on information gathered on-site, manufacturer data and experience with previous audits involving schools and human behaviour.

Note that in any audit, calculations of estimated benefits and costs rely on many assumptions.

Key assumptions:

- Loads have been estimated based on equipment counts, estimates of individual loads, and prior experience.
- Costs remain the same.
- Hours of operation have been estimated based on normal school occupancy and estimates regarding what is regularly left running at night.
- As estimates have been widely used, calculations should be considered as indicative only.

Factors, which will affect outcomes, include:

- Fluctuations in student or staff numbers
- Changes to the hours of use of class rooms
- Tariff changes
- Control system changes.
- Recommendations may not be fully implemented.

Therefore any calculations of estimated benefits and costs should be considered as indicative only, within the constraints of these assumptions.

2.2 Site Services.

Killara Primary School was opened in 1993. In 2013, there were 598 students enrolled at the school. The site consumes electricity by Power Direct and Gas provided by Tru Energy.

According to entered SETS data, electricity is on a peak/off-peak tariff, at an overall cost of 23 and 13 cents per kilowatt hour (kWh) respectively. Averaged Gas cost is 0.13 cents per mega joule (MJ).
The site currently relies on brown coal generation for supply.
www.greenpower.com.au

2.3 School Operational Hours

School runs from 8.30 am until 3.30 pm, with lunch and recess running for a total of 1.5 hours. The school is usually occupied from around 7.30am to 6.30pm on most school days with some after school activities and programmes. Cleaners occupy the school for approximately 3 hours per day. We have estimated an average of 6 to 8 lighting hours across the school, although the true amount is most likely higher.

2.4 Utility Costs and Emissions Factors

Emissions and Conversion Factors Scope 2		
Electricity emission (e) factor	kg CO_2 / kWh	1.19
GHG emissions (kg CO_2) = electricity used (kWh) x e-factor (1.19) To express in tonnes, divide by 1000		
Natural gas e-factor)	Tonnes CO_2-e / MJ	0.05133
1 GJ	MJ	1000
1 kWh	MJ	3.6
1 kWh = 1000 watts used over the course of an hour		
e-factor is variable depending on type and quality of fuel being used		
Tariff Information		
Electricity peak	$ / kWh	0.23
Off peak	$ / kWh	0.13
Natural gas	cents / MJ	0.013

Table 1: Emission and conversion factors.

2.5 Carbon Emission Scopes

Explanation of Carbon Emission Scopes	
Carbon Emissions: Carbon that enters the atmosphere as a result of human activity, especially the burning of fossil fuels. Used interchangably with 'Greenhouse Gas (GHG) Emissions' since carbon is a major component of greenhouse gas.	
Scope 1	Direct Emissions (fuel) The fuel you burn (petrol, gas, diesel)
Scope 2	Purchased Energy (electricity) The electricity you buy
Scope 3	Supply Chain Emissions Embedded in goods and services you buy

Table 2: Emission scopes.

3 Energy Consumption and emissions generation.

3.1 Current consumption whole of campus (2012)

Killara Primary School consumed 1,005,964 mega joules (Mj's) of energy at a cost of $35,590 producing 222 tonnes of GHG emissions.

- 169,820 kWhr of electricity at an estimated cost $30,050 producing 202 tonnes of GHG emissions. (Coal generation)
- 394,612 Mj's of Natural gas at a cost $5,540 producing 20 tonnes of GHG emissions.
- Emissions per student 0.37 Tonnes.

Consumption and Emissions Summary			
Student Numbers			598
Electricity Consumption		kWh	169,820
		MJ	611,352
Natural gas Consumption		MJ	394,612
Total energy Consumption		MJ	**1,005,964**
Total Energy Cost		$	**35,590**
Floor Area		m^2	6,727
Emissions (Vic Scope 2)	Electricity	tonnes CO_2-e	202.09
Emissions (Vic Scope 2)	Nat Gas	tonnes CO_2-e	20.26
Emissions (Vic Scope 2)	Bottled Gas	tonnes CO_2-e	0.00
Total Emissions		tonnes CO_2-e	**222.34**
Cost	per m2	$	5.3
	per student		60
CO_2-e Emissions	per m2	tonnes	0.03
	per student		0.37
Energy Consumption	per m2	MJ	150
	per student		1,682

Table 3: Consumption and emissions summary, whole of campus.

3.1.1 Benchmarks.

Benchmark: Emissions per student per annum	
School type	**Tonnes per student**
State primary	0.49
State secondary	0.89
Private primary	0.68
Private secondary	1.10
Benchmarks complied from 400 energy audits conducted over 8 years	

Table 4: State benchmarks.

3.1.2 SETS Data.

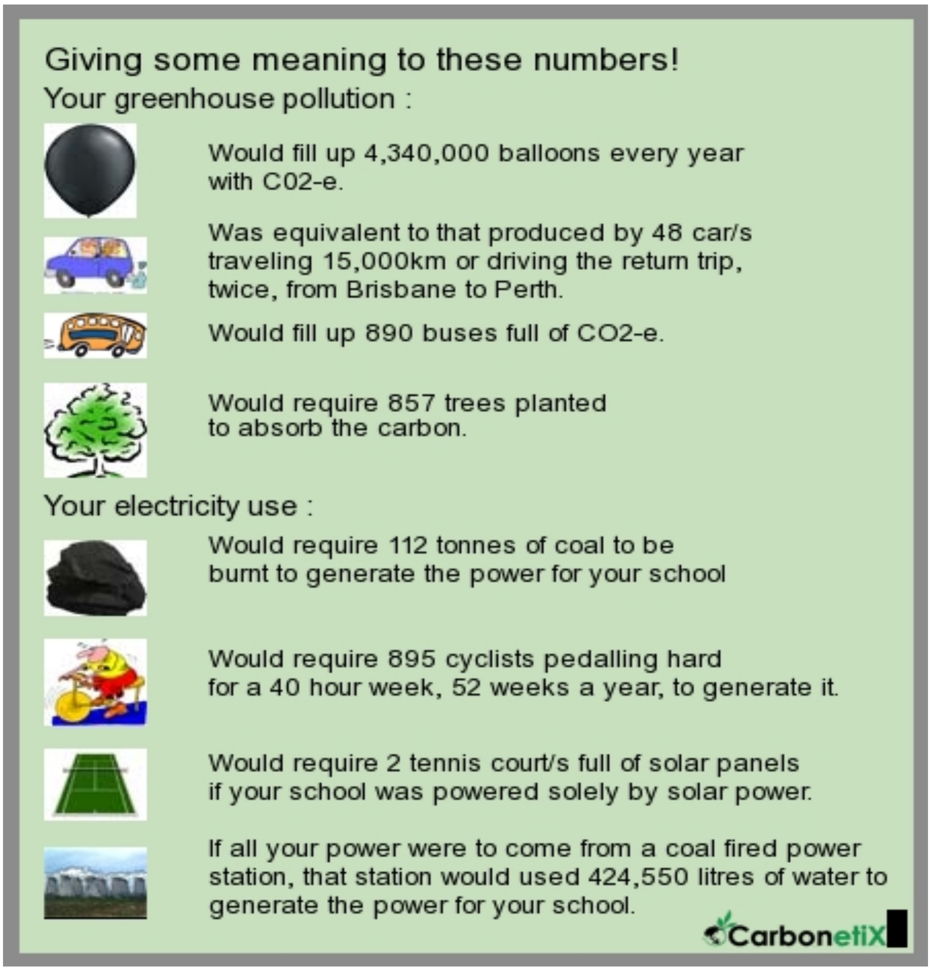


Table 5: Meaningful numbers.

3.1.3 Energy, GHG and Cost.

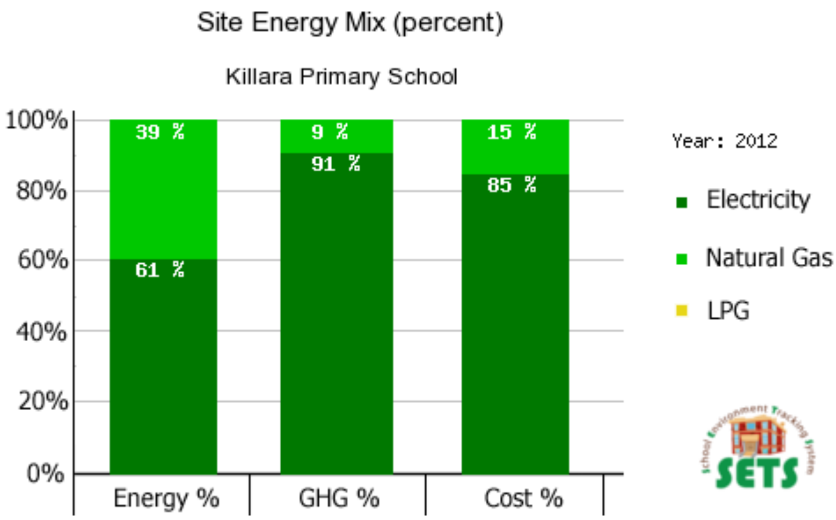
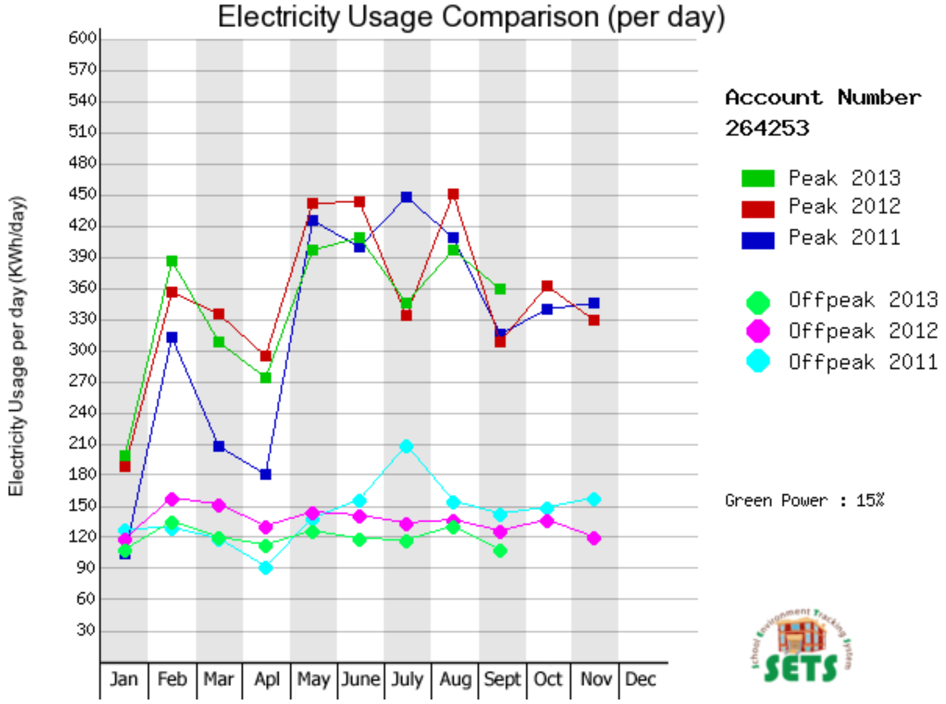


Table 6: gas & electricity breakup.

3.1.4 Electricity.

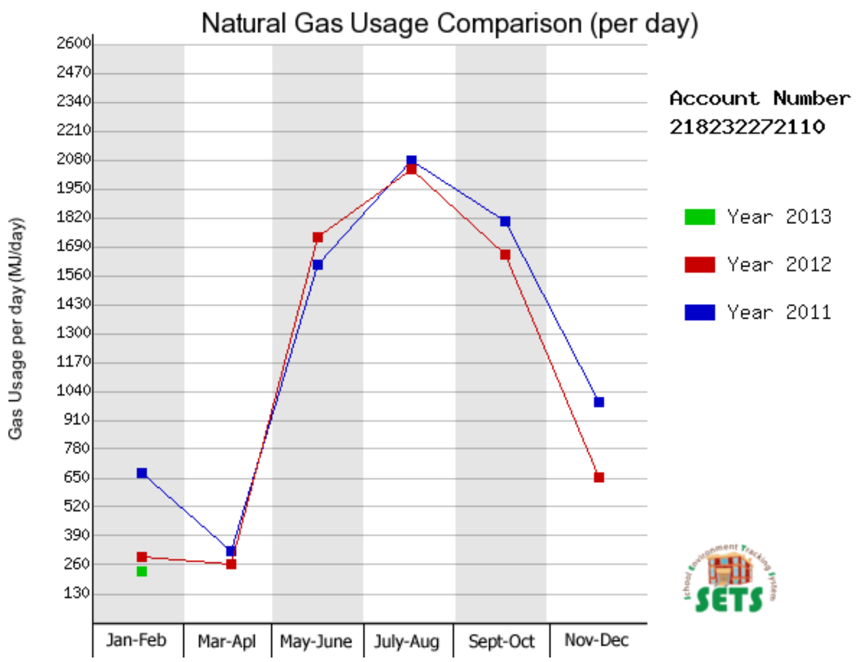


Electricity consumption follows typical patterns for a school in that consumption drops during temperate months and increases in line with winter months.

- 2013 consumption has dropped in comparison to 2012 possibly due to a better switch off regime?

3.1.5 Gas.

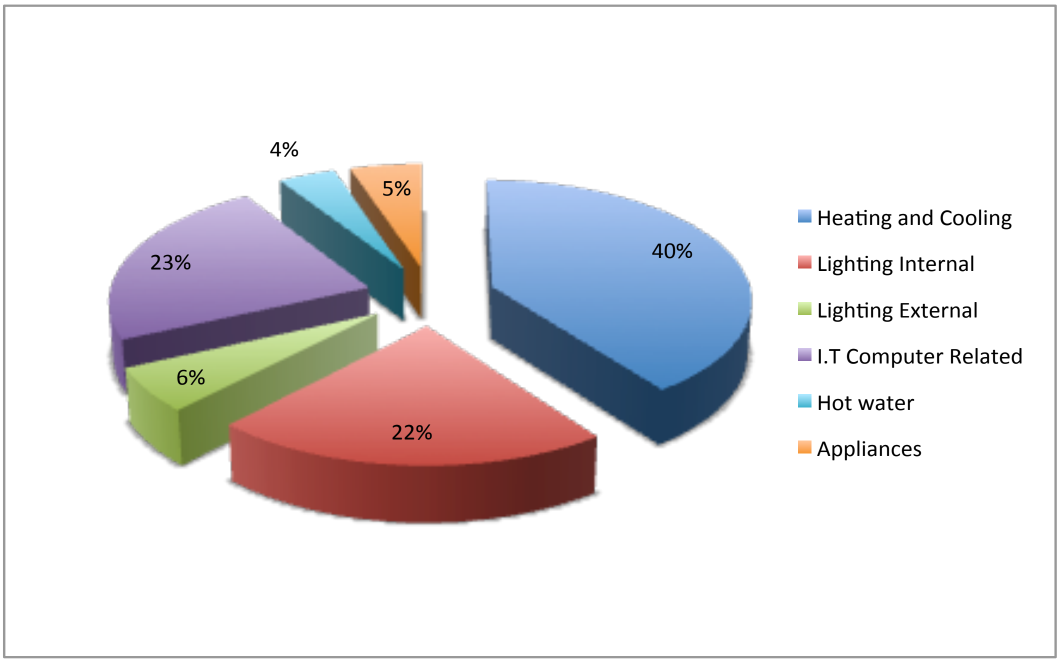
Gas consumption follows a typical bell curve for a school facility.



- Gas consumption never ceases which indicates pilot lights are in operation or gas hot water systems are present.

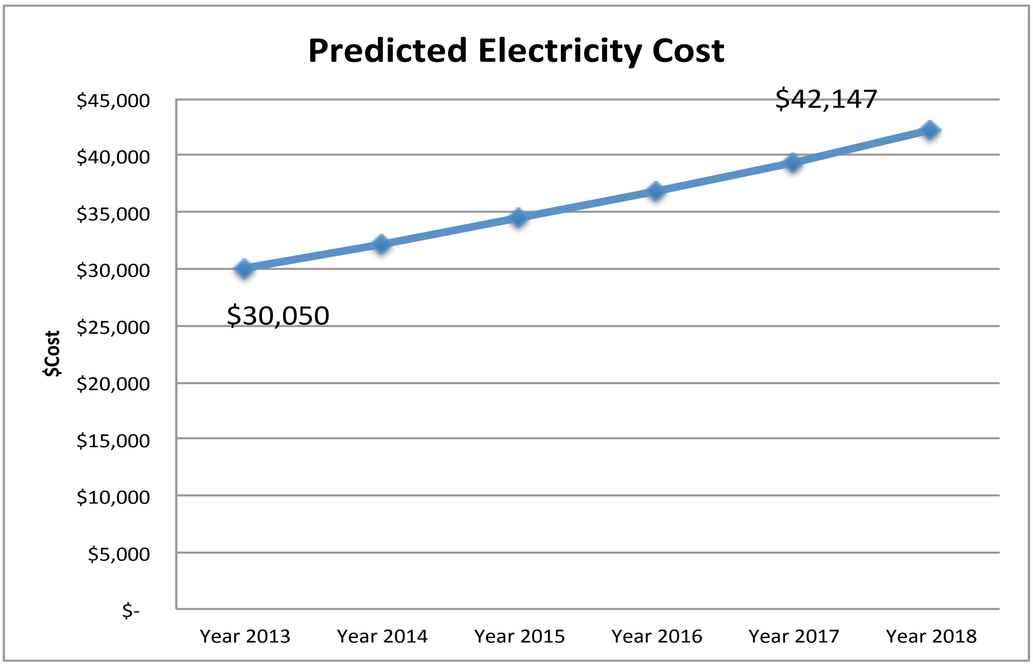
Gas consumption is on the decrease. Well Done!

3.1.6 Energy consumption breakdown in Victorian schools.

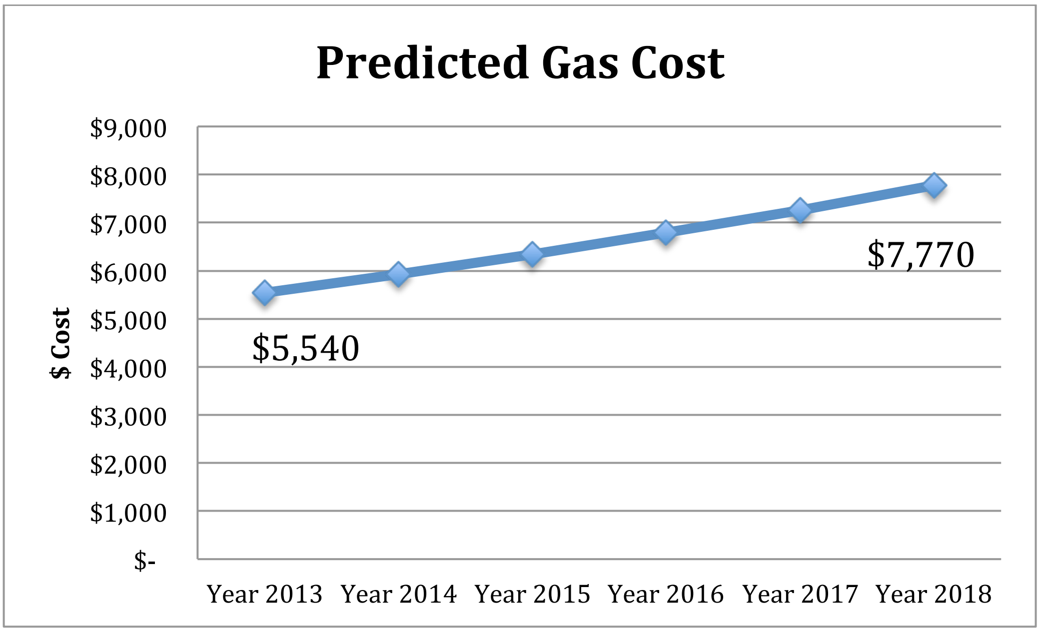


3.1.7 Future energy cost increases.

The Australian Energy Regulator is an independent incorporated body charged with the regulation of Australian energy pricing. As of 2011/12 they have approved minimum increases in electricity charges of 36 to 48% over the coming five years for the upgrade of electrical infrastructure such as poles and wires. Gas is predicted to increase by even higher margins due to the baulk of Australian gas supply now committed to export markets. The graphs below show Killara Primary School potential percentage cost increases based on a 7 % per annum over the next five years. These figures are conservative estimates.



Graph 1: Increasing electricity costs.



Graph 2: Increasing gas cost.

3.2 Recommendations Summary.

This report contains quantified and unquantified recommendations for reducing energy waste at Killara Primary School.

3.2.1 Total for recommendations.

Recommendation	Savings per Year		GHG pollution saved	Cost	Payback
	kWh	$	tonnes	$	years
Switch off at recess, lunchtime and after-school	5,557	1,278	6.6	0	immediate
* Delamp flourescent and relamp with LED	14,939	3,436	17.8	24,696	7.2
* Retrofit twin fittings with energy efficient single LED fittings	16,183	3,722	19.3	32,760	8.8
Replace traditional security lighting with motion sensored LED	7,045	1,268	8.4	2,400	1.9
Hot water services and water coolers: Install timers	2,851	656	3.4	500	0.8
Switch off interactive whiteboards	1,200	276	1.4	0	immediate
Install timer delay switches on air-conditioners	2,908	669	3.5	3,360	5.0
Totals	**35,744**	**7,869**	**43**	**39,020**	**5**
* *Figures are based on only one of these measures being implemented. Savings are not accumulative.* *Total represents estimated maximum savings possible. All costs and savings are exclusive of GST*					

Table 7: Total of recommendations.

3.2.2 Estimated Costing's

Estimation of labour and installation costs varies from region to region, making it very difficult to accurately predict costs. Every effort has been made to obtain accurate costing from local service providers. Site-specific variations and contractor rates are subject to change. We recommend that before any budgetary commitment is made, quotes be obtained for all costed energy saving recommendations.

4 Recommendations

The recommendations are divided into four key areas of energy consumption…

- Lighting.
- Air-conditioning.
- Appliances.
- Information Technology.

Each area contains costed and uncosted recommendations designed to gather "Low Hanging Fruit" while identifying long term environmental and financial benefits.

All recommendations are conservatively costed to ensure that payback periods are not understated. This means that many savings identified have a potentially greater level of return than stated in this report (+ or – 20%).

All prices are exclusive of GST.

4.1 Lighting

Lighting is used night and day at every school; internal during the day, external at night for security and movement around campus after hours. Options for reducing energy consumption from lighting are explained below.

Internal Lux level readings taken on the day of audit show very high light levels throughout the campus.

Minimum lux level required under Australian standards is 240 Lux. See table below.

photograph 2: Lighting.

The high levels of natural light in most rooms suggests that most of the lighting used throughout the day is unnecessary.

Australian Standards for Illumination Levels		
Area		**LUX** *
Classrooms and other areas		
General purpose classrooms		240
Fine work laboratories (eg art rooms)		600
First aid	Rest rooms	40
	Treatment rooms	400
Kitchen	General	160
	Food preparation	240
Cafeterias	General	160
	Counters	240
Administration areas		
Office	Background	160
	Reading, typing & writing	320
Filing areas	Clear detail	240
	Fine detail	320
Meeting rooms		320
Training and seminar rooms		240
Photocopying		240
Amenity areas		
Corridors, passageways		40
Toilets, change rooms, lockers, cleaner's rooms		80
Stair wells	Internal	80
	External	20
Foyers, lobbies, entrances		160
Waiting rooms		160
Enquiry desks		320
** Minimum recommended illuminance (LUX) AS 1680:1990*		

Table 8: Australian Standards Lux Level table.

4.1.1 Switch Off

The simplest and most cost effective option is to turn off the lights when exiting rooms. Killara Primary School will soon implement a student action program of turning off lights. Well Done! This will reduce greenhouse gas emissions by an estimated 6.6 tonnes per year and have the added benefit of instilling staff and students with a culture of energy conservation.

Lights and computers create heat, which results in air-conditioning working harder to cool the room. Switching off lights, computers and appliances when they are no longer required will create additional energy savings by reducing heat load.

Photograph 3: Lights on in empty rooms

Switch off at recess, lunchtime and after-school			
36W Total number of fluorescent lamps		504	
Percentage of lamps left on		60	
Number of lamps left on		302	
Load per lamp & ballast	kW	0.046	
Load saving from switching lights off	kW	13.892	
Lighting hours per day (estimate)	hours	8.0	
Classroom hours	hours	6.0	
Total time saved **	hours	2.0	
School days per year	days	200	
Lighting hours saved per year	hours	400.0	
Electricity tariff	$	0.23	
Electricity emission (e) factor	kg CO_2/kWh	1.19	
Savings per year	**kWh**	**5557**	*
	$	**1278**	*
GHG pollution saved (scope 2 & 3)	**tonnes**	**6.6**	*
Cost	**$**	**0**	
Payback period		**immediate**	

* *Savings are based on current lighting configuration.*
If energy saving recommendations are followed, savings will be accordingly less.

* *Savings are conservatively low because additional savings from reduced air-conditioning heat load are not factored in.*

** *Conservative estimate to allow for after school activities and cleaners*

Table 9: Switch off at recess, lunchtime and after school

Photograph 4: Student leaders.

4.1.2 Labelling

A key to successfully implementing a switch-off campaign is prominent signage on lighting switches and on doorways as staff and students are exiting rooms.

Signage is successful when the statements used to encourage action have a relevance to the user. Statements showing an immediate impact or consequence to our environment will have a more lasting impact.

Image 1: Planet Saver signage.

Planet Savers Australia in conjunction with The Thin Green Line Foundation has designed a range of signage design to motivate good behaviour. Contact mark@planetsavers.com.au to learn more.

If not design and place your own signage around your campus

Photograph 5: Label switches.

4.1.3 Upgrade Fluorescent Lighting.

Lighting technology is changing rapidly. As Killara Primary School will continue regular ongoing upkeep of lighting, it is essential to be aware of new and improving lighting options.

A longer-term option is to upgrade all light fixtures more than fifteen years old. This will provide longer-term benefits to lighting infrastructure and reduce load factors. A typical replacement cost for a single high efficiency lamp is approximately $ 120 per fitting, including labour.

- T5 fluorescents 28 watts per tube depending on the brand used as opposed to 36 watts from the standard T8 tri phosphor fluorescents. This is a reduction of approximately 25% to 40% per tube.
- LED (Light Emitting Diode) technology consumes 20 watts net, which equates to nearly a 60% reduction when efficiency loses and ballast are factored in.
    - LEDs
        - Are solid-state forms of lighting and do not strobe like conventional fluorescent lighting.
        - Have no glass components

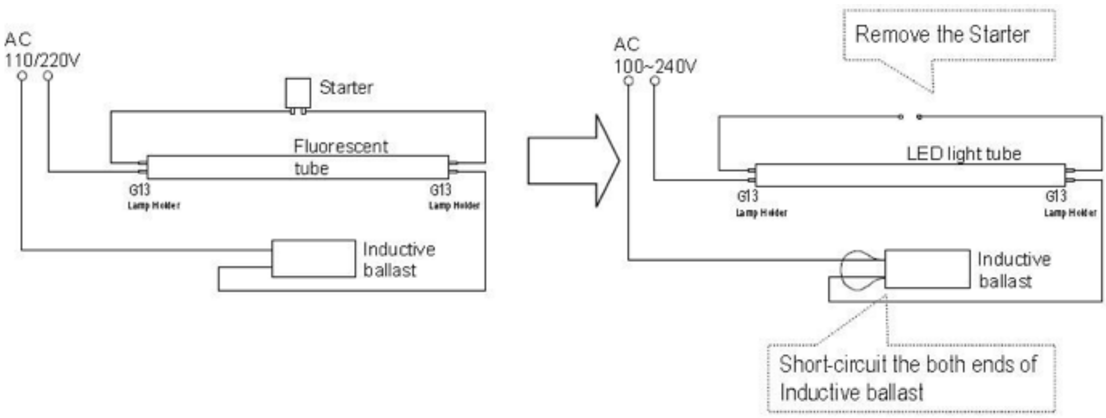
- Do not contain mercury
- Have a reported 50,000-hour life expectancy compared with 8,000 to 15,000 hours from fluorescent alternatives.
- Can be fitted directly into existing fittings and do not require the starter or ballast. Some models require that the starter be bypassed.

When replacing light fittings that have failed or aged, there are some things to consider…

- Make sure new fittings have dimmable electronic ballast (rather than magnetic) ballast. This allows for easy adoption of lighting control such as Lux or motion sensor.
- Replace double fittings with high efficiency single tube options and quadruple fittings with doubles.

4.1.4 Replace existing T8 tubes with LED tubes.

Existing T8 fluorescent tubes can be replaced with LED tubes. There are a number of things that first need to be considered. The age of the existing fitting must be taken into consideration. Tombstones that hold the tubes in place can become brittle with age and may not function properly after a retrofit has taken place. The existing capacitor should be disconnected and the existing magnetic ion ballast should be bypassed. This will ensure correct operation. If existing fittings are not suitable for a retrofit then new fittings should be installed. Before any lighting alteration is considered all fittings should be inspected by a lighting professional or quality electrician.



Delamp flourescent and relamp with LED			
Delamp, clean diffusers and replace remaining lamps with brighter quad-phosphor lamps			
36 W	Total number of fluorescent lamps		504
	Load per Lamp	kW	0.046
18 W LED	Number of replacement LED lamps		504
	Load per lamp	kW	0.020
	Saving in energy consumption per relamp fitting	kW	0.026
Diversity (approximate % of lights working)		%	95
Load saving from change over		kW	
Load saving from LED replacement of standard T8		kW	13.104
Load saving total x diversity		kW	12.449
Lighting hours per day (estimate)		hours	8.0
Hours saved by switching off at recess, lunch and after school		hours	2.0
Lighting hours per day –		hours	6.0
School days per year		days	200
Lighting hours per year		hours	1200
Electricity tariff		$	0.23
Electricity emission (e) factor		kg CO_2/kWh	1.19
Cost per LED installed		$	49
Savings per year		**kWh**	**14,939** *
		$	**3,436** *
GHG Pollution saved (scope 2)		**tonnes**	**17.8** *
Cost		**$**	**24,696**
Payback period		**years**	**7.2**

* *Savings are based on current lighting configuration.*
If energy saving recommendations are followed, savings will be accordingly less.

* *Savings are conservatively low because additional savings from reduced air-conditioning heat load are not factored in.*

Table 10: Relamp with LED.

4.1.5 Replace existing fittings with LED fittings.

Photograph 6: LED panels and T5 fitting.

Fittings at Killara Primary School are mostly original which puts them at near the end of their useful life. Replace these fittings with Latest technology LED panels or single T5 fittings.

Retrofit twin fittings with energy efficient single LED fittings		
Total number of twin 36W fluorescent fittings		252
Number of twin 36W fluorescent fittings to be replaced		252
Load per twin 36W lamp + magnetic ballast	kW	0.092
Load per LED fitting	kW	0.040
Load saving per fitting (twin vs single)	kW	0.052
Load saving lighting (estimate)	kW	12.449
Air-conditioning: COP (Coefficient of Performance)		12.00
Load saving AC (estimate) **	kW	1.037
Load saving total	kW	13.49
Lighting hours per day (estimate)	hours	8.0
Hours saved by switching off at recess, lunch and after school	hours	2.0
Lighting hours per day – Hours saved by switching off	hours	6.0
School days per year	days	200
Lighting hours per year	hours	1200
Electricity tariff	$	0.23
Electricity emission (e) factor	kg CO_2/kWh	1.19
Cost per fitting replaced installed	$	130
Savings per year	**kWh**	**16,183** *
	$	**3,722** *
GHG Pollution saved (scope 2 & 3)	**tonnes**	**19.3** *
Cost	**$**	**32,760**
Payback	**years**	**8.8**

** Savings are based on current lighting configuration.*
If energy saving recommendations are followed, savings will be accordingly less.

*** The lighting load reduction from this recommendation will result in a significant cooling load reduction in the building. Hence, additional savings in air conditioning load are included.*

Table 11:LED fittings.

Motion Sensor? Timed Control? for Toilets.

Motion sensoring intermittently used areas can have significant impact on lighting waste. Toilet lighting is typically left on all day and usually all night in most schools. It is easy to forget. At Killara Primary School we have estimated that the lighting in toilet areas is left on for 8 hours per day. Timed control button switches are a good option in that they are robust and limit light to the time set. Some classrooms and staffrooms are also high use areas that could benefit from motion sensoring.

Photograph 7: motion sensor.

Photograph 8: Time delay switch

4.1.6 External Security Lighting

If a school suffers vandalism the tendency is to have more security lighting installed in order to deter would-be vandals. This increases lighting load and has little effect in discouraging vandalism. In fact, we would argue that more lighting has the potential to increase the incidences of vandalism.

Either way, they do not need to be on all night. Security lighting can be controlled by timers, motion sensored and/or relamped with more energy efficient lighting types, reducing energy consumption and providing adequate light only when needed. LED alternatives use 80% less energy than traditional HD lamps such as Metal Halide, Mercury Vapour and High Pressure Sodium

Photograph 9 : Large security lights.

4.1.7 Replace security HD lamps with motion sensored LED.

Traditional HD security lighting is efficient in light delivery but not in energy consumption. Replace this light with a high output LED. This will reduce energy consumption from this lighting by 75% on normal operation. Savings are increased if when motion sensored.

Replace traditional security lighting with motion sensored LED			
400W	Total number of Metal Halide lights		4
	Load per lamp	kW	0.450
120W	Total number of motion sensored LED		4
	Load per lamp	kW	0.125
Existing configuration load		kW	1.800
New configuration load		kW	0.500
Prior to installation :			
	Security lighting hours per night (estimate)	hours	11.0
	Lighting hours per year	hours	4015
	Annual load of old configuration	kWh	7227
	Annual load of new configuration (11 hour operation)	kWh	2008
After installation of LED and sensors:			
*	Security lighting hours per night (estimate)	hours	1.0
	Lighting hours per year	hours	365.0
	Annual load of new configuration	kWh	182.50
Cost per replacement LED lamp		$	350.00
Cost per motion sensor installed		$	250
Number of motion sensors			4
Electricity tariff (average of peak and off-peak)		$	0.18
Electricity emission (e) factor		kg CO_2/kWh	1.19
Savings per year		**kWh**	**7,045**
		$	**1,268**
GHG Pollution saved (scope 2)		**tonnes**	**8.4**
Cost		**$**	**2,400**
Payback period		**years**	**1.9**
** This is a very conservative estimate; allowing every security light to be on for three hours per night after motion sensors have been installed. In reality, most lights should not come on at all.*			

Table 12: Replace security lighting.

4.2 Air-conditioning (Heating and Cooling)

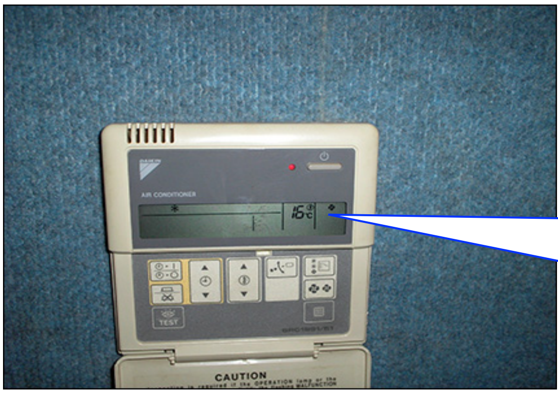
Air-conditioning is the major contributor to energy consumption within Victorian schools accounting for around 40% of consumption.

Planet Savers Australia strongly recommends that Killara Primary School undergo a thermal efficiency assessment conducted by Eco Master. www.ecomaster.com.au The effectiveness and efficiency of any heating and or cooling system can be dramatically improved by first improving the thermal performance of a building. Draft proofing, insulation and secondary glazing will have a dramatic impact on energy efficiency.

Photograph 10: Heating and cooling systems.

Myths and misunderstandings as to how temperature control systems operate are a large contributor to energy waste. An example of this is turning the temperature control up or down with the intent of heating or cooling the room faster. **<u>This is not how these units operate</u>**.

In the case of a heater or split system, the units heat or cool at a set rate. It makes no difference to the speed at which the room heats or cools by increasing or decreasing the temperature setting. You will only succeed in wasting energy and money as the unit will fight to get to temperature it will never reach.



Photograph 11 Example of wasting energy.

To succeed in your energy policy you will first need the to implement following key strategies.

- An agreed temperature set range from all staff. Discuss the policy at a staff meeting and have staff agree. This step is very important in gaining support and compliance (Cooling temp 24 to 26/ Heating 18 to 20 degree's)
- Clear signage on doorways and appliances showing temperature ranges and reminders to close doors and leave settings in place.
- Thermometers in classrooms, staff rooms and offices.

Photograph 12: Thermometers and signage in classrooms.

4.2.1 Install Timed control on Electric Heaters.

Electric panel heating is costly and inefficient. It generally takes time to heat a room so is left operating even when rooms are not occupied. Timed control will prevent systems being left on for protracted periods. Two options should be investigated.

- Timed control at the appliance (set 2 hour Duty Cycle)
- Timed control at the main circuit board. (Set 2 hour Duty Cycle)

Timed control at the appliance is the more costly as it involves a control device for each heating panel but also offers operational flexibility. Timed control at the circuit board is more cost effective as one unit could potential control a number of panel heaters on the same circuit. Care needs to be taken that the electric panel heaters are on their own circuit and not wired in series with other appliances before implementing this action.

Photograph 13: Timed control for panel heating.

4.2.2 Timed control for Split systems.

History and experience has shown us that many split systems are accidently left operating much longer than is needed or intended. This can be avoided by restricting the operation time. A one-button operation set to switch off 1 or 2 hours after being switched on, guarantees that no system can be left operating throughout the day or night or on weekends.

Photograph 14: Timed control.

Install timer delay switches on air-conditioners			
Install timer delay switches on split system air-conditioning units to reduce operating hours			
> 5 - 7.5 kW rating	Number of units		12
	Air conditioning load (estimated)	kW_R	6
	COP (estimated)*		2.6
	Average diversity (estimated) **	%	70
	Electrical input for refrigeration energy	kW	19.385
	Total time saved per year	hours	150.0
	Savings per year	kWh	2908
Cost per timer switch installed		$	280
Number of timer switches			12
Electricity tariff		$	0.23
Electricity emission (e) factor		kg CO_2/kWh	1.19
Total savings per year		**kWh**	**2,908**
		$	**669**
GHG Pollution saved (scope 2 & 3)		**tonnes**	**3.5**
Total Cost		**$**	**3,360**
Payback period		**years**	**5.0**
** COP: coefficient of performance = efficiency factor. Fan energy of PAC units is included in COP*			
*** Diversity estimates the percentage of maximum possible load the unit runs at, on average.*			

Table 13: Timed control for splits.

Alternatively many systems have timed control already built into the operating features but this is rarely used simply because of a lack of understanding of how to operate these features. The other barrier is even if these features are understood, many staff are not interested in reprogramming every time they use the system and simply revert to the on/off button.

Most Split systems have a ‘repeat’ feature built in. So once programmed for time and temperature the operator would simply push repeat cycle rather than on/off. This is worth investigating as it could provide major savings with little of no financial outlay. It would also require some re-education in correct usage behaviour for staff.

4.2.1 Close evaporative vents during winter.

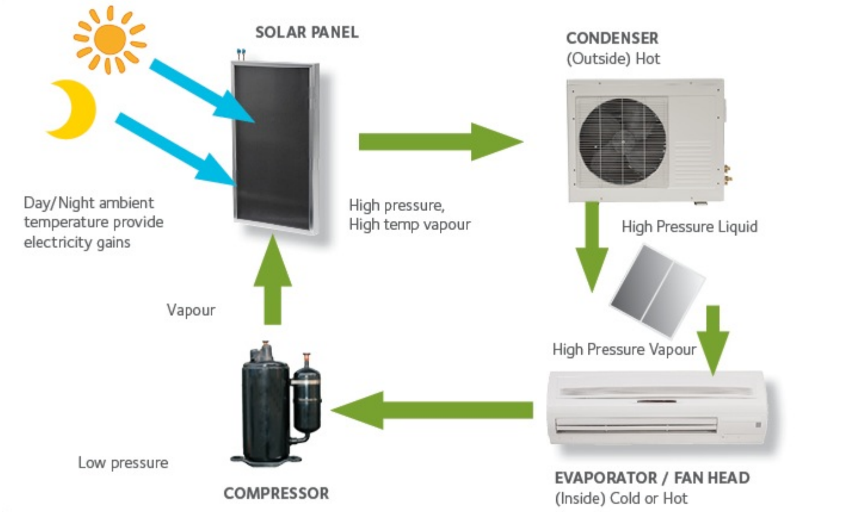
A very large volume of heat is escaping via the evaporative cooling vents during the winter period. The vents can be manually closed or fitted with magnetised plastic covers.

photograph 15: Evaporative units and ducting.

photograph 16: Winter covers for ducted vents

4.2.2 Solar air-conditioning.

In a solar thermal air conditioning system the sun is used as a heat source to reduce the energy needed to drive the cooling process, which in turn reduces the electrical energy required to run the compressor. Solar air-conditioning is potential 40 to 60% more energy efficient than equivalent Inverter systems and is approximately $1500 more than an inverter equivalent. They achieve maximum efficiency during the highest demand periods further reducing demand charges as well as usage costs.



4.2.3 Heat reflective paint for roof areas.

With the call for greater energy efficiency across all sectors of the market we are seeing the development of products that have the potential to provide significant energy savings by reducing internal demands for cooling. One such product is heat reflective paint.


Photograph 17: Heat reflective paint.

The technology relies on a two-part application with hollow ceramic beads embedded in the coatings providing greater reflectivity and resistances to absorbency . manufacturers claim a 40% reduction in air-conditioning running costs. We suspect that this would be the optimistic end of the savings spectrum and if achievable be in optimum conditions.

We suspect savings are achievable but would estimate potential savings at between 20% and maybe 30% of potential air-conditioning loads.
Roof area, existing insulation levels, single or multi storey and orientation all would have a bearing of the effectiveness of these products.
Lighter colours in the spectrum are naturally heat reflective. White as apposed to black for example. Application costs range start at $25 per sqmtr.

Additional benefits are the extended life of the existing roof material and reduced maintenance factor. Testimonials from customers are encouraging with significant savings achieved across a range of building types. Maroondah city council have been particular impressed with the savings that have been achieved.

4.2.4 Future decisions with heating and cooling systems.

Efficiencies are improving with the release of nearly every new model of heating or cooling appliance. In the case of split systems, efficiencies have generally hovered around 2.4 to 2.8 COP (Co-efficient of performance) The higher the COP the better performance and lower cost of operation.

Latest model Fujitsu Inverter reverse cycle systems have a COP of 4.2 consuming 830 watts of cooling and 1.2 KW of power for heating.

Mitsubishi have released their smaller 2.5 kW unit, which has a COP of 5.7. This equates to consumption of 350 watts for cooling and 450 watts for heating.

Consult this web site www.energyrating.gov.au before purchasing heating and cooling appliances. When consulting suppliers of air-conditioning systems, have them put forward their best energy performing systems.

In the case gas heaters and splits the temperature ranges can be internally SET and timed control features built in at the point of purchase. We recommend space heaters with a high-energy star rating and an inbuilt tamper proof timer, such as the Rinnai 556 and 1004 FDT models. These 'count down timers' allow the heater to run for a set period after the 'On' button is pressed, then stop automatically.

The timer must be specified at the time of order, and we recommend it be set to run for one to two hours. Additionally we recommend that the thermostat control be locked on no more than 20 degrees Celsius.

4.2.5 Building fabric, Solar Gain and Heat Loss

Solar gain can either reduce or increase energy consumption depending on the capabilities to control it. Heat loss leads to increased gas use.

Photograph 18: External blinds

External blinds are the best option for reducing heat gain. Preventing heat penetrating the glass is the best option. It is also by far the most expensive at $120 to $160 per square meter.

Internal blinds can also be effective as long as they are designed to reflect energy back out through the glazed areas while at the same time allowing in filtered light. Renshade is an aluminium based reflective material that is effective at both.

Photograph 19; School fitted with Renshade.

Brunswick South primary have invested in this product due to every increasing solar gain issues. pricing is estimated at $35 per square meter..

4.3 Appliances and Hot water

Schools use a wide range of appliance types, all with varying degrees of power consumption. Many appliances are left on in the event that they may be needed during the course of the working day. The problem we have witnessed in nearly every school we have visited is that these appliances are often left on or in standby mode 24/7, leading to increased emissions and costs. They are not shut down at the wall.

Many appliances carry 'Phantom' or 'Standby' loads. This means that the appliances are still drawing power even though they have been switched off. These standby loads are the proverbial 'dripping taps' of energy waste.

An eco Switch for hard to reach switches makes switch off more likely to occur. $20

Barriers to switching off at the wall are GPO (general purpose outlet) placement and general apathy for turning off appliances. An eco switch can make hard reach switches easy.

4.3.1 Timers for Water Boilers

Hot water boilers do not need to be operating out of normal working hours. Fit with 24-hour plug-in timers to reduce operational times.

A plug in timer, such as the one pictured below, will cost around $20 and save approximately $40 and nearly half a tonne of greenhouse gas emissions per annum for a typical staff room water boiler.

Photograph 20: Staff room water boiler

Sometimes staff remain at school and require tea or coffee after hours. Have an electric kettle placed on the bench to be used after the hot water boiler has shut down.

4.3.2 Timers for Hot Water Services and Water Coolers

These units consume large amounts of energy chilling or heating water. They do not need to be operating out of normal working hours. We recommend that 365-day hard-wired timers control them.

Photograph 21: 365-day hard-wired timer for hot water services.

Hot water services and water coolers: Install timers		
Number of hot water services		2
Heating element load	kW	3.600
* Diversity (average)	%	10
Load saving	kW	0.720
Switch-off hours per school week	hours	
School weeks per year	weeks	0
Total switch-off hours - school weeks	hours	0
Holiday days per year	weeks	165
Total switch-off hours - holidays	hours	3960
Total switch-off hours: holidays + school weeks	hours	3960
Electricity tariff	$	0.23
Electricity emission (e) factor	kg CO_2/kWh	1.19
Cost per timer	$	250
Number of timers required		2
Savings per year	**kWh**	**2,851**
	$	**656**
GHG Pollution saved (scope 2 & 3)	**tonnes**	**3.4**
Total Cost	**$**	**500**
Payback period	**years**	**0.8**
** Heating element and coolers cycle on and off as required.* *Diversity estimates the percentage of maximum possible load the unit runs at, on average.*		

Table 14: Timers for HWS.

4.3.3 Switch Off Refrigerators Over School Breaks

Many refrigerators remain running over school holidays. Some refrigeration is necessary in staff and canteen areas, but the remainder can be shut down. Doors of the refrigerators and freezers should be left open to prevent mould build up and odour. Include this in your student action programme at the end of each term.

Photograph: Switch off refrigerators during breaks.

4.3.4 Upgrade Refrigerators to More Efficient Types

Keep the best-rated refrigerators and gradually weed out inefficient models. Replace two existing refrigerators for one larger, more efficient type. Many of the refrigerators at Killara Primary School are rated 900 kWhrs per year, with capacities around 200 to 300 litres. Some of the bar fridges are rated 400 kWhrs per year for less than 100 + litres.

There are 5.5 stars, 360 litre refrigerators available that consume only 353 kWhrs per year. This is less than the bar fridges around the campus and treble the litre capacity.

New, efficient model:
320 kWs / year, 360 litre.
This large refrigerator uses less energy than many typical bar fridges with less than one

Photograph 22: Energy efficient refrigerator

Look at the energy rating website at http://www.energyrating.gov.au for the most efficient models on the market.

4.4 Information Technology

Computers are a fast growing energy consumer in schools. They consume vast amounts of energy, much of which can be eliminated. Energy waste in this sector is set to grow with the increasing popularity of interactive white boards and the current government policy of a computer for every secondary student. Most schools we visit do not have a coordinated IT shutdown policy.

There are three computer types common to all schools…

- PC and CRT (Cathode Ray Tube)
- PC and LCD (Liquid Crystal Display)
- Laptop

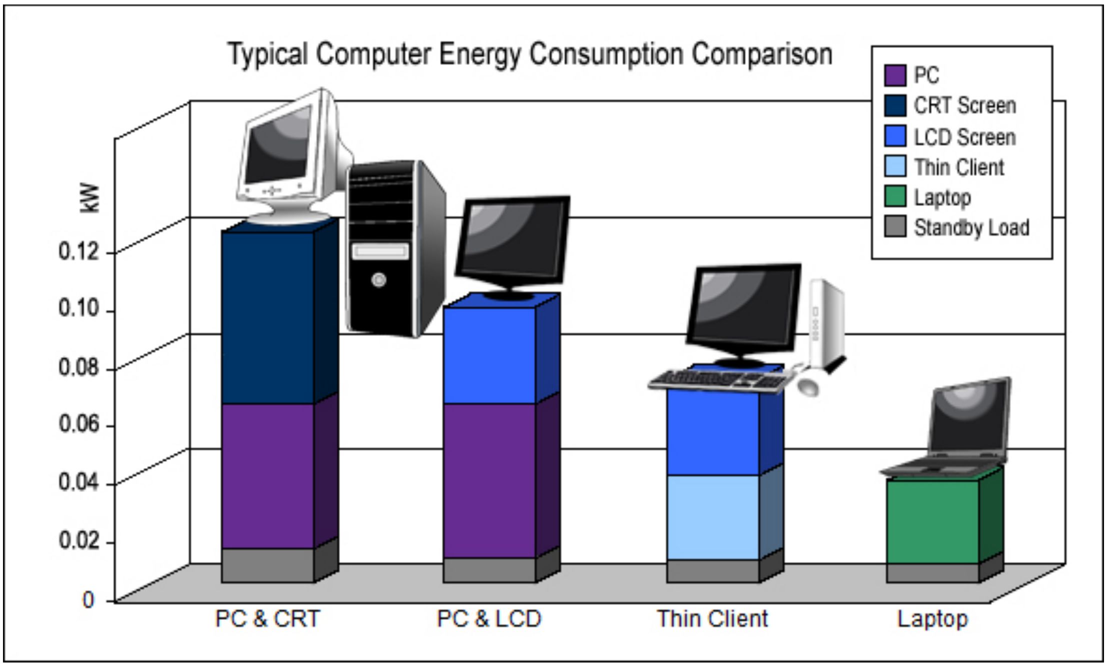


Figure 1: Typical computer energy consumption comparison

Photograph 23: Computers.

4.4.1 Computer Standby and Hibernation

A persistent myth is that screen savers save energy. This is *not* the case. They were designed to save pixels in earlier CRT screens.

Using the screen standby and hibernation functions in your computers can provide considerable reductions in emissions and save your school money.

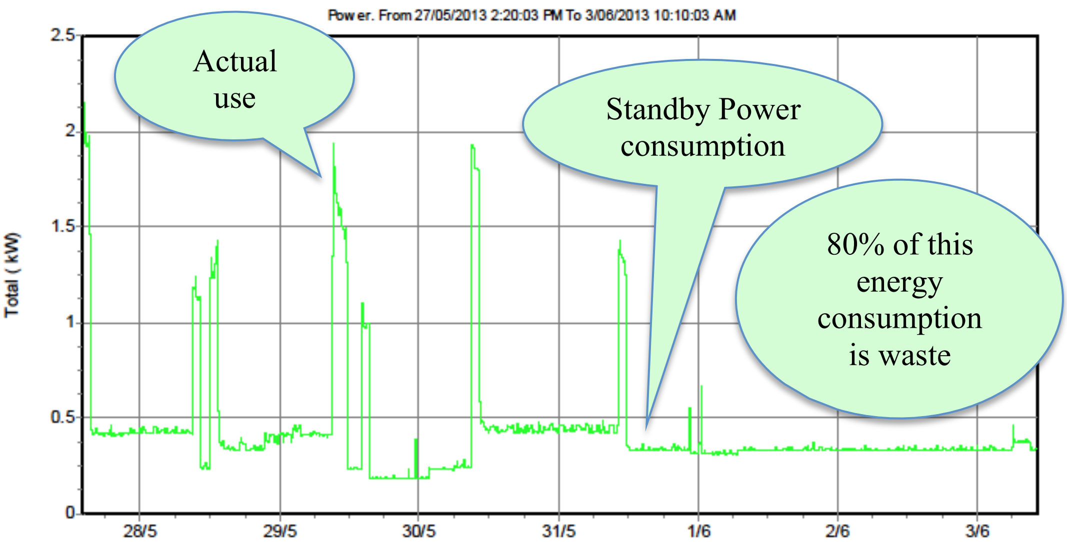
Using standby for your screen will cut energy consumption on a typical CRT by over 55%. For LCDs the reduction is about 40%. This function switches off your screen after a set period of inactivity. 20 minutes is typical but the time can be adjusted. You will find this function in:

Control Panel → Display Settings → Screen Saver → Power.

Using hibernation shuts down both the hard drive and the screen after a set period of inactivity. It runs reliably on XP and Vista and shuts down almost completely to within 5 to 10% of normal power use. The computer, when entering hibernation, will save any open files to the hard drive. To restart the computer, push the power button once and the computer will restart with the documents you had open previously. The hibernation function is common in laptops due the fact that laptops often run on battery power. Computers typically take less than a minute to restart. To achieve maximum energy saving combined with convenient operation we suggest the following settings…

- 5 minutes for blank screen.
- 10 minutes for standby.
- 20 minutes for hibernation.

4.4.2 Shut down at the wall or switchboard.



Graph 3: Computer energy use over 7 days.

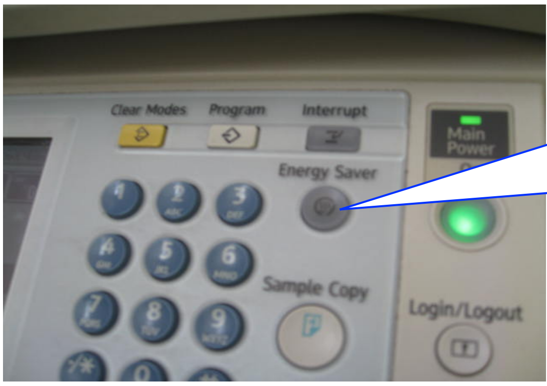
Recently Planet Savers conducted a measurement exercise in which we monitored the actual energy consumption and standby energy of a range of I.T hardware typically found in schools. These included computers, laptops, laptop chargers, Interactive whiteboards, Photocopiers and printers. The results were startling.

The above graph is a measurement taken for a typical computer lab, over seven days comprising 12 desktop computers. The spikes in energy consumption are the periods in which the computers are in use by students. The rest of the energy consumption is standby and ready state. Power down at the switch to avoid this waste and cost.

During holiday periods, shutdown the circuits at the switchboard controlling the GPO's for your computer labs.

4.4.3 Use Photocopier Power Save Mode.

Place signage above photocopiers reminding staff to use the power-save option after use. Power-save modes can reduce the typical running consumption by up to 95%



Use the power save button when your copying is complete.

Photograph 24: Use the power-save button on photocopiers.

4.4.4 Switch off Printers and Copiers at the Wall.

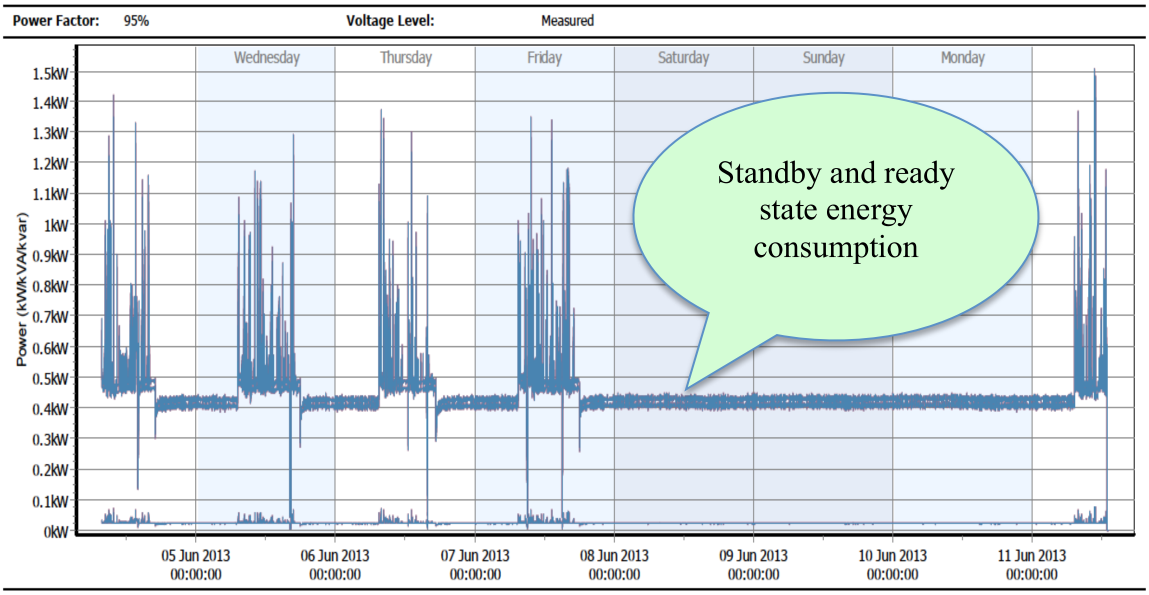
Switching off at the wall is the only way to guarantee against energy waste. Typical printer standby loads are 5 to 20 watts depending on the model.

If it is difficult for staff and students to switch off at the wall then it is far less likely to occur. If the switch is hard to reach, place the copier on a 7-day timer. This will add $20 for each copier or printer on a timer.

Photocopiers carry much larger phantom loads; sometimes over 150 watts. This is because most models have a heating element designed to keep paper in the inlet tray warm. The heating function does not need to operate throughout the night. Place the copier on plug timer and set the power to come at 6 am. This will allow paper to be warmed and reduce unnecessary energy consumption.

Over the course of a year, this one large printer left in ready mode will consume 271 kWh at a cost of $54 and generate 370 Kgs of emissions.

This is before a single print or copy is produced.



Photograph 25: Photocopier energy consumption over 7 days.

4.4.5 Switch Off Interactive whiteboards.

Interactive whiteboards are a valuable teaching aid, providing a range of visual teaching options. They also consume large amounts of energy. The projector

consumes between 360 and 500 watts, depending on the model. Speakers and laptop add another 60 watts between them. On top of this, most projectors are wired into a switch either mounted on or in the roof, making it difficult or impossible to switch it off completely.

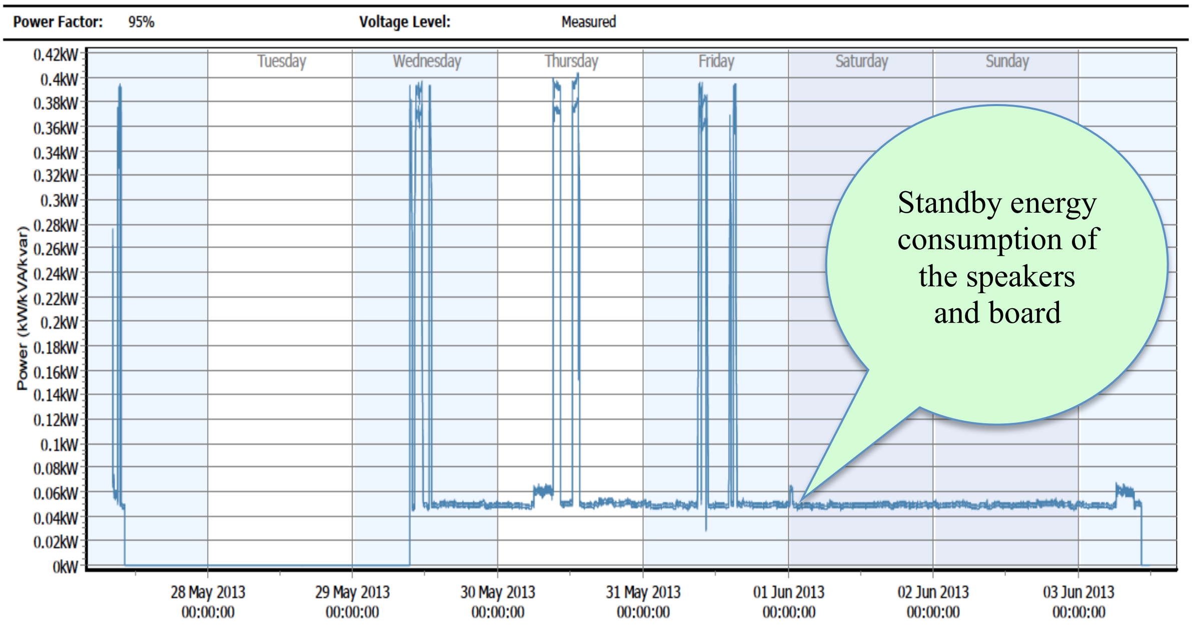


Table 15: Switch off INT WB.

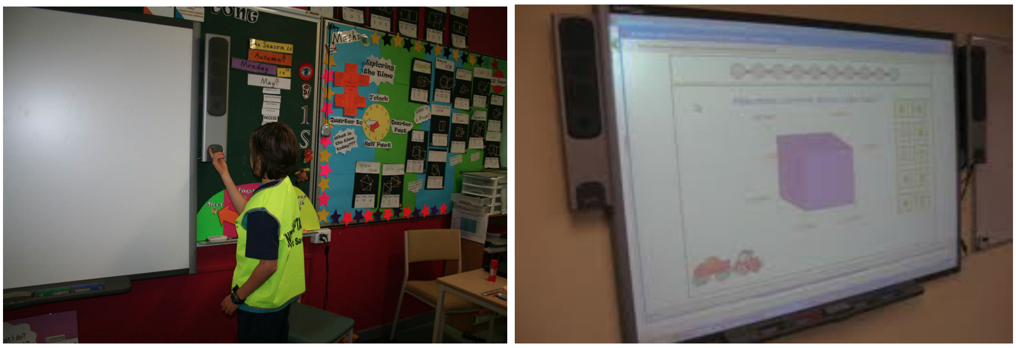


Table 16: Switch off INT WB.

Power-down whiteboards after use. Do not leave them running throughout the day. Killara Primary School has 12 electronic whiteboards and their power consumption is considerable.

A great action for the Planet Saver teams!

Switch off interactive whiteboards		
Number of interactive whiteboards		12
Load per interactive whiteboard	kW	0.500
Total Load	kW	6
Hours saved per day (estimate)	hours	1
School days per year	days	200
Hours saved per year	hours	200
Electricity tariff	$	0.23
Electricity emission (e) factor	kg CO_2/kWh	1.19
Savings per year	**kWh**	**1,200** *
	$	**276** *
GHG Pollution saved (scope 2 & 3)	**tonnes**	**1.4** *
Cost	**$**	**0**
Payback	**years**	**immediate**

Table 17: Switch off INT WB.

5 What does Your Solar Generate.

Solar System Power Generation.		
Kw generation	**21 cents (yearly $)**	**Co2-e (tonnes)**
1 Kw 1,533	323	2
2 Kw 3,066	646	4
3 Kw 4,599	969	6
4 Kw 6,132	1,292	8
5 Kw 7,665	1,615	10
6 Kw 9,198	1,938	12
7 Kw 10,731	2,261	14
8 Kw 12,264	2,584	16
9 Kw 13.797	2,907	18
10 Kw 15,330	3,230	20
11 Kw 16,863	3,553	22
12 Kw 18,396	3,876	24
13 Kw 19,929	4,199	26
14 Kw 21,462	4,522	28

Table 18: Solar Generation.

When asked to advise schools on the best use of the funds, we always promote energy efficiency first, solar system second.

6 Implementation Strategies

There are three essential elements necessary to complete a successful energy management strategy:

1. Sustained behavioural change, education and awareness.
2. Identification of opportunities and implementation of technological change.
3. Tracking and measurement of the results against stated targets.

Elements 2 and 3 have been put in place with the re-establishment of your SETS account and the completion of this report. Your baseline data and peer measurables are available via your SETS account: www.schoolenergysavings.com.au

This information is vital in setting realistic and achievable greenhouse gas pollution reduction targets and is also a valuable education and curriculum tool. It will allow you to become aware of your true impact on the environment from energy consumption.

Element 1 is commenced with the presentation to staff and/or students, showing the opportunities for change, the need for urgent action and how the whole school community can participate in the solutions to global warming.

6.1 Target One Area at a Time

Our experience in achieving sustained results has demonstrated that an ordered rollout programme of initiatives and actions is both effective and easily measurable.

Human beings typically take between 6 to 8 weeks to form habits; good or bad. Roll out each action that requires staff and student participation on a 6-week timeline. Once you are confident that sustained behaviour change is taking hold, move on to the next initiative.

6.2 Celebrate Your Success

Create a section in the school newsletter and website showing your strategy and goals for emissions reduction.

Schools are centres for change within communities and, as such, have an excellent opportunity to lead those communities. Promote and share your successes with your peers. Set a reduction target with your own framework and timetable.

6.3 Empower the Student Body

When we, as adults, were students, we were not allowed to touch anything electrical. If we did, we were reprimanded and/or punished. This resulted in two outcomes: Firstly, we were absolved of any responsibility for energy waste. Secondly, we were disempowered. The result is that we will walk past a room with everything left on and ignore it because it is not our responsibility nor do we associate any consequence with that waste.

We need to change that culture to one of understanding energy waste and its consequences. Empowering the student body to turn off items after use will foster good switch-off habits, reduce greenhouse gas pollution and save the school money. Students and staff should ask themselves, “Do I need to turn it on in the first place?”

6.4 Implement an Energy Wise Purchasing Policy

All decisions have some form of impact on the environment. Choose appliances that consume less energy for the same resulting benefit. These appliances produce less greenhouse gas pollution and cost less to run over their lifetime. Making decisions based on purchase cost alone is short-sighted.

The following sites are excellent for comparison of products, price and their energy use:

www.energystar.gov.au

www.epeat.net

www.energyrating.gov.au

6.5 Form an Environment Committee.

Participation is vital to the success of this programme. It should not be left up to one individual to run and manage everything. This can often lead to burnout or a feeling that individual efforts are not appreciated.

Climate change action requires a whole of school community response and involvement.

6.6 Embed Activities in the Curriculum

The curriculum should include major and minor units of work on energy and global warming dispersed through all levels and domains. This could include students operating SETS in IT, mathematics and other learning areas.

6.7 Embed Activities With the Business Manager

The use of SETS provides an easy resource accounting tool for the school and enables accurate tracking and cost savings.

SETS is accessible at http://schoolenergysavings.com.au

6.8 Create a Sustainability Fund

Savings that are achieved from your energy strategy should not go back into the global budget. Put these savings into a separate account and use them to implement a greater level of action that, in turn, further reduces your school's impact without requiring a budget increase.

We call this "Sustainable Loop Funds".

Use what was previously your energy waste to fund your reduction in greenhouse gas emissions.

Conduct a competition amongst year levels as well as allocating a share of the financial savings to projects of environmental or social benefit. Have students decide on the best possible outcome for these savings. This will encourage student participation if there is a vested interest in the resulting savings.

6.9 APPENDIX D: Websites and Links

www.planetsavers.com.au

www.energystar.gov.au

www.epeat.net

www.energyrating.gov.au

www.schoolenergysavings.com.au

www.greenpower.com.au

6.10 APPENDIX E: References

- *Australian Government, Department of Climate Change: National Greenhouse Accounts (NGA) Factors; November 2010; Updating and Replacing the AGO Factors and Methods Workbook.*
- *Ceres Sustainability Centre. www.ceres.org.au*
- *Thermoshield Australia Pty Ltd. www.thermoshield.com.au*
- *Hewlett Packard Development Company. HP Servers; Innovation based on standards. www.hp.com*
- *Thorn Lighting Pty Ltd. www.thornlighting.com.au*
- *. Ultralite*
- *Carbonetix Pty Ltd. www.carbonetix.com.au*

7 Limits of Liability

This is a summary of potential energy efficiency measures for Killara Primary School

We, at Planet Savers Pty. Ltd., have used our best efforts in preparing this summary. We, the authors, make no warranties or representations with respect to the accuracy, fitness, applicability, or completeness of the contents of this report. We disclaim any warranties (implied or expressed), merchantability or fitness for any particular purpose. The authors shall in no event be held liable for any loss or other damages, including, but not limited to, incidental, special, consequential or other damages.