May 2018

Energy Audit and Solar Review

for the Shire of Bridgetown-Greenbushes

H2 Energy Solutions

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1 Executive Summary

H2 Energy Solutions (*H2ES*) were engaged by the Shire of Bridgetown-Greenbushes (*the Shire*) to conduct an energy audit,

tariff review and investigate the benefits of solar systems on the following Shire owned buildings:

1) Admin/Civic Centre block
2) Library
3) Pool
4) Leisure/Recreation Centre
5) Visitors Centre
6) Fire Control - Emergency Centre
7) Depot & Sportsgrounds

1.1 Recommendations

The review found several opportunities to reduce cost and greenhouse emissions through a combination of tariff change, obtaining competitive quotes from other retailers for contestable sites, solar PV installation, energy efficiency retrofits and energy conservation.

1.1.1 Tariff Review

The audit modelled the tariff charges using the past twelve months of Western Power interval meter data (where available) or by assuming a typical load profile based upon the energy audit. The table below shows the results on site by site basis and indicates approximately $9,033 ex GST of annual savings are available by changing to the proposed tariff.

Table 1 Tariff Review Summary

	Current Tariff	Current Tariff Charges (ex GST)	Proposed Tariff	New Tariff Charges (ex GST)	Annual Saving (ex GST)
Leisure Centre	L3	$31,402	STAY	$31,402	
Pool	L1	$50,909	R3	$44,677	$6,232
Library	L1	$15,235	R1	$13,146	$2,089
Visitor Centre	K1	$6,724	STAY	$6,724	
Admin-Civic Centre	L3	$16,325	STAY	$16,325	
Depot & Sports Club	L1	$8,504	R1	$8,092	$412
Fire Control Centre	L1	*$4,606*	R1	$4,306	$300
Totals		***$133,705***		***$124,672***	***$9,033***

1.1.2 Site Contestability

The audit noted that the following four sites are contestable (or eligible to be deemed contestable) and therefore may churn to an alternative electricity retailer:

- Leisure Centre,
- Pool
- Admin-Civic centre
- Operations Depot and Sports Ground.

H2 can obtain competitive quotations for energy tariffs if required by the Shire.

1.1.3 Solar PV Benefits

H2 determined the suitability of solar PV system for each site. The review includes assessment of typical weekday and weekend load which may utilise solar generation, a review of available roof space to install solar panels and calculation of the optimal sizing to obtain shortest payback or

greatest savings. The following table summarises the findings. The orange and red shading indicate supplier proposals which exceed the maximum recommended size.

Table 2 Summary of

	[redacted]	Recommended Max. Size (kW)	Estimated Saving ($ ex GST)	Proposed Tariff with Solar	Notes
Leisure Centre		30	14,090	L3	
Pool		27	10,659	R3	Note 1,3
Library		10*	3,593	R1	
Visitor Centre		10	4,183	K1	
Admin-Civic Centre		21	8,902	L3	
Depot & Sportsclub		15	5,233	R1	Note 2
Fire Control Centre		6.5	2,329	R1	Note 2
		109.5	**48,989**		

* Note the Library has an existing 10kW system, this is the maximum additional size recommended.
Note 1: Saving after switching from L3 to R3 tariff
Note 2: Saving after switching from L1 to R1 tariff
Note 3: There is limited roof capacity to install solar PV for the pool, we estimate up to 27kW, refer section 4.4.2)

Note: In order to maximise annual output (yield), solar panels should ideally be oriented North, mounted with a tilt angle corresponding to the latitude of the building (33.5 degrees) and free of shade across any part of the panels from roof structures (antennae, vents), trees or buildings. Some variation of orientation or tilt (up to 15 degrees) will have a small effect on yield, however, greater variation (e.g. West facing or flat mounting) will significantly reduce yield. For example, if the panels are flat mounted they are likely to produce approximately 13% less energy per annum and reduce savings.

1.1.4 Energy Efficient Lighting Upgrades

The table below summarises LED lighting upgrade opportunities and estimated costs and benefits.

Table 3 Summary of Lighting Upgrade Measures

Site	Measure	Saving $ p.a. (ex GST)	Qty	Replacement Product cost (ex GST)	Install cost (ex GST)	Unit Cost (ex GST)	Total Cost (ex GST)	Simple Payback (years)
Admin Centre	LED replacement of T8 tubes in troffer (Opt 2)	$450	102	$8.55	$10.00	$18.55	$1,892	4.2
	LED replacement of batten mount T8 fluoro	$156	30	$8.55	$10.00	$18.55	$557	3.6
Operations Depot	LED replacement of Hi bay lighting	$95	2	$200.00	$150.00	$350.00	$700	7.4
	LED replacement of batten mount T8 fluoro	$238	43	$8.55	$10.00	$18.55	$798	3.3
Fire Control Centre	LED replacement of batten mount T8 fluoro	$217	16	$8.55	$10.00	$18.55	$297	1.4
Library	LED replacement of CFL	$1,733	209	$15.00	$15.00	$30.00	$6,270	3.6
Leisure Centre	LED replacement of batten mount T8 fluoro	$1,816	108	$8.55	$10.00	$18.55	$2,003	1.1
	LED replacement of CFL	$675	55	$15.00	$15.00	$30.00	$1,650	2.4
Visitor Centre	LED replacement of batten mount T8 fluoro	$420	38	$8.55	$10.00	$18.55	$705	1.7

	LED replacement of CFL	$16	4	$15.00	$15.00	$30.00	$120	7.5
	Summary of Measures	**$5,814**	**607**				**$14,991**	**2.6**

Note: The lighting audit did not involve removing diffusers to confirm lamp or ballast type and therefore the installer will need to verify lamp/tube and ballast types prior to ordering and replacing lamps. Prices and costs are indicative based upon installation by Shire staff or contractors and do not include any allowance for travel, freight or parts mark-up.

1.1.5 Other Measures

Other energy efficiency measures for consideration include:

a) Upgrade of filtration pool pumps at end of life with IE3 or IE4 energy efficient models (section 4.6.3.1)

b) Installation of Variable Speed Drive (VSD) onto pool filtration or flow pumps where a reduction in flow rate is feasible (section 4.6.3.2)

c) Upgrade of the hot water system at the operations depot with an energy efficient heat pump model (section 8.5.3.3)

d) Installation of energy monitoring at the operations depot and other sites without interval metering to improve energy management (section 8.5.5)

e) It was noted during the audit of the Admin-Civic centre there were several emergency exit signs where lamps were not illuminated. It is recommended to check and replace the lamps (section 2.6.5)

Disclaimer

This report has been prepared using information provided by the Shire and therefore may contain information deemed commercial-in-confidence by the Shire.

Any recipient of this document should not disclose this report, its subsidiary documents or information contained within these documents to other parties unless expressly permitted by an authorized representative of the Shire.

H2 Energy Solutions base this report upon information obtained through observation, measurement and interview of staff on-site. Information has also been obtained from documentation, schematics, and a summary of quotations of solar PV estimates provided by the Shire. Estimates of savings are based upon information gathered and engineering judgment using assumptions where data is not available. Whilst all due care has been provided in the preparation of this information, H2 Energy Solutions nor its employees or subcontractors accept liability for any errors or omissions made in this report.

Table of Contents

2 Administration & Civic Centre

2.1 Overview of Site

The administration centre is on the corner of South Western Hwy and Steere Street occupying three levels of office space in a brick and tin roof building which also includes the town hall. Adjacent to the town hall a newer building contains the Lesser Hall, kitchen and public amenities.

2.2 Electricity Supply & Tariff

The site is supplied from a three phase Low Voltage (LV) electricity supply which is interval metered in a locked room at the rear of the annex walkway.

- NMI 80010029270
- Meter 0348003002
- Tariff: Business Plan Fifty (L3)
- Rate: $0.321/kWh
- Supply: $0.4886/day

The electricity supply meets the threshold for contestability (50,000 kWh p.a.) as its metered consumption for the 12 months from April 17 to March 18 was 50,357kWh. This means the Shire is eligible to select an alternative electricity retailer for this site.

The table below shows the expected cost for each of the eligible Synergy energy tariffs based upon the past 12 months of metering data. The most cost effective eligible tariff is the L3 tariff which it is currently on. The Solar Assisted columns denote the estimated tariff and savings that could be obtained with a 21kW three phase solar PV system installed. The table shows the Civic Centre is on the most cost effective tariff and should remain on this when the solar PV is installed.

Table 4 Synergy Tariff comparison Admin-Civic Centre present and with 21kW solar PV

	L3	R3
Without Solar	$16,325	$17,939
With Solar	$7,423	$8,956
Savings	**8,902**	**8,982**

2.3 Electrical Energy Profile

2.3.1 Daily Profile

Figure 1 below shows the annual average week day and week end energy consumption of the site based upon interval metering data from the twelve months March 18 obtained from Western Power. The dark grey shaded area shows the on-peak tariff period during weekdays.

The graph shows there is approximately 2kW of constantly on ("baseload") overnight which is attributed mainly to ancillary lighting, refrigeration, security monitoring and office equipment on standby. The weekend profile shows low daily energy consumption indicating only occasional use of the office and public facilities.

The majority of energy use is during peak tariff periods (grey shaded area).

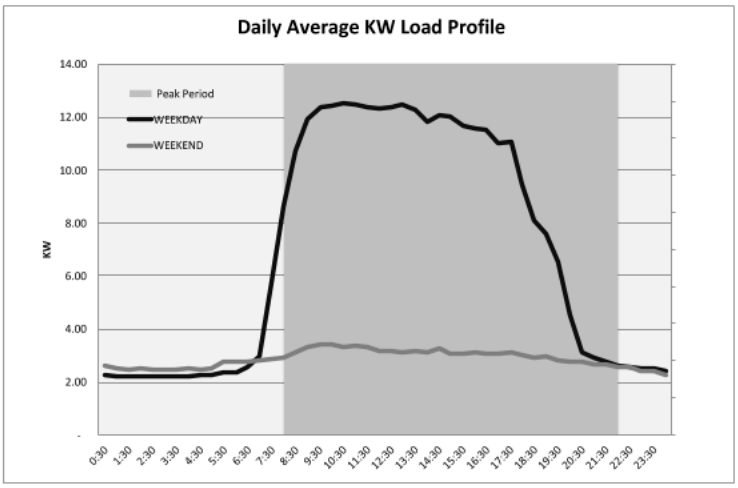
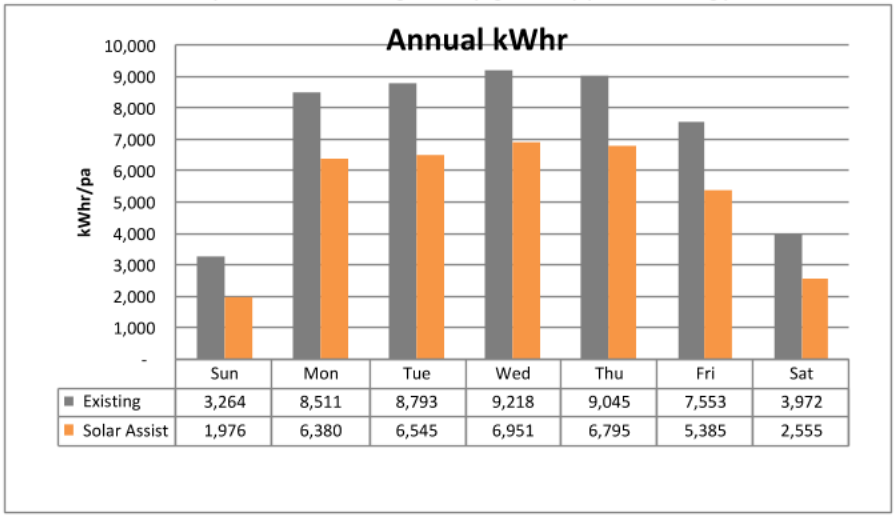


Figure 1 Daily Average Energy profile from Western Power Meter data

2.3.2 Weekly Profile

The figure below shows there is only slight variation in midweek energy use. The orange bars show the effect of a 10kW solar PV system on average daily grid supplied energy.



	Sun	Mon	Tue	Wed	Thu	Fri	Sat
Existing	3,264	8,511	8,793	9,218	9,045	7,553	3,972
Solar Assist	1,976	6,380	6,545	6,951	6,795	5,385	2,555

Figure 2 Annual Average energy use by day of week

2.3.3 Seasonal Profile

The figure below indicates the main variation in seasonal energy use are likely attributed to heating during Winter mornings and cooling during Summer afternoons using the reverse cycle air conditioning.

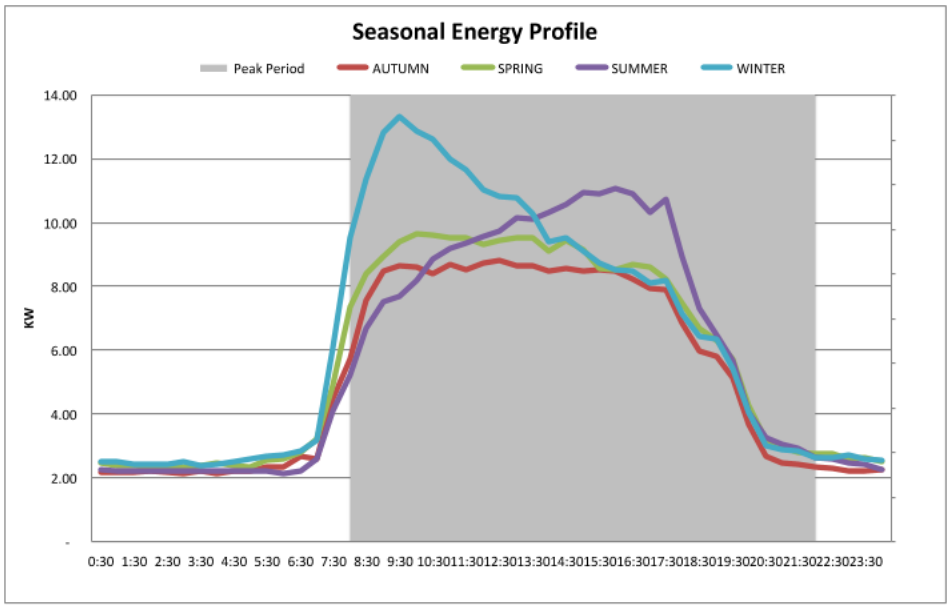


Figure 3 Seasonal Weekday Average Energy Profile (Admin Centre)

2.4 Solar Recommendation

2.4.1 Recommended System Size

The load profile is well suited to a solar PV system which will reduce grid supplied energy at peak tariff rates (currently $0.321/kWh ex GST).

We recommend up to a 21kW three phase solar PV system as providing the optimal payback and maximum savings. Alternatively, higher annual savings can be achieved with a larger system but we would not recommend this unless there is planned expansion or increase in load, as return on investment declines.

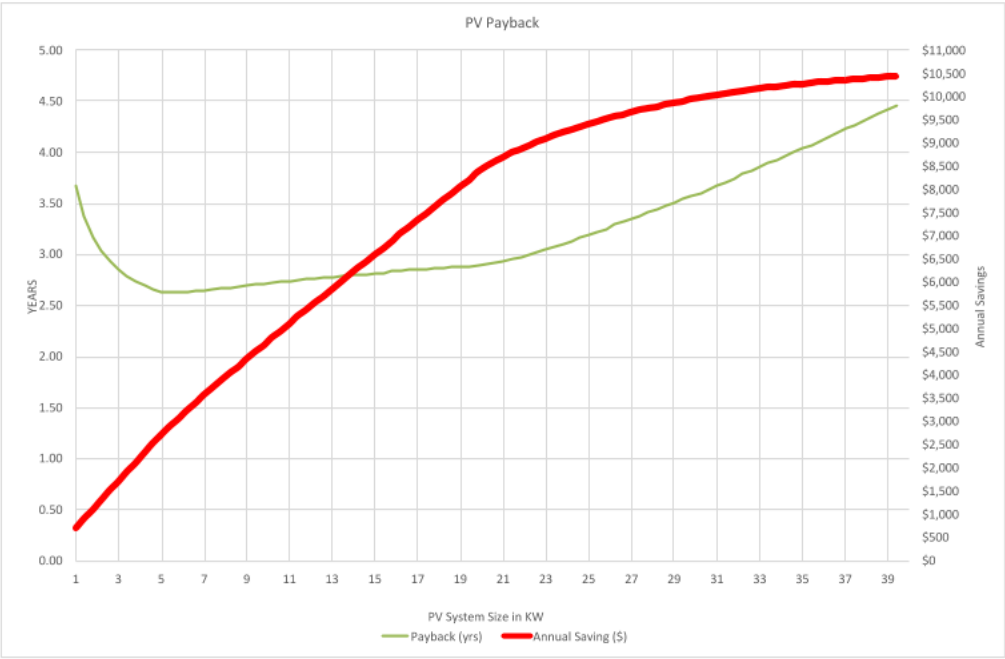


Figure 4 Admin Centre Solar PV payback and savings

2.4.2 Effect on Grid Import

The figures below shows the effect of a 13.25kW solar system (as proposed by SolarGain) on average weekday and weekend grid import. Note that the solar PV output varies significantly by season and will result in a net export of energy to the grid during periods of peak solar output and low load (most weekend days). We estimate for a system of this size 87% of energy would be used on-site with the balance being exported during periods of low load. The system will not be eligible for Renewable Energy Buyback Scheme (REBS) credit from Synergy for exported energy (however some other retailers may purchase excess).

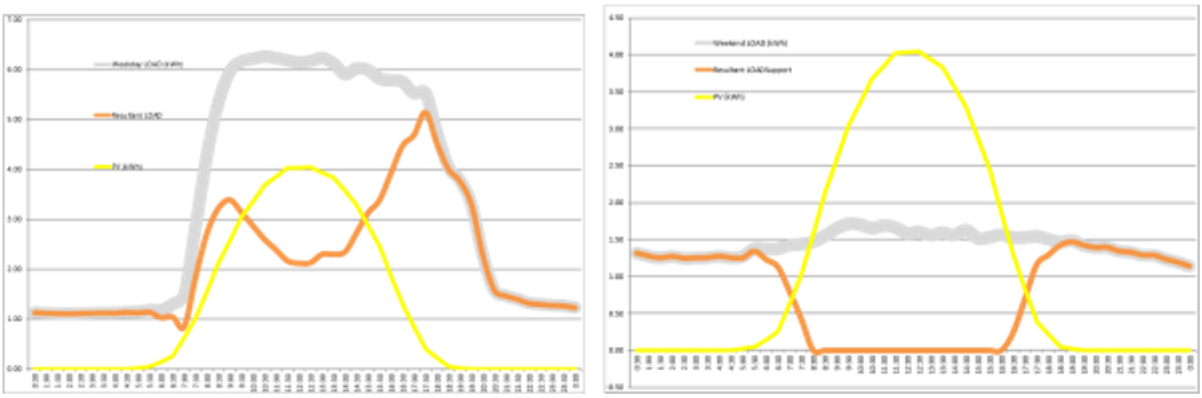


Figure 5 Annual Average Weekday and Weekend Load profile with 13.25kW Solar

2.4.3 Available Roof Space

We estimate approximately 22kW can be installed on the North and East-West facing roof sections of the main Civic Centre building. An additional system could be installed on the roof of the Lesser Hall building in future if required. The below photo shows the recommended installation areas. Note the solar installer should perform a rooftop shade analysis to ensure panels wont be shaded by roof structures (air conditioners, antennae, vents etc.) or surrounding trees or buildings.

Systems over 30kW are required to pay an application fee of $5,000 to Western Power (systems below 30kW do not attract this fee) and may be required by Western Power to fit reverse current limiters (at additional cost). It is not clear if these costs have been factored into supplier's pricing.

Figure 6 Admin Centre Solar PV Roof Space

2.4.4 Comparison of Proposals

We note that two solar PV suppliers offered systems as large as 39kW. The graph below shows the average solar yield for a 39kW system will vastly exceed the average weekday load with 48% of energy produced exported to the grid. As noted earlier, we recommend a system up to approximately 21kW in size.

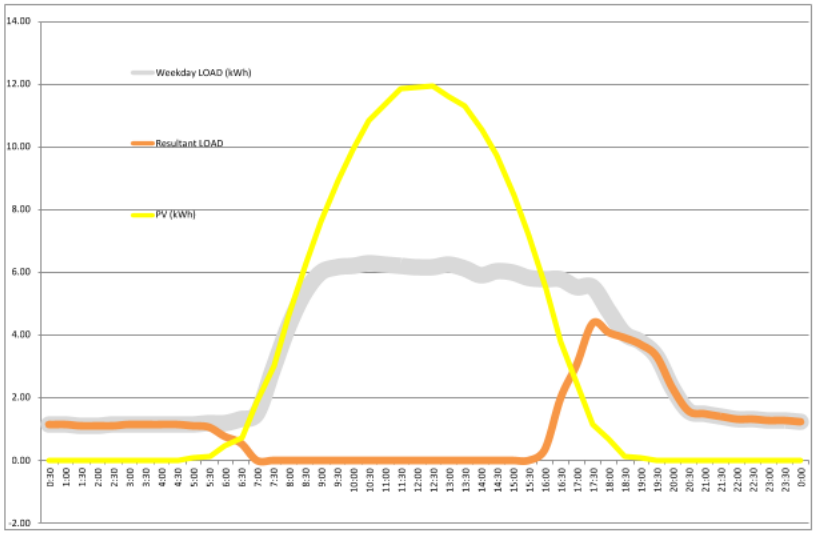


Figure 7 Annual Average Weekday Load profile with 39kW Solar

The table below compares the estimated cost, benefit and simple payback of the various sized systems with the following assumptions[1]:

a) The Quoted Gross Price from each supplier for the specified system size and
b) Calculating the number of STCs available (if installed by Dec 2018) and

[1] Note that suppliers estimates of STC rebates differ to those shown in the table below. Earlier system installation or higher STC price may have been assumed.

c) Assuming the value of the rebate at $35 per STC and
d) Using the estimated savings calculated by H2 energy solutions.

Table 5 Comparison of Solar PV Options Civic Centre

[redacted]

2.5 Equipment Audit

The equipment audit uses measurement of equipment power or appliance rating data combined with estimated weekday and weekend hours of operation to determine average weekday and weekend energy use of equipment.

2.5.1 Energy Use by Equipment Type

The audit assumed normal office hours of 8.30am to 5pm Monday to Friday and allowed for an average of 2 hours of operation on weekend days. The audit data and rating information is contained in Annexure 1 to this report.

The purpose of the audit is to estimate the energy use attributed to different items and categories of equipment. This can be used to inform estimate of savings from energy conservation or efficiency retrofit (e.g. lighting or equipment upgrade).

The estimated contribution to the daily energy use of each equipment type are shown in the figures below.

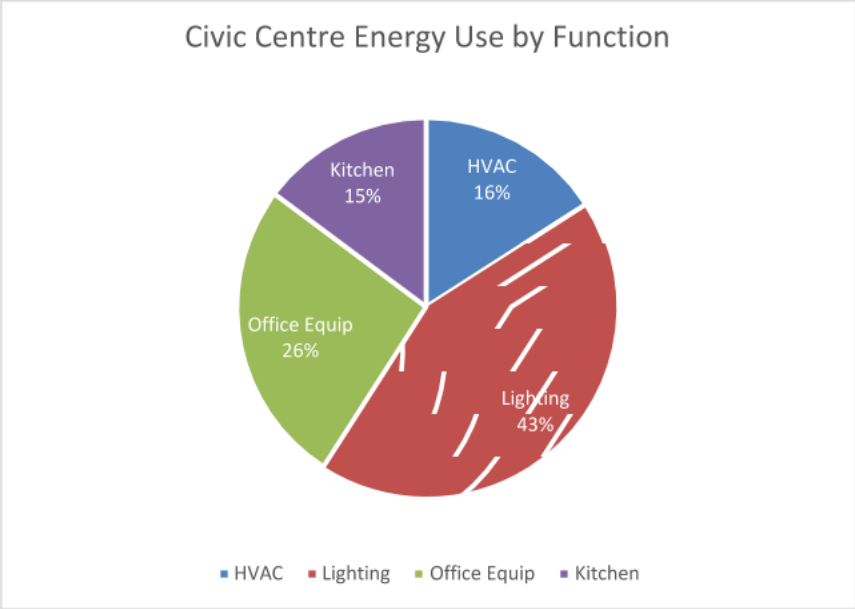


Figure 8 Energy use by equipment type

2.5.2 Energy Use by Time of Day

The figure below represents the contribution to daily demand by equipment type.

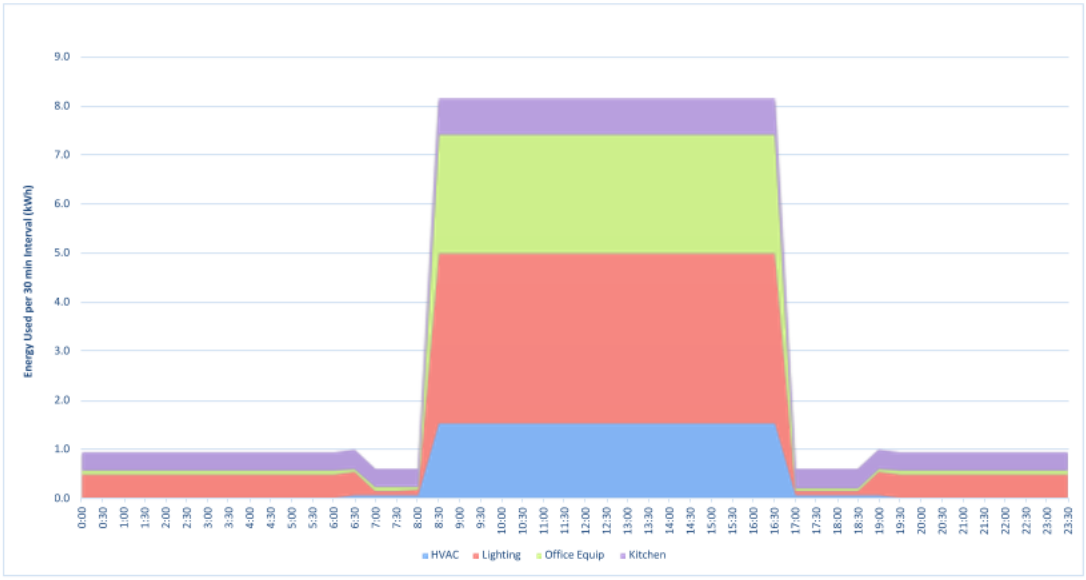


Figure 9 Average work day profile

2.5.3 Energy Use by Area

The following table shows the areas of the Admin complex where energy is used.

Table 6 Admin Centre and Annex Energy use by Area

Row Labels	Sum of Total WD kWhr/Day	Sum of Total WE kWhr/Day	Sum of Weekday On Peak kWhr	Sum of Weekday Off Peak kWhr	WD %	WE %
Ground	77.5	30.1	69.9	7.6		
Foyer	16.9	5.4	16.1	0.8	11.41%	8.73%
Corporate Services Open area	5.4	1.8	5.1	0.3	3.66%	2.93%
Disabled Toilets	0.3	0.1	0.3	0.0	0.21%	0.12%
Exec Manager Works Services	2.3	0.5	2.3	0.0	1.56%	0.87%
Exec Manager-Corp Services	4.4	1.0	4.4	0.0	2.94%	1.64%
Female Toilets	0.6	0.1	0.6	0.0	0.37%	0.21%
Finance Officer	1.1	0.3	1.1	0.0	0.74%	0.41%
Foyer-Entrance	1.4	0.3	1.4	0.0	0.97%	0.54%
General Ops	2.2	0.5	2.2	0.0	1.47%	0.82%
IT Manager	1.7	0.4	1.7	0.0	1.15%	0.64%
Male Toilets	0.7	0.2	0.7	0.0	0.49%	0.28%
Meeting 1	1.2	0.3	1.2	0.0	0.83%	0.46%
Records Files	0.9	0.2	0.9	0.0	0.62%	0.35%
Reception	5.5	1.3	5.5	0.0	3.75%	2.09%
Records Officer	3.3	0.8	3.3	0.0	2.25%	1.26%
Safe-Records	0.0	0.0	0.0	0.0	0.01%	0.01%
SE Tech Officer	6.7	2.2	6.7	0.0	4.53%	3.59%
Senior Finance Officer	1.7	0.4	1.7	0.0	1.15%	0.64%
Southern Corridoor	0.9	0.2	0.9	0.0	0.57%	0.32%
Staff Kitchen	8.8	7.5	6.0	2.8	5.92%	11.97%
Staff Lunchroom	2.5	0.6	2.5	0.0	1.72%	0.96%
Works and Services	1.8	0.4	1.8	0.0	1.23%	0.69%
Works and Services admin	2.1	0.5	2.1	0.0	1.42%	0.80%
External Walls	5.0	5.0	1.3	3.8	3.39%	8.04%
Level 1	53.7	15.4	50.5	3.3		
Foyer	1.1	0.3	1.1	0.0	0.76%	0.43%
Staff Kitchen	3.2	1.5	2.7	0.4	2.13%	2.46%
Council Chamber	3.9	2.4	2.9	1.1	2.66%	3.91%
Committee Room	2.0	1.2	1.6	0.4	1.34%	1.90%
Staff Toilets	1.6	0.4	1.6	0.0	1.11%	0.62%
Store Sth	0.0	0.0	0.0	0.0	0.01%	0.01%
IT room	2.5	2.4	1.5	1.0	1.66%	3.88%
Office-Rangers	2.4	0.6	2.4	0.0	1.61%	0.90%
Office-Exec Community Services	2.1	0.5	2.1	0.0	1.42%	0.80%
OfficeBuilding Surveyor	3.8	0.9	3.8	0.0	2.57%	1.44%
CEO	6.1	1.4	6.1	0.0	4.10%	2.29%
Printer Room	1.7	0.4	1.7	0.0	1.17%	0.65%
Office: HR	2.1	0.5	2.1	0.0	1.42%	0.80%
Store Nth	0.1	0.0	0.1	0.0	0.08%	0.05%
Office: Planning	2.1	0.5	2.1	0.0	1.42%	0.80%
Office: Exec Assist	1.7	0.4	1.7	0.0	1.16%	0.65%
Office: Environ/Heath	3.0	1.6	2.5	0.5	2.01%	2.58%
Level 1 Office	14.3	0.4	14.3	0.0	9.65%	0.58%
Ground-Annex	12.3	12.3	9.0	3.3		
Kitchen	9.5	9.5	6.4	3.1	6.44%	15.29%
Corridor-Old/New Building	1.3	1.3	1.3	0.0	0.85%	2.01%
New Hall	0.8	0.8	0.6	0.2	0.52%	1.24%
Hallway	0.0	0.0	0.0	0.0	0.03%	0.07%
Ladies	0.1	0.1	0.1	0.0	0.06%	0.14%
Gents	0.1	0.1	0.1	0.0	0.04%	0.11%
Cleaner	0.0	0.0	0.0	0.0	0.01%	0.02%
Unisex	0.6	0.6	0.6	0.0	0.39%	0.93%
External	4.4	4.4	1.1	3.3		
Car Park	2.4	2.4	0.6	1.8	1.62%	3.85%
Gents	0.2	0.2	0.1	0.2	0.15%	0.35%
Lawn	1.8	1.8	0.5	1.4	1.22%	2.89%
Grand Total	**148.0**	**62.3**	**130.5**	**17.5**	**100%**	**100%**

2.6 Summary and Recommendations

2.6.1 Tariffs

The Admin centre is presently on the anytime energy (L3) tariff and this is the most cost effective tariff.

2.6.2 Solar PV

The energy consumption and available roof space of the Admin office justifies the installation of approximately 21kW of solar PV system. There will be the option in future to install an additional system on the annex building if required. Based upon comparable quotes the Shire received we expect the cost of a system after STC rebates to be approximately $25K (ex GST) with annual savings of $8.6K (ex GST) and simply payback of approximately 3.0 years.

2.6.3 Efficiency Upgrade

2.6.3.1 Upgrade of recessed troffer fluoro lighting

The audit noted many fittings had been upgraded to LED however counted a number of remaining fluorescent T8 style fittings throughout the facility. Each 1200mm T8 fluorescent tube has a 36W rating with double fittings requiring 72W (or 80W including ballast). These can be replaced with equivalent LED fittings which typically use 50% less energy (refer appendix D for upgrade options). Replacing all fittings with LED equivalent would lead to estimated annual savings of at least $1,500 ex GST.

Table 7 Recessed Fluorescent troffer replacement with 1200x300mm LED panels

Area/Zone	Qty	Watts	Total WD kWhr/Day	Total WE kWhr/Day	LED Upgrade (W)	WD Energy Saving (kWh/day)	WD Saving ($/day)	WE Energy Saving (kWh/day)	WE Saving ($/day)
Corporate Services Open Area	3	72	1.836	0.432	36	0.92	0.29	0.22	0.07
Exec Manager-Corp Services	2	72	1.224	0.288	36	0.61	0.20	0.14	0.05
IT Manager	1	72	0.612	0.144	36	0.31	0.10	0.07	0.02
Meeting 1	2	72	1.224	0.288	36	0.61	0.20	0.14	0.05
Records Officer	4	72	2.448	0.576	36	1.22	0.39	0.29	0.09
Reception	4	72	2.448	0.576	36	1.22	0.39	0.29	0.09
Senior Finance Officer	1	72	0.612	0.144	36	0.31	0.10	0.07	0.02
Open Office Area	14	72	8.568	2.016	36	4.28	1.38	1.01	0.32
Office-Rangers	1	72	0.612	0.144	36	0.31	0.10	0.07	0.02
Office-Exec Community Services	2	72	1.224	0.288	36	0.61	0.20	0.14	0.05
OfficeBuilding Surveyor	3	72	1.836	0.432	36	0.92	0.29	0.22	0.07
CEO	3	72	1.836	0.432	36	0.92	0.29	0.22	0.07
Printer Room	2	72	1.224	0.288	36	0.61	0.20	0.14	0.05
Office: HR	2	72	1.224	0.288	36	0.61	0.20	0.14	0.05
Store Nth	1	72	0.1224	0.0288	36	0.06	0.02	0.01	0.00
Office: Planning	2	72	1.224	0.288	36	0.61	0.20	0.14	0.05
Office: Exec Assist	2	72	1.224	0.288	36	0.61	0.20	0.14	0.05
Corridor-Old/New Building	2	72	0.9792	0.9792	36	0.49	0.16	0.49	0.16
	51	**3,672**	**30.5**	**7.9**	**1,836**	**15.2**	**4.9**	**4.0**	**1.3**

Annual Saving (kWh): 1,404

Annual Saving ($): $450

Power reduction (kW): 1.8

The following table shows two upgrade options for recessed troffers being replacement with a LED panel (option 1) or replacement of the fluorescent tubes with LED tubes (option 2). Option 2 has a shorter payback.

Table 8 Lighting Upgrade Options

Measure	Saving $ p.a. (ex GST)	Qty	Replacement Product cost (ex GST)	Install cost (ex GST)	Unit Cost (ex GST)	Total Cost (ex GST)	Simple Payback
Option 1: LED panel replacement of recessed troffer	450	51	$75.00	$25.00	$100	$5,100	11.3
Option 2: LED T8 tube replacement of recessed troffer	450	102	$8.55	$10.00	$18.55	$1,892	4.2

2.6.3.2 Upgrade of T8 Fluoro Batten Lighting

Each 1200mm batten mounted T8 36W fluorescent tube can be replaced with a 18W LED equivalent.

Table 9 Batten mounted fluorescent T8 1200mm tube replacement with LED tube

Area/Zone	Description	Number	Watts	Total WD kWhr/Day	Total WE kWhr/Day	LED Upgrade (W)	WD Energy Saving (kWh/day)	WD Saving ($/day)	WE Energy Saving (kWh/day)	WE Saving ($/day)
Disabled Toilets	Batten 1200mm Single Fluoro T8	1	36	0.306	0.072	18	0.28	0.09	0.07	0.02
Committee Room	Batten 1200mm Single Fluoro T8	1	36	0.0612	0.0144	18	0.06	0.02	0.01	0.00
Staff Toilets	Batten 1200mm Single Fluoro T8	3	36	0.918	0.216	18	0.85	0.27	0.20	0.06
IT room	Batten 1200mm Single Fluoro T8	1	36	0.0612	0.0144	18	0.06	0.02	0.01	0.00
New Hall	Batten 1200mm Double fluoro T8	3	72	0.0918	0.0918	36	0.09	0.03	0.09	0.03
Kitchen	Batten 1200mm Double fluoro T8	5	72	0.153	0.153	36	0.15	0.05	0.15	0.05
Hallway	Batten 1200mm Single Fluoro T8	3	36	0.0459	0.0459	18	0.05	0.01	0.05	0.01
Ladies	Batten 1200mm Single Fluoro T8	1	36	0.0153	0.0153	18	0.02	0.00	0.02	0.00
Ladies	Batten 1200mm Double fluoro T8	1	72	0.0306	0.0306	36	0.03	0.01	0.03	0.01
Gents	Batten 1200mm Single Fluoro T8	1	36	0.0153	0.0153	18	0.02	0.00	0.02	0.00
Cleaner	Batten 1200mm Single Fluoro T8	1	36	0.0153	0.0153	18	0.02	0.00	0.02	0.00
		21	**1,080**	**1.7**	**0.7**	**540**	**1.6**	**0.5**	**0.7**	**0.2**

Annual Saving (kWh): 488

Annual Saving ($): $156

Power reduction (kW): 0.5

The following table shows payback for batten mount fluoros being replaced with LED tubes.

Table 10 Lighting Upgrade Options

Measure	Saving $ p.a. (ex GST)	Qty	Replacement Product cost (ex GST)	Install cost (ex GST)	Unit Cost (ex GST)	Total Cost (ex GST)	Simple Payback
Option 1: LED replacement of batten mount T8 fluoro	156	30	$8.55	$10.00	$18.55	$557	3.6

2.6.3.3 Air-conditioning

The audit noted five modern Daikin split system air conditioners and a central ducted air conditioning system. For the purpose of modelling we assumed the Daikin units operate from 8.30am to 5pm with a duty cycle of 30%. The large central ducted system and the split system in the staff room are assumed to operate only half as often.

The Daikin split systems are estimated to cost $3.50 per day to operate. We were unable to identify the model and rating of the central ducted system. We measured the power at the switchboard to be 10kW when operating. From this measurement we estimate the average daily running cost of this unit to be $8.60[2].

The manufacturer specification for the Daikin units installed in the centre indicate the following Energy Efficiency Ratio (EER) / Coefficient of Performance (COP) ratings[3]:

- FTXS71LVMA model (2 units): Cooling 3.41 (2 star) /Heating 3.67 (2.5 star)
- FTXS35LVMA model: (1 unit): Cooling 3.85(3 star) / Heating 4.55 (4.5 star) •
  FTXS25LVMA model (2 units): Cooling 4.63 (4 star) /Heating 4.87 (4.5 star).

These are reasonably efficient by current standards for their respective sizes and appear to be operated on an as required basis with the exception of the Ground Floor unit which we were advised is programmed to operate daily.

Daikin produce a high efficiency series and the comparable energy cost of operating these models is shown in the table below. The estimated savings resulting from an upgrade are very low at less than $1 per day and therefore the investment payback period of upgrading air conditioning with more efficient models will be quite long.

It is recommended to reduce energy use by prioritising the operation of smaller Daikin split systems over the central ducted system where possible.

Table 11 Airconditioning Upgrade Savings

DAIKIN MODEL	QTY	RATING (COOL)	EER	COP	WEEKDAY ENERGY (KWH)	UPGRADE MODEL	RATING (COOL)	EER	COP	NEW WD ENERGY (KWH)	ENERGY SAVING (KWH)	ENERGY SAVING ($/DAY)
FTXS25LVMA	2	2.5	4.63	4.86	3.1	FTXZ25NV1B	2.5	5.95	5.81	2.5	0.6	0.2
FTXS35LVMA	1	3.5	3.85	4.55	1.1	FTXZ35NV1B	3.5	5.15	5.05	0.9	0.2	0.1
FTXS71LVMA	2	7.1	3.41	3.67	6.7	FTXZ50NV1B	5	4.24	4.6	5.4	1.3	0.4
Grand Total	*5*				*10.9*					*8.8*	*2.1*	*0.7*

2.6.4 Energy Conservation

Other measures the Shire may wish to consider:

- We noted occupancy sensors had been installed in two of the toilets. We recommend these be installed in other spaces such as infrequently used public spaces (hallway to annex), staff kitchen, staff room, printer and storage rooms.
- An alternative to LED retrofitting is to delamp double fluorescent light fixtures (remove one tube) where a reduction in lighting levels is acceptable. We noted this had already occurred in some offices.
- From time to time request staff to check that computers are set with power saving options (e.g. turning off screens and base unit after a set period of time).
- Turn off printers and copiers after hours.

[2] We estimate the daily running cost of this unit to be approximately $8.60 per day assuming 9 hours per day at 30% duty cycle.

[3] EER (cooling) and COP (heating) are measures of the operating efficiency of air-conditioning under certain climatic conditions and are normally designated with an Energy Star rating. Daikin's most energy efficient current split system units have an EER/COP of 5.95/5.81 (7 stars) but larger units are noticeably less efficient.

2.6.5 Emergency Lighting

It was noted during the audit there were several emergency exit signs where lamps were not illuminated. It is recommended to check and replace the lamps.

3 Library

3.1 Overview of Site

The library centre located at 75 Steere Street is a modern building with tin roof and extensive glazing on the North side. The building has a 10kW solar PV system installed and has a ducted reverse cycle air-conditioning system.

3.2 Electricity Supply & Tariff

The site is supplied from a three phase Low Voltage (LV) electricity supply. Metering is via an accumulation meter (NMI 8002169165) which are read bi monthly and thus daily load profiles are not available.

- NMI 80021691654
- Meter 0530123219
- Tariff: Business Plan (L1)
- Rate: $0.3032/kWh
- Supply: $0.4614/day

The electricity supply doesn't meet the threshold for contestability (50,000 kWh p.a.) as its metered consumption for the 12 months from Mar 17 to Feb 18 was 34,039 kWh. The following table shows the estimated annual energy cost under each tariff. The Shire can save approximately $2,089 p.a. ex GST by switching from the anytime energy (L1) to a time of use (R1) tariff.

Table 12 Tariff comparison for Library with existing 10kW solar and with an additional 10kW solar

	L1	R1
With existing Solar	$15,235	$13,146
With additional Solar	$11,162	$9,553
Saving	**$4,074**	**$3,593**

3.3 Electrical Energy Profile

The figure below shows the meter readings over the past two years. The readings show an increase in grid energy consumption during Winter. This is likely to be attributable to a combination of increased reverse cycle air conditioning use and due to the seasonal reduction in solar PV generation.

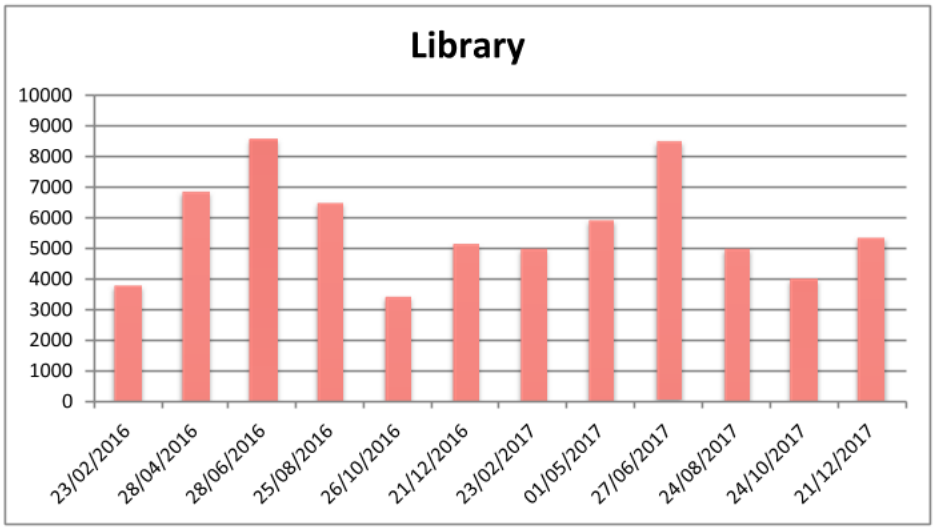


Figure 10 Bi Monthly Meter reads (Libary)

3.4 Solar Review

3.4.1 Annual Savings

The data from the 10kW SMA inverter of the existing solar PV system was downloaded to ascertain the output of this system and the benefit to the Library.

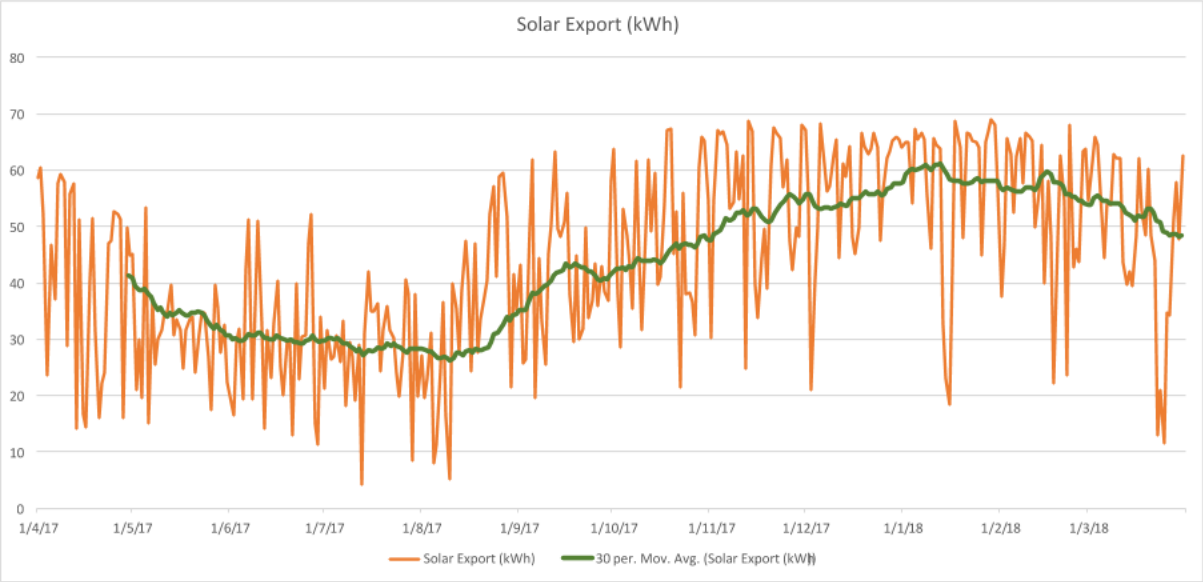
The table below shows the solar PV output and potential savings for the period April 17 to March 18 (at $0.3032/kWh ex GST) assuming all energy were used on-site[4].

Table 13 Library Solar PV output and tariff savings

	Energy (kWh)	*Saving ($ ex GST)*
Annual Yield	16,027	4,860
Daily Average	43.9	13.31

We estimate the existing system provides annual savings of approx. $3,590 when accounting for energy which cannot be used on weekends. The figure below shows the daily output over the 12 months to end of March 18 with the 30 day moving average illustrating the change in system output due to seasonal variation. The high daily fluctuations are likely attributed to cloud cover.

[4] As there is no interval metering data available it is not possible to determine how much energy is exported to the grid.



3.4.2 Daily Profile

The figure below shows the daily export of the system on 21 Feb 2018.

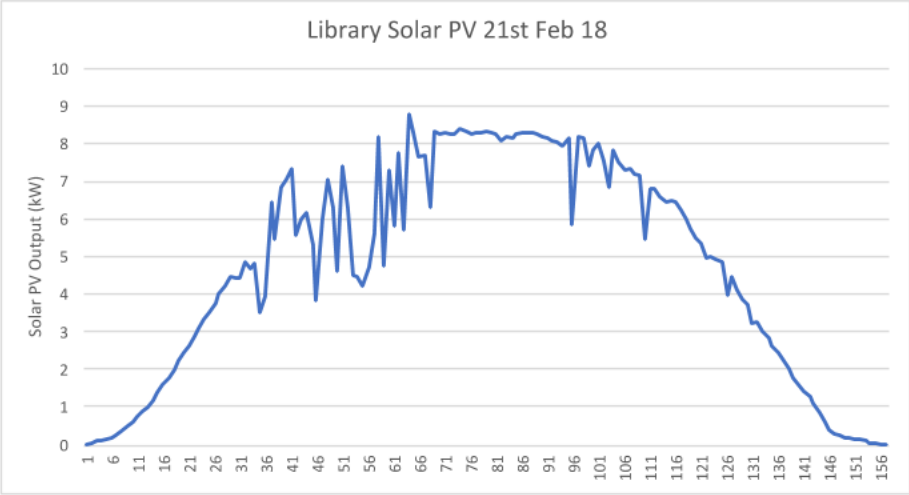


Figure 11 Library Solar Daily Profile 21 Feb 18

3.4.3 Recommended System Size

The load profile is suited to an additional small to medium solar PV system. The graph below shows the estimated annual savings (RHS) and payback period (LHS) for additional solar PV using the average per kW cost of the quoted systems, excluding GST and including STC rebates. Note this is based upon the total installed solar PV (includes existing 10kW system). Therefore, 16kW would include 10kW of existing and 6kW additional system. The graph below shows the optimal total size system to maximise RoI is up to 4kW of additional capacity.

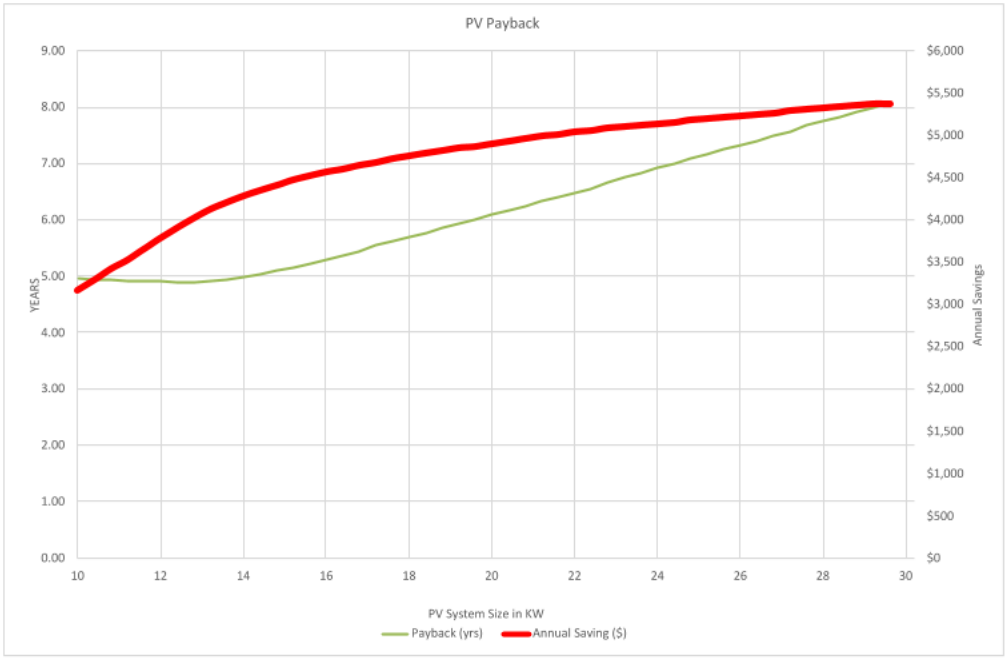


Figure 12 Solar PV savings and payback for Library

3.4.4 Available Roof Space

The following photo shows the available roof space on the Library for additional solar installation. The yellow shaded area would accommodate up to 15kW of 250W panels and the green shaded area would accommodate approximately 6kW of 250W panels. We recommdend panels be tilted North to increase annual yield. Flat mounted panels will produce approximately 13% energy annually less than tilt mounted.

Figure 13 Library available roof space for solar PV

3.4.5 Effect on Grid Import

The figures below show the effect of an additional 6.5kW solar system (as proposed by SolarE) on average weekday and weekend grid import. Note that the solar PV output varies significantly by season and will result in a net export of energy to the grid during periods of peak solar output and low load (most weekend days). We estimate for a system of this size 77% of energy would be used on-site with the balance being exported or curtailed during periods of low load. The system will not be eligible for Renewable Energy Buyback Scheme (REBS) credit from Synergy for exported energy.

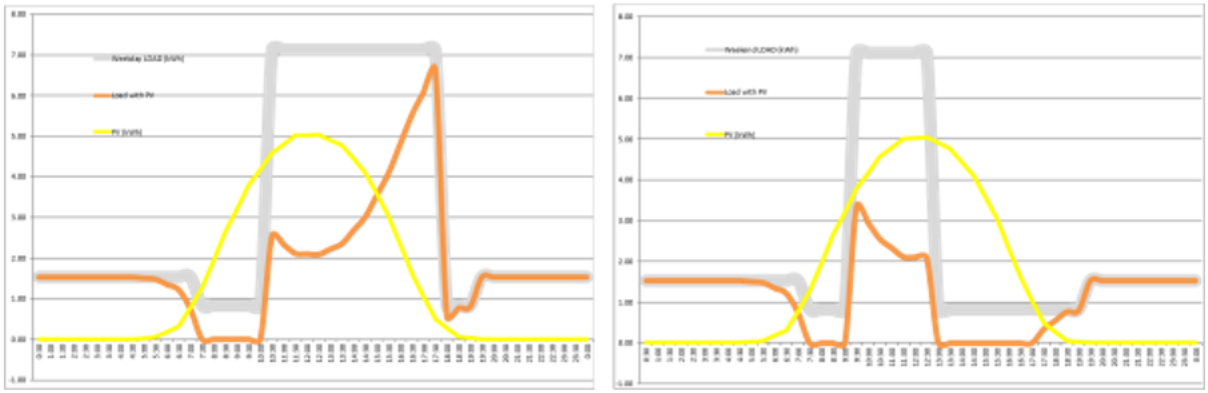


Figure 14 Annual Average Weekday Load profile with 31.8kW Solar

3.4.6 Comparison of Proposals

The table below compares the estimated cost, benefit and simple payback of the various sized systems with the following assumptions[5]:

a) Estimated below are the savings in addition to the saving from the existing 10kW solar PV which can be obtained by installing additional solar
b) The Quoted Gross Price from each supplier for the specified system size and
c) Calculating the number of STCs available (if installed by Dec 2018) and
d) Assuming the value of the rebate at $35 per STC and
e) Using the estimated savings calculated by H2 energy solutions.

[redacted]

[5] Note that suppliers estimates of STC rebates differ to those shown in the table below. Earlier system installation or higher STC price may have been assumed.

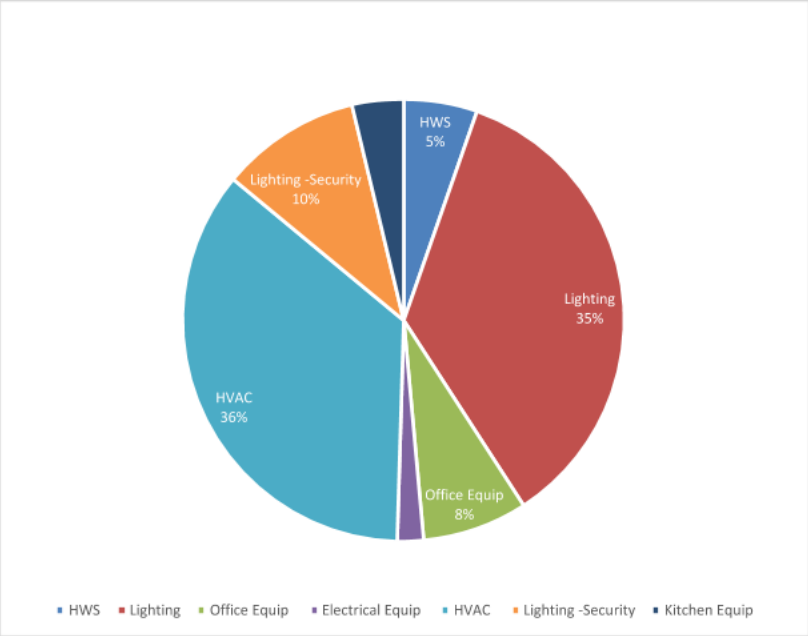
3.5 Equipment Audit

The equipment audit uses measurement of equipment power or appliance rating data combined with estimated weekday and weekend hours of operation to determine average weekday and weekend energy use of equipment.

3.5.1 Energy Use by Equipment Type

The audit assumed normal opening hours of 8.30am to 5pm Monday to Friday and allowed for an average of 2 hours of operation on weekend days. The audit data and rating information is contained in Annexure 1 to this report.

The purpose of the audit is to estimate the energy use attributed to different items and categories of equipment. This can be used to inform estimate of savings from energy conservation or efficiency retrofit (e.g. lighting or equipment upgrade). The estimated contribution to the daily energy use of each equipment type are shown in the figure below.



Library Energy Use by Function

Figure 15 Energy use by equipment type total

3.5.2 Energy Use by Time of Day

The below figure shows the contribution to average daily demand.

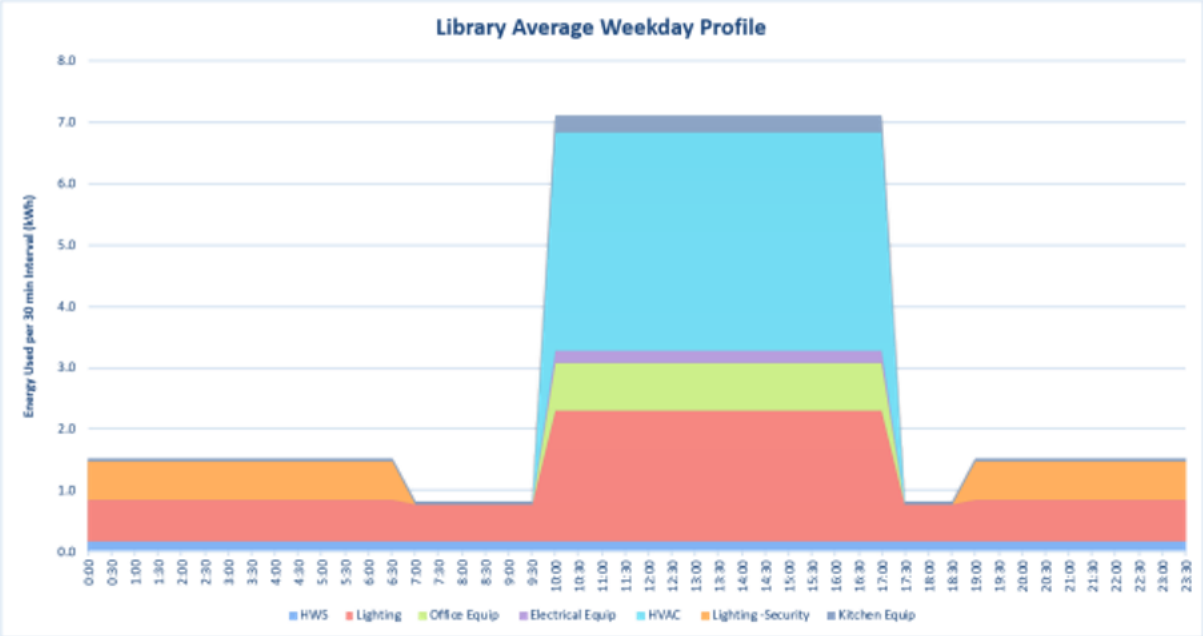


Figure 16 Energy Use by Equipment Type Weekday Time of Use

3.5.3 Energy Use by Area

The following table shows the energy use by area within the Library.

Table 15 Energy Use by Location

Location	***Weekday (kWh/day)***	***Weekend (kWh/day)***	***% of Weekday Use***
Office	1.4	0.6	0.9%
Computer Rm-Young Adult	6.9	5.9	4.6%
Entrance	2.1	1.0	1.4%
Entrance-Corridor	1.4	0.7	0.9%
Exterior	15.5	15.5	10.2%
Female Toilets	1.3	0.6	0.9%
Golden Holdsworth-RM1	1.7	0.8	1.1%
Golden Holdsworth-RM2	2.1	1.0	1.4%
Main Room	35.5	30.2	23.5%
Male Toilets	1.4	0.7	0.9%
Unisex Toilets	0.1	0.0	0.1%
Help Desk	3.3	1.5	2.2%
Meeting Room/Gallery	5.2	3.0	3.4%
Staff Lunch Room	3.0	2.0	2.0%
Staff Toilets	0.2	0.1	0.1%
Workroom	8.1	3.8	5.4%
Exterior (inc A/C, HWS & lighting)	61.8	33.2	41.0%
Grand Total	150.9	100.5	100.0%

3.5.4 Tariffs

It is recommended to change tariff from the anytime energy (L1) to time of use (R1) tariff with estimated savings of $2,089 ex GST p.a.

3.5.5 System PV Expansion

There is adequate roof space to install an additional solar PV system on the Library. In the absence of interval metering, the following figure shows the expected load profile with the existing system. The graph which is based upon the equipment audit indicates the daytime load is approximately 14kW (7kWh per 30 min interval). We would recommend up to an additional 5kW of solar generation could be used on-site.

Note that a 5kW system will produce a maximum output of approximately 4.5kW due to system losses. Larger systems could be installed however this is likely to lead to diminishing savings due to export of a significant portion of system output. Energy efficiency measures (such as replacing CFL lighting with LED) will potentially reduce demand by 1.6kW further reducing the benefit of additional solar PV.

We recommend the installation of an energy monitoring system to determine the daily load profile and calculate the benefits of further solar generation.

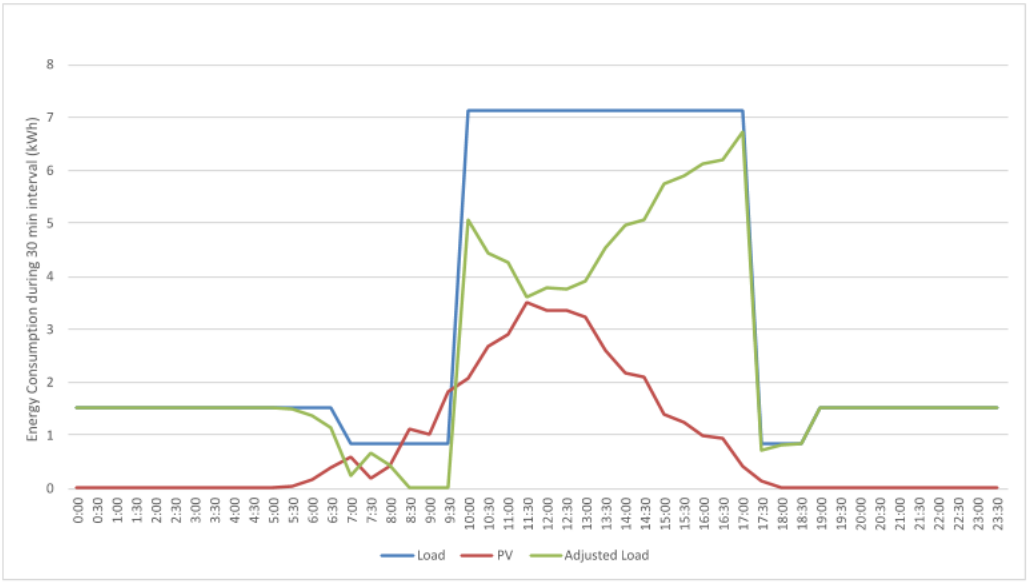


Figure 17 Weekday Load Profile with Solar

3.5.6 Efficiency Upgrade

3.5.6.1 Lighting

The audit noted a prevalence of plug in compact fluorescent (CFL) lamps in two recessed fittings. Type 1 are a smaller diameter fitting and type 2 larger diameter fitting. The type 1 fittings appear to be 18W CFL (approx. 1200 lumens output) and type 2 are 26W CFL (approx. 1800 lumens output). A number of lamps had failed and therefore actual energy use and savings will be slightly lower than assessed.

GE manufacture direct replacement LED lamps which produce the same lumen output but use less power, 9W (instead of 18W, 1200 lumen) and 18.5W (instead of 26W, 1800 lumen), as shown in the following figure. The benefits of this upgrade are summarised below:

- Annual Saving (kWh): 5,714 kWh
- Annual Saving ($): $1,733
- Power reduction (kW): 1.6kW (reduced power will also reduce air-conditioning cooling load).

The lamps can be either upgraded as part of a programmed retrofit or may be replaced as existing lamps fail. GE claim the LED lamps have at 50,000 hour rated life and typically last 2.5 time longer than the existing CFL.

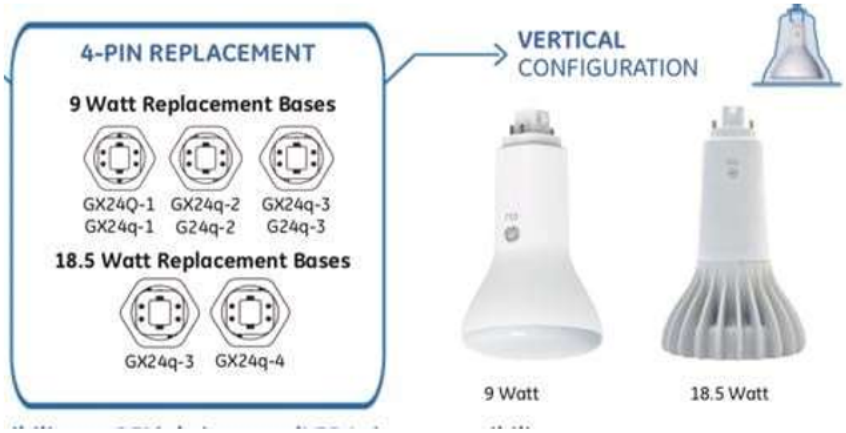


Figure 18 GE LED Replacement to CFL Lamps

The following table lists the CFL fittings, LED upgrade option, location and estimated weekday (WD) and weekend day (WE) energy savings. The annual savings are based upon the Library operating hours.

Note: the assessment is based upon a ground based visual inspection and light fitting sizes, quantities, plug type and ballast compatibility should be separately assessed by installers prior to ordering parts and materials.

Table 16 LED CFL Upgrade Energy Saving

Area/Zone	Description	Qty	Watts	Total WD kWhr/Day	Total WE kWhr/Day	LED Upgrade (W)	WD Energy Saving (kWh/day)	WD Saving ($/day)	WE Energy Saving (kWh/day)	WE Saving ($/day)
Computer Rm-Young Adult	Compact Recessed Fluro	8	26	4.99	4.99	18.5	1.44	0.44	1.44	0.44
Entrance	Compact Fluro - Type 1	12	18	1.62	0.76	9	0.81	0.25	0.38	0.11
Entrance-Corridor	Compact Fluro - Type 2	2	26	0.39	0.18	18.5	0.11	0.03	0.05	0.02
Exterior	Pathway to Entrance	8	26	2.50	2.50	18.5	0.72	0.22	0.72	0.22
Exterior	Exterior Building	30	26	9.36	9.36	18.5	2.70	0.82	2.70	0.82
Exterior	Exterior Building-Uplight/Downlight	8	26	2.50	2.50	18.5	0.72	0.22	0.72	0.22
Female Toilets	Compact Recessed Fluro-Type 2-Occ sensor	2	26	0.10	0.05	18.5	0.03	0.01	0.01	0.00
Golden Holdsworth-RM1	Compact Recessed Fluro	4	26	0.78	0.36	18.5	0.23	0.07	0.11	0.03
Golden Holdsworth-RM1	Compact Recessed Fluro	7	18	0.95	0.44	9	0.47	0.14	0.22	0.07
Golden Holdsworth-RM2	Compact Recessed Fluro	10	18	1.35	0.63	9	0.68	0.20	0.32	0.10
Golden Holdsworth-RM2	Compact Recessed Fluro	4	26	0.78	0.36	18.5	0.23	0.07	0.11	0.03
Meeting Room/Gallery	Recessed Ceiling Lights 600mm Flu	8	18	1.08	0.50	9	0.54	0.16	0.25	0.08
Meeting Room/Gallery	Recessed Compact Fluro - Type 1 -High Ceiling	4	18	0.54	0.25	9	0.27	0.08	0.13	0.04
Main Room	Recessed Compact Fluro - Type 2 -Low Ceiling	36	26	22.46	22.46	18.5	6.48	1.96	6.48	1.96
Main Room	Recessed Compact Fluro - Type 2 -High Ceiling	16	26	3.12	1.46	18.5	0.90	0.27	0.42	0.13
Main Room	Recessed Compact Fluro - Type 1 -High Ceiling	8	18	1.08	0.50	9	0.54	0.16	0.25	0.08
Main Room	Compact Fluro - Type 2 -Pendants	11	26	2.15	1.00	18.5	0.62	0.19	0.29	0.09
Male Toilets	Compact Recessed Fluro-Type 2-Occ sensor	4	26	0.20	0.09	18.5	0.06	0.02	0.03	0.01
Office	Compact Recessed Fluro	2	26	0.39	0.18	18.5	0.11	0.03	0.05	0.02
Staff Lunch Room	Recessed Compact Fluro - Type 2	4	26	0.78	0.36	18.5	0.23	0.07	0.11	0.03
Staff Toilets	Recessed Compact Fluro - Type 2- Occ Sensor	3	26	0.15	0.07	18.5	0.04	0.01	0.02	0.01
Workroom	Recessed Compact Fluro - Type 2 -High Ceiling	18	26	3.51	1.64	18.5	1.01	0.31	0.47	0.14
		209	**5,042**	**60.8**	**50.7**	**3,401**	**18.9**	**5.7**	**15.3**	**4.6**

Annual Saving (kWh): 5,714

Annual Saving ($): 1,733

Power reduction (kW): 1.6

Measure	Saving $ p.a. (ex GST)	Qty	Replacement Product cost (ex GST)	Install cost (ex GST)	Unit Cost (ex GST)	Total Cost (ex GST)	Simple Payback
LED panel replacement of CFL	1,733	209	$15.00	$15.00	$30	$6,270	3.6

3.5.6.2 Air-conditioning

The audit noted two Fujitsu central ducted air conditioning systems located under the West side of the building. The table below shows the estimated weekday and weekend energy use assuming operation during library operating hours and 30% duty cycle. The estimated annual energy consumption is 15,254 kWh and annual cost of operation is $4,625. The EER and COP have been calculated in the table below and the efficiency of the existing units are reasonable. The benefits of upgrade will be marginal.

Table 17 Library Airconditioning

Description	Qty	Total WD kWhr/Day	Total WE kWhr/Day	Input Power Cooling (W)	Cooling Capacity (kW)	EER	Input Power Heating (W)	Heating Capacity (kW)	COP
Fujitsu-AJY144LALH	1	32	15	14,170	45	3.18	12600	50	3.97
Fujitsu-AJY108LALH	1	22	10	9,680	33.5	3.46	9280	37.5	4.04
		54	**25**	**23,850**					

3.5.6.3 Hot Water System

The hot water system utilises an energy efficient Stiebel Eltron heat pump system. No upgrade is recommended.

3.5.7 Energy Conservation

Other measures the Shire may wish to consider:

- The air-conditioning temperature set point is 23 degrees. We recommend 24 degrees in Summer and 22 degrees in Winter. This will help reduce air-conditioning load.
- From time to time request staff to check that computers are set with power saving options (e.g. turning off screens and base unit after a set period of time).
- Turn off printers and copiers after hours.

3.5.8 Maintenance

A number of lights in the Library are permanently on due to failure of occupancy sensors. We counted 44 CFL lamps in the affected areas. We estimate the cost of operating this lighting outside of normal operating hours is approximately $2,500 per annum[6]. We understand the Shire are aware of this issue.

4 Pool

4.1 Overview of Site

The pool is located at 89 Steere Street comprising an amenity building and shed with the pool pumps and filtration system. There are two pools and a balance tank:

- Lap pool of 850,000L volume
- Leisure pool of 150,000L volume

[6] Assumes all 44 CFL lamps are 26W and operating continuously.

- Balance tank of 187,000L volume

4.2 Electricity Supply & Tariff

The site is supplied from a three phase Low Voltage (LV) electricity supply which is interval metered from a cubicle located on the street verge.

- NMI 80018331883
- Meter 0214004330
- Tariff: Business Anytime (L1)
- Rate: $0.3032/kWh (ex GST)
- Supply: $0.4614/day

The electricity supply meets the threshold for contestability (50,000 kWh p.a.) as its metered consumption for the 12 months from April 17 to March 18 was 167,338kWh. This means the Shire is eligible to select an alternative electricity retailer for this site.

We note that the pool is presently on a tariff (L1) which is normally only available to non-contestable customers (<50,000kWh p.a. energy use). The equivalent tariff for contestable customers is the L3 tariff which would be more expensive. However, the Shire will be able to substantially reduce its energy cost by changing tariff from an anytime energy to a time of use tariff. *Table 18 Anytime Energy Tariffs (inc GST)*

	L1 Non Contestable	L3 Contestable
Supply Charge: cents/day	50.7504	53.7522
First 1650 units/day: c/kWhr Over	33.3546	35.3197
1650 units/day: c/kWhr	30.0972	31.8798

Table 19 Time of Use Tariffs (inc GST)

	R1 Non Contestable	R3 Contestable
Supply Charge: Dollars/Day	2.0964	2.666
Off Peak Energy:	11.3493	14.3697
c/kWhr On Peak	36.7981	46.677
Energy: c/kWhr		

The table below shows the expected cost for each of the Synergy energy tariffs based upon the past 12 months of metering data. The savings for a R1 (for non-contestable, if available) are approximately $17K p.a. or for R3 (for contestable) are $7K p.a.

The Solar Assisted columns denote the estimated tariff and savings that could be obtained with a 39kW three phase solar PV system installed as has been proposed by two suppliers. Assuming the Shire switched to the eligible R3 tariff then a 39kW system would save an additional $16K p.a. ex GST in addition to the $7K p.a. of tariff related savings.

Table 20 Synergy Tariff comparison Pool

	Standard		SOLAR Assisted		Savings/pa
ROLR-SUMMARY	inc GST	ex-GST	inc GST	ex-GST	
L1	$56,000	$50,909	$41,001	$37,273	$14,999
L3	$59,299	$53,909	$43,416	$39,469	$15,883
R1	$38,761	$35,237	$26,073	$23,703	$12,688
R3	$49,145	$44,677	$33,055	$30,050	

4.3 Electrical Energy Profile

4.3.1 Daily Profile

Figure 1 below shows the annual average week day and week end energy consumption of the site based upon interval metering data from the twelve months March 18 obtained from Western Power. The dark grey shaded area shows the on-peak tariff period during weekdays.

The graph shows there is approximately 17kW of constantly on ("baseload") overnight which is attributed to filtration pumps. The weekend profile shows negligible difference in weekday and weekend operation.

Approximately 55% of energy use is during the off peak tariff periods (all weekend and light grey shaded area on weekdays making it suitable for a time of use tariff.

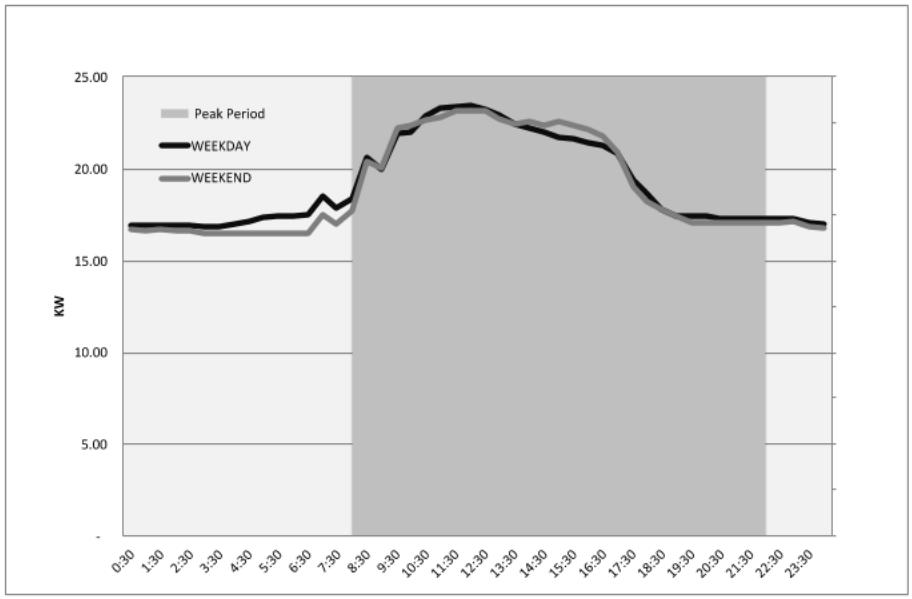


Figure 19 Energy profile using Western Power Meter data

4.3.2 Weekly Profile

The figure below shows there is only slight variation in daily energy use between weekdays. Note this is the annual average load (including Winter months) so non-Winter use will be higher.

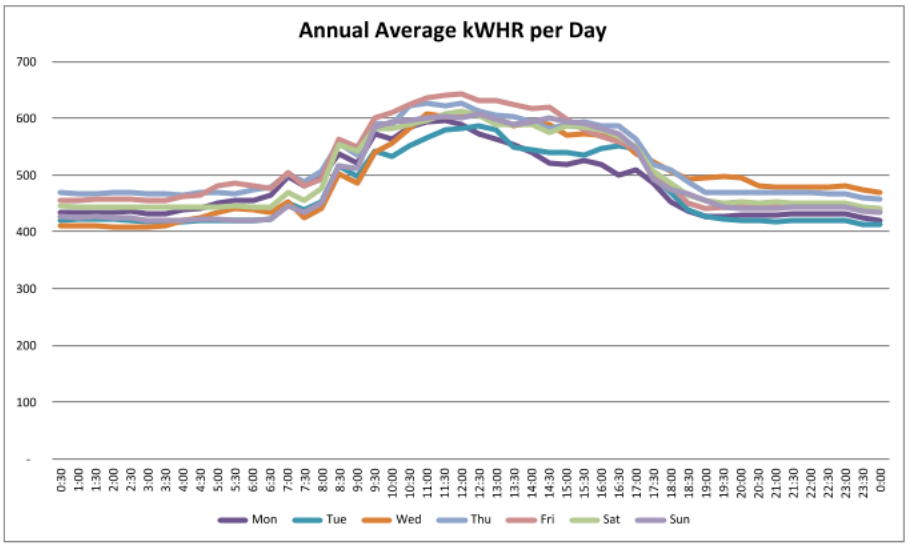


Figure 20 Annual Average energy use by day of week

4.3.3 Seasonal Profile

The figures below show the pool pumps are not operating during Winter with peak use occurring during Summer.

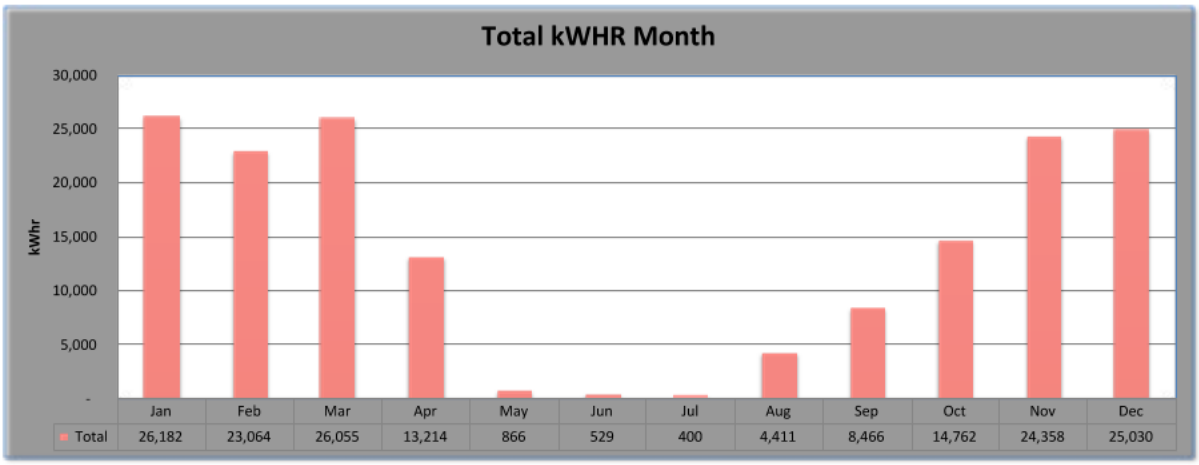


Figure 21 Monthly Energy Import for Pool Apr 17 to Mar 18

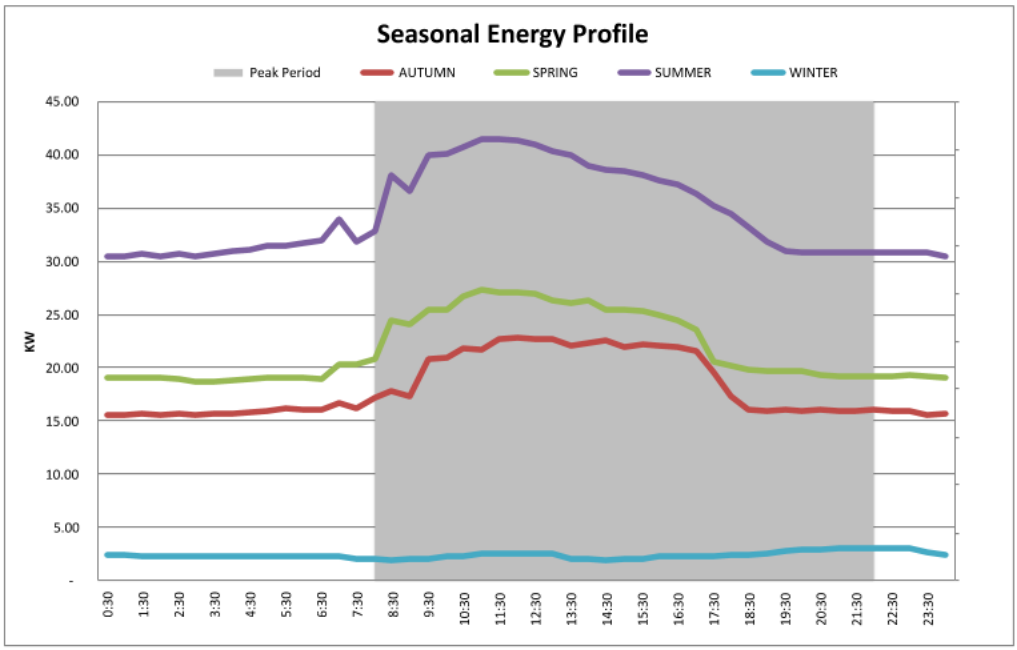


Figure 22 Seasonal Average Daily Energy Profile (Pool)

4.4 Solar Recommendation

4.4.1 Recommended System Size

The load profile is well suited to a solar PV system which will reduce grid supplied energy at peak tariff rates.

As noted for the Admin-Civic Centre, solar PV systems above 30kW will attract a $5,000 Western Power assessment fee. As there is negligible load during Winter there may also be a requirement from Western Power to install reverse current limiting devices (additional expense). It is unclear if these costs have been factored into supplier's proposals.

The payback of the system will also be reduced by the loss of benefit for approximately 4 months of the year where the pool is dormant. We therefore recommend the maximum size system which can be readily accommodated on the pool amenity building and shed, approx. 27kW (refer next section). The estimated savings of a 27kW system are $10,659 ex GST.

An additional system could be installed on the Leisure centre roof in the future if this is feasible and warranted.

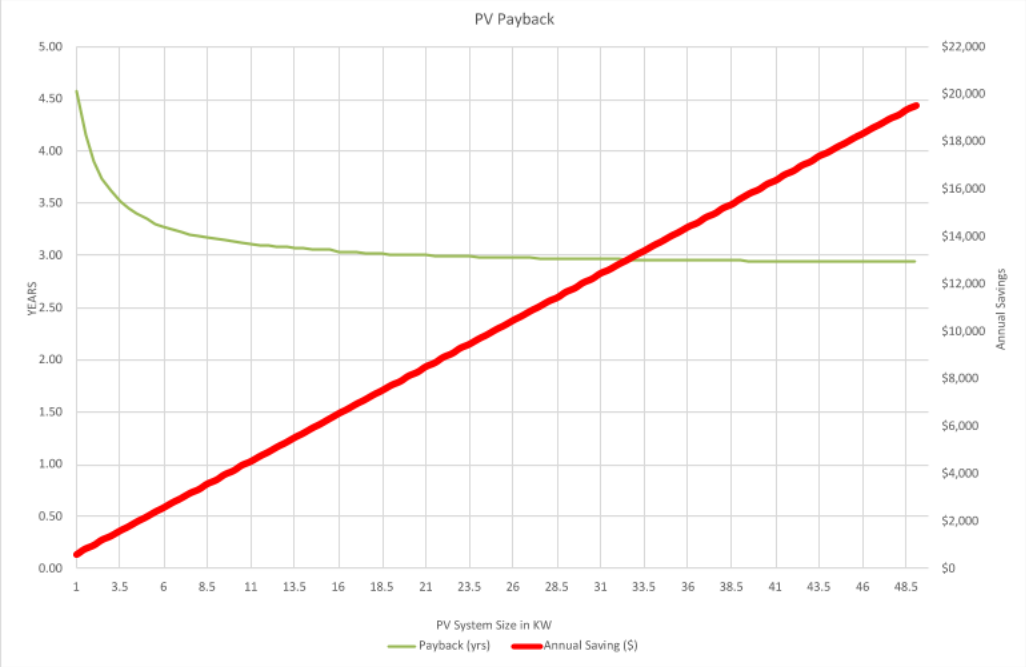


Figure 23 Solar PV Estimated savings and payback Pool

4.4.2 Available Roof Space

The majority of load (pump motors) are connected to the switchboard in the pump shed. We estimate there is approx. 120sqm of available roof space which will accommodate up to 15kW on the pump shed with East-West orientation. There is approximately 100sqm of East, West and North facing sections of the roof of the amenities building which would accommodate an additional 12kW system[7]. Refer the photo below.

The adjacent leisure centre has plenty of available roof space to install solar PV. We do not recommend using the roof space with the present solar water heating system due to the potential for any water leak to affect the solar PV system and limited access to both systems for maintenance. We recommend the roof space on the South West corner, however, at least 60m of cable will be required to the shed and regulations may prohibit supplying AC power from a separate lot (to the Pool). The solar PV system installer will need to resolve these issues in its application.

We recommend installing the panels tilted toward the North in order to maximise yield. Flat mounting panels will result in approximately 13% reduction in annual yield.

[7] Note this assumes using 250W panels and does not allow for roof structures (vents, antennae etc) which can cast shade across panels. The installer should complete a proper rooftop shade analysis to size the system to avoid shading from these structures.

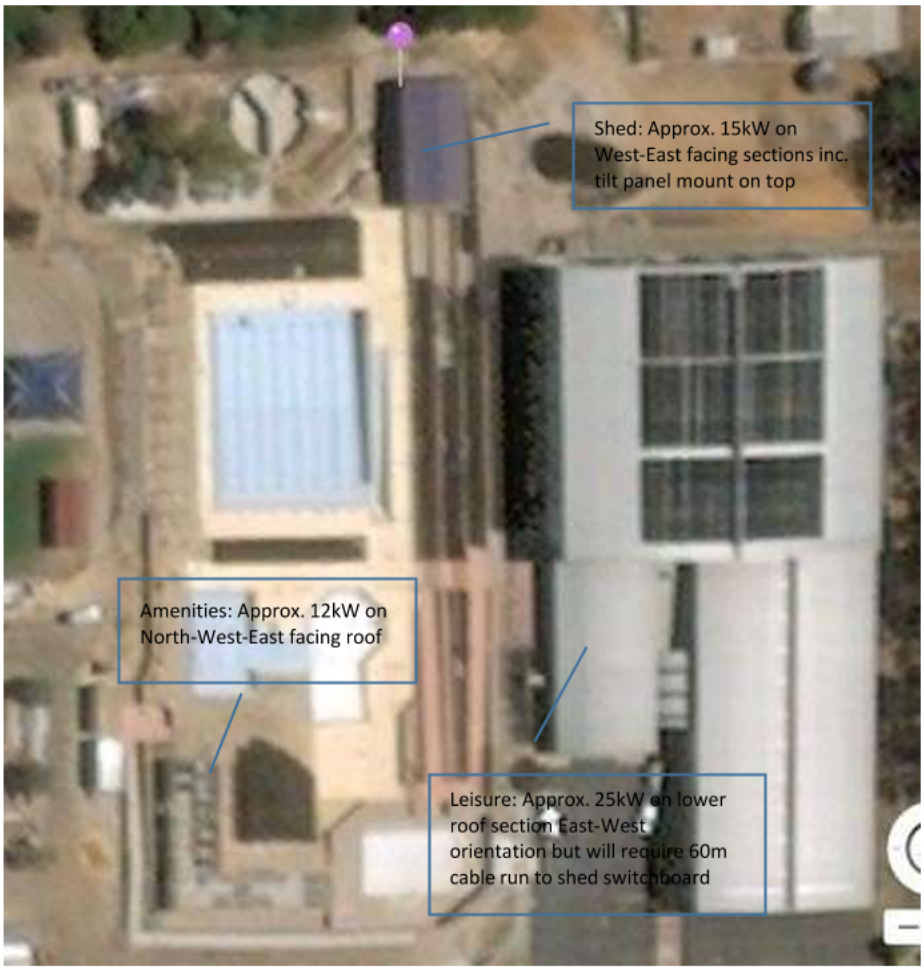


Figure 24 Available Roof space for solar PV supplying Pool

4.4.3 Effect on Grid Import

The figures below show the effect of a 27kW solar system on average weekday and weekend grid import. We estimate during the pool operating months all energy would be used on-site.

Figure 25 Annual Average Weekday and Weekend Load profile with 27kW Solar

4.4.4 Comparison of Proposals

The table below compares the estimated cost, benefit and simple payback of the various sized systems with the following assumptions[8]:

e) The Quoted Gross Price from each supplier for the specified system size and
f) Calculating the number of STCs available (if installed by Dec 2018) and
g) Assuming the value of the rebate at $35 per STC and
h) Using the estimated savings calculated by H2 energy solutions.

4.5 Equipment Audit

The equipment audit uses measurement of equipment power or appliance rating data combined with estimated weekday and weekend hours of operation to determine average weekday and weekend energy use of equipment.

4.5.1 Energy Use by Equipment Type

The audit assumed opening hours of 8am to 6pm (outside of Winter), pool filtration pumps operate 24/7 and feature pumps operate 50% of the opening hours. The audit data and rating information is contained in Annexure 1 to this report.

The purpose of the audit is to estimate the energy use attributed to different items and categories of equipment. This can be used to inform estimate of savings from energy conservation or efficiency retrofit (e.g. lighting or equipment upgrade).

The estimated contribution to the daily energy use of each equipment type are shown in the figure below. It is clear pool pumps contribute the majority of energy use.

[8] Note that suppliers estimates of STC rebates differ to those shown in the table below. Earlier system installation or higher STC price may have been assumed.

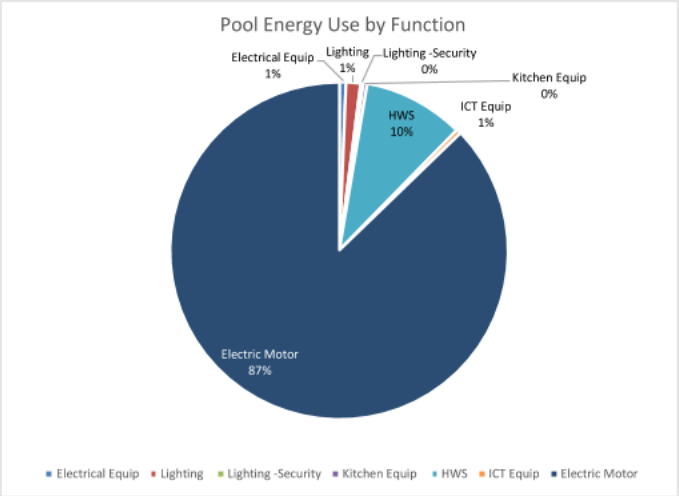


Figure 26 Energy use by equipment type total

4.5.2 Energy Use by Time of Day

The following table shows the estimated profile of average daily energy use. The increase during the day is due to operation of jet and flow pumps in the leisure pool.

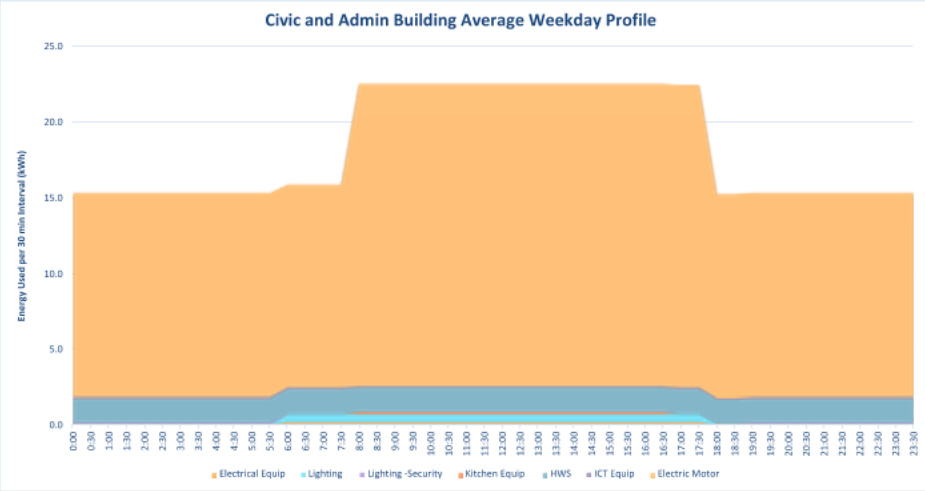


Figure 27 Energy Use by Equipment Type Weekday Time of Use

4.5.3 Energy Use by Area

The following table shows the areas of the Pool complex where energy are used.

Table 22 Energy use by Area

Row Labels	Sum of WD kWhr/Day	Total Sum of Total WE kWhr/Day	Sum of Weekday On Peak kWhr	Sum of Weekday Off Peak kWhr	WD %	WE %
Ground	800.0	744.0	540.1	259.9		
Store Room	0.4	0.4	0.4	0.1	0.05%	0.05%
Staff Room	4.1	4.1	3.4	0.7	0.46%	0.50%
Pump Room	777.2	721.2	521.5	255.7	88.04%	87.23%
Office	3.6	3.6	2.3	1.3	0.41%	0.44%
Ladies Amenities	5.8	5.8	5.1	0.7	0.66%	0.71%
Gent Amenities	5.8	5.8	5.1	0.7	0.66%	0.71%
First Aid Room	0.4	0.4	0.4	0.1	0.05%	0.05%
First Aid	1.2	1.2	0.7	0.5	0.14%	0.15%

Disabled Amenities	1.4	1.4	1.3	0.2	0.16%	0.18%
Outdoor	82.7	82.7	49.3	33.4		
Under Eaves	1.1	1.1	0.7	0.4	0.12%	0.13%
External Walls	81.7	81.7	48.7	33.0	9.25%	9.88%
Grand Total	**882.7**	**826.7**	**589.5**	**293.3**	**100.00%**	**100.00%**

4.6 Summary and Recommendations

4.6.1 Tariffs

We recommend the Shire change from an anytime energy tariff (presently L1) onto a time of use tariff, R1 (ideally if available) or R3. This will provide immediate savings at no cost or risk to the Shire.

4.6.2 Solar PV

We recommend installing up to 30kW of solar PV at the site.

4.6.3 Efficiency Upgrade

4.6.3.1 Pump Motor Efficiency

Circulation pump motors can use several times their purchase cost in energy each year due to the high running hours (duty cycle) as they typically operate 8,760 hours per year (less maintenance and repair time). Therefore, the efficiency of the pump motor at its design rating will have a significant impact upon the annual operating cost of the motor.

We have calculated the estimated pump motor rating (power) and annual energy cost assuming the lap pool filtration pumps are operating for 8 months of the year assuming water turnover rate of 2.5 hours (which is in accordance with a Category 6 swimming pool, refer Appendix A).

The estimated running cost of one of the two 11kW pumps for 8 months of the year is $20,619 ex GST on the proposed lower cost R3 tariff. The current lap pool pump motors are 11kW WEG W22 IE2 efficiency class which have minimum efficiency of 89.8%. IE4 motors have minimum efficiency of 93.3%. We estimate the Shire can save $773 ex GST p.a. per motor by upgrading the pump motors to a higher efficiency motor (IE4 specification).

We expect the cost to replace these motors is several thousand dollars and therefore the payback period is likely to be significantly longer than solar. We recommend prioritising investment in solar over motor upgrade for this reason but would recommend future replacement with an IE4 efficiency class motor.

Table 23 Comparison of Pump Motor operating cost

Pool Capacity		1,187,000 Litres	includes balance tank, lap and leisure pool
Filtration Capacity per pump	593,500 Litres		
Set point temp	22 deg C		
Turn time		150 mins - time to turnover water	
Required flow rate	3,957 L/min		
Differential Head		15.0 m	estimated resistance from pool plumbing & filter
Hydraulic Power	9.7 kW		
Require motor power IE2 Eff.	10.8 kW		
Off Peak Electricity Tariff	0.1306 $/kWh		
On Peak Electricity Tariff	0.4668 $/kWh		
On Peak hours	14 hours per day		
IEC 60034 Motor Efficiency Class		Existing	Premium Eff. UG	Super Premium UG
Minimum Efficiency			
Shaft Power at min Eff.			
Operation time			
Months/Year Operation			
Daily energy use			
Annual Energy Use			
Annual energy cost			
Annual Cost Saving (ex GST)			

	IE2	IE3	IE4	
	89.8%	91.6%	93.3%	From WEG W22 efficiency specification
	10.81	10.59	10.40	Motor power is an average of the measured powe
	24	24	24	
	8	8	8	
	259.3	254.2	249.6	
	63,107	61,867	60,739	
$20,619 $20,214 $19,845 $405	$773			

4.6.3.2 Variable Speed Drives

We note that the circulation pumps and feature pumps are fitted with mechanical throttling mechanisms (red lever in photo below). Mechanical throttling creates resistance in the circulation system which the pump must overcome by "working" harder. If the pump motors do require throttling during normal operation then we recommend the installation of Variable Speed Drives (VSD) which may be retrofitted to most pump motors. The VSD will slow the motor and use substantially less energy than mechanical throttling. Typically the savings make this a short payback option which will depend upon the amount of throttling.

VSD can also save significant amounts of energy and cost of operating circulation pump motors by reducing the flow rate if the water turnover rate exceeds requirements (refer appendix A). Our calculations in the above table indicate the pump motors are the correct size (10.8kW required for IE2 class motor) assuming the circulation system hydraulic resistance is 15m of differential head.

Figure 28 Filtration and feature pump motors

4.6.4 Energy Conservation

Other measures the Shire may wish to consider:

- The water feature pump (5.5kW) and jet pump (2.2kW) will cost approximately $2.50 ex GST per hour and $1.00 ex GST per hour respectively to operate during weekday peak periods.

We recommend turning these off during low use periods or alternatively installing a motion sensor to turn the pump on as people approach the pool.

5 Leisure Centre

5.1 Overview of Site

The leisure centre is located at 95 Steere Street comprising indoor courts, gymnasium, dance class, change rooms, café and reception.

The opening hours are 6am to 6pm Mon, Wed, Fri; 6am to 8.30pm Tues, Thu and 8am to 6pm SatSun. The Gym is open to members by secure access 24 hours per day and lights operate continuously.

The following table shows the annual attendance at the centre. The busiest period occurs between November and March. Based upon annual electricity tariff of approx. $35,000 (inc GST) and annual admissions of 31,000 the average energy cost is $1.12 per customer.

Table 24 Leisure Centre Annual Admissions

Type	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	Total
Monthly Admissions (BLC programs / entry)	5,600	5,300	3,200	1,100	1,400	1,000	900	1,000	1,000	1,200	5,200	4,100	**31,000**
Additional Monthly Admissions	-			-	-	-	-	-	-		2,128	2,128	
Basketball (players + spectators average)		2,128	2,128							2,128			**10,640**
Netball (players + spectators average)	-	-	-	-	2,320	2,320	2,320	2,320	2,320	-	-	-	**11,600**
Martial Arts	-	140	140	140	140	140	140	140	140	140	140	-	**1,400**
Gymnastics (players + spectators average)	-	-	-	-	200	200	200	200	200	-	-	-	**1,000**
Total Monthly Admissions	5,600	7,568	5,468	1,240	4,060	3,660	3,560	3,660	3,660	3,468	7,468	6,228	**55,640**
Average Daily Admissions	181	270	176	41	131	122	115	118	118	112	249	201	**152**

5.2 Electricity Supply & Tariff

The site is supplied from a three phase Low Voltage (LV) electricity supply which is interval metered from a cubicle located on the street verge.

- NMI 80010157361
- Meter 01360002014
- Tariff: Business Plan Fifty (L3)
- Rate: $0.3211/kWh (ex GST)
- Supply: $0.4887/day

The electricity supply meets the threshold for contestability (50,000 kWh p.a.) as its metered consumption for the 12 months from April 17 to March 18 was 97,242kWh. This means the Shire is eligible to select an alternative electricity retailer for this site.

The leisure centre is presently on the anytime energy tariff (L3) which is lower cost than the time of use tariff (R3). The tariff rates are shown in Table 18 Anytime Energy Tariffs (inc GST) and Table 19 Time of Use Tariffs (inc GST).

The table below shows the expected cost for each of the Synergy energy tariffs based upon the past 12 months of metering data. The Solar Assisted columns denote the estimated tariff and savings ($13,158 ex GST p.a.) that could be obtained with a 31.8kW three phase solar PV system installed as has been proposed by one supplier.

	Standard		SOLAR Assisted	
ROLR-SUMMARY	inc GST	ex-GST	inc GST	ex-GST
L3	$34,542	$31,402	$20,069	$18,244
R3	$35,777	$32,525	$20,494	$18,631

Table 25 Synergy Tariff comparison Leisure Centre as is and with 31.8kW solar PV

Savings/pa
$14,473
$15,284

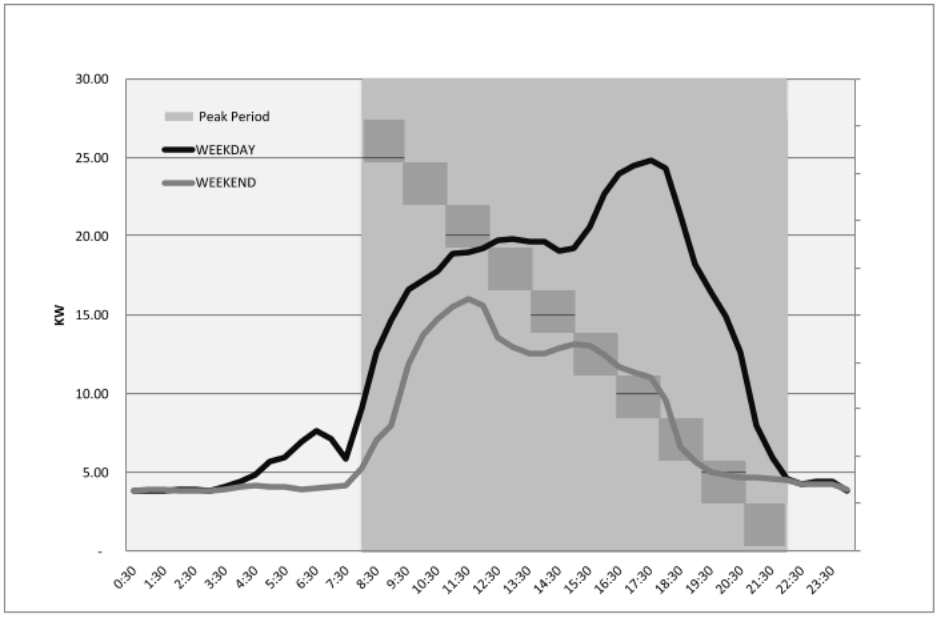
5.3 Electrical Energy Profile

5.3.1 Daily Profile

Figure 1 below shows the annual average week day and week end energy consumption of the site based upon interval metering data from the twelve months March 18 obtained from Western Power. The dark grey shaded area shows the on-peak tariff period during weekdays.

The graph shows there is approximately 4kW of constantly on ("baseload") overnight which is attributed to Gym and security lighting, refrigeration and miscellaneous equipment. The weekend profile shows negligible difference in weekday and weekend operation.

The weekday peak occurs around 6pm when court lighting is highly utilised. The weekend load is lower than the weekday and the peak occurs in the morning about 11.30am.



Daily Average KW Load Profile

Figure 29 Energy profile using Western Power Meter data

5.3.2 Weekly Profile

The figure below shows there is only slight variation in daily energy use between weekdays. Note this is the annual average load (including Winter months) so non-Winter use will be higher.

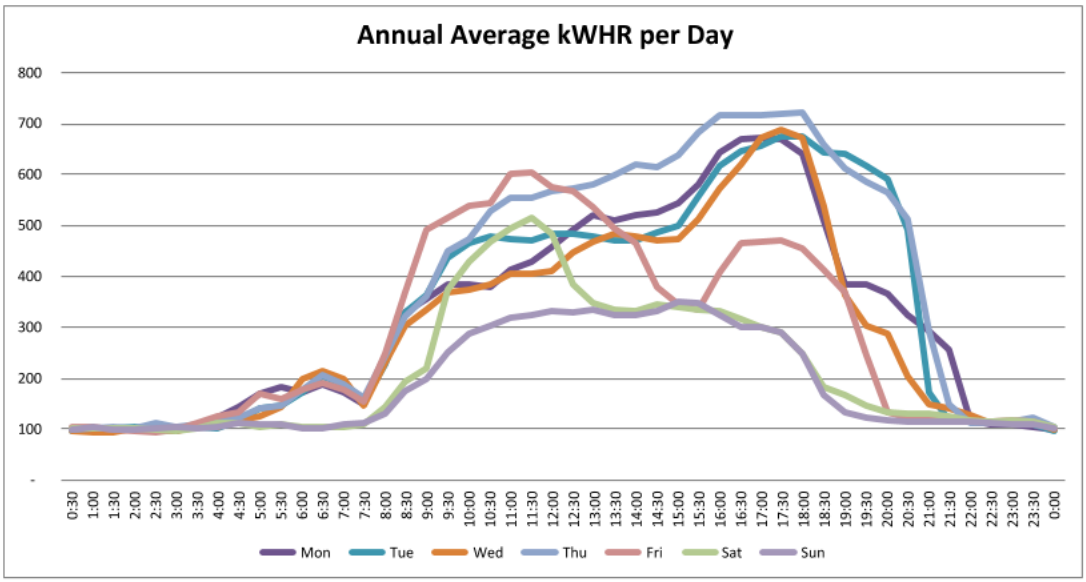


Figure 30 Annual Average energy use by day of week

5.3.3 Seasonal Profile

The figures below shows only slight seasonal variation in energy use.

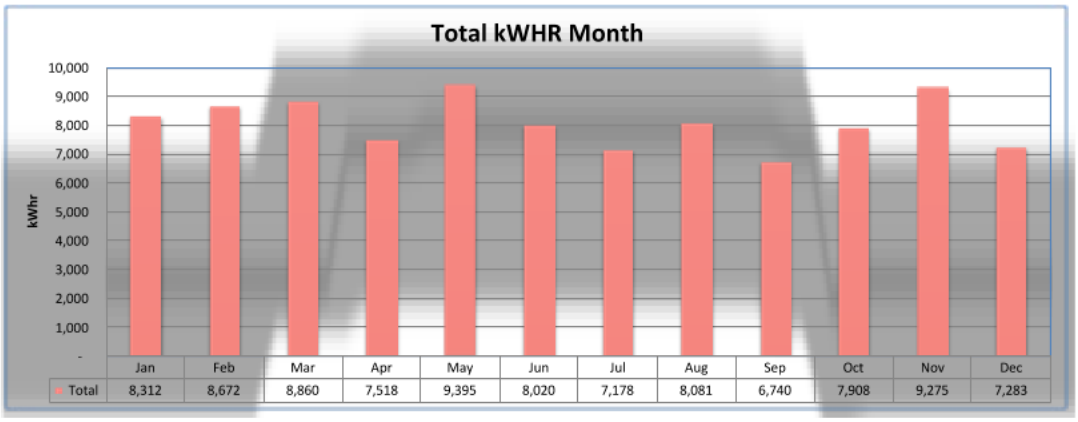


Figure 31 Monthly Energy Import for Pool Apr 17 to Mar 18

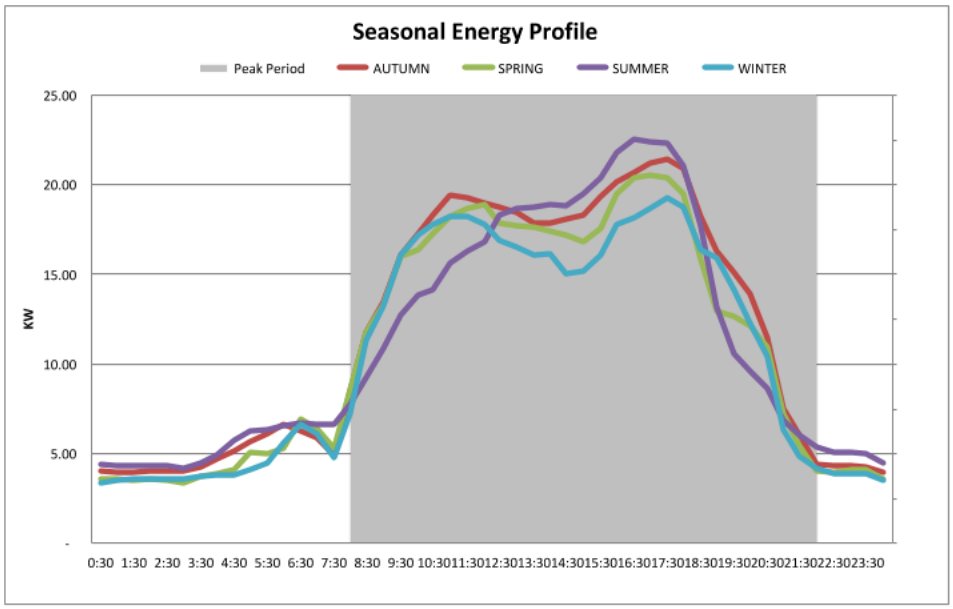


Figure 32 Seasonal Average Daily Energy Profile (Leisure Centre)

5.4 Solar Recommendation

5.4.1 Recommended System Size

The load profile is well suited to a solar PV system. The graph below shows the estimated annual savings (RHS) and payback period (LHS) for various sized solar PV systems using the average per kW cost of the quoted systems, excluding GST and including STC rebates. The graph below shows the optimal size system to maximise RoI is approximately 22kW with 2.5 year payback although there is a wide range of sizes where payback is short. The energy savings rate tapers off above 30kW. As noted previously solar PV systems above 30kW will attract a $5,000 Western Power assessment fee.

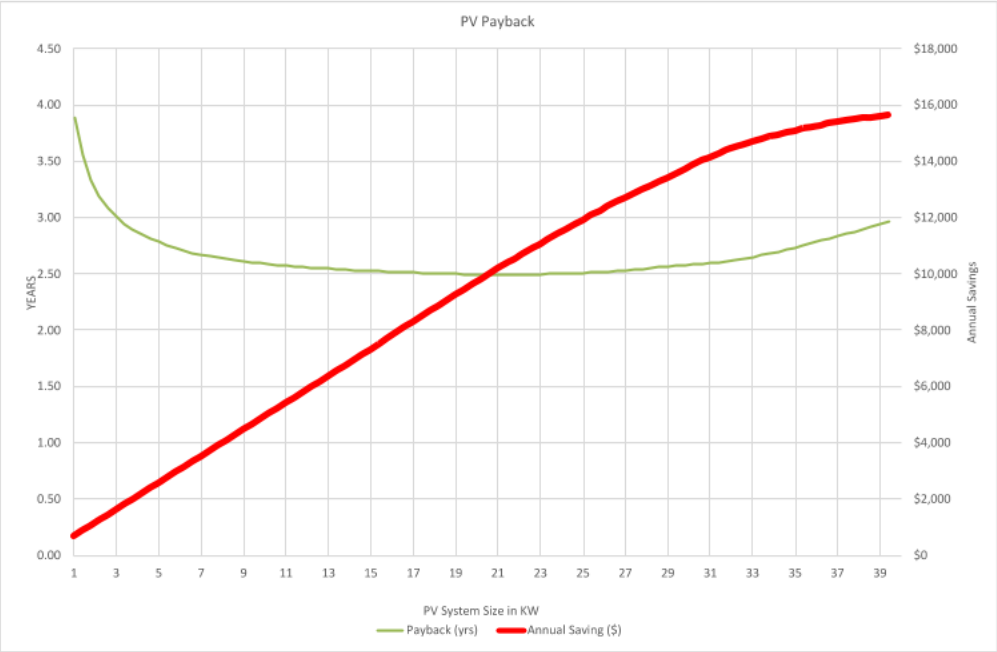


Figure 33 Solar PV savings and payback for Leisure Centre

5.4.2 Available Roof Space

The Leisure centre has plenty of available roof space to install solar PV. The blue shaded area is recommended as it avoids shading from the Northern roof section. The shaded area is 420sqm and this would accommodate approximately 52kW of 250W panels.

Whilst flat mounting of panels is acceptable the yield of the system will be reduced compared to tilt mounting the panels. The ideal orientation is North facing tilted at the latitude of the building (33.5 degrees). If the panels are flat mounted they are likely to produce approximately 13% less energy per annum. We recommend tilt mounting the panels for this reason.

Figure 34 Recommended Roof space for solar PV supplying Leisure Centre

5.4.3 Effect on Grid Import

The figures below show the effect of a 31.8kW solar system (as proposed by SolarGain) on average weekday and weekend grid import. Note that the solar PV output varies significantly by season and will result in a net export of energy to the grid during periods of peak solar output and low load (most weekend days). We estimate for a system of this size 82% of energy would be used on-site with the balance being exported or curtailed during periods of low load. The system will not be eligible for Renewable Energy Buyback Scheme (REBS) credit from Synergy for exported energy (however some other retailers may purchase excess).

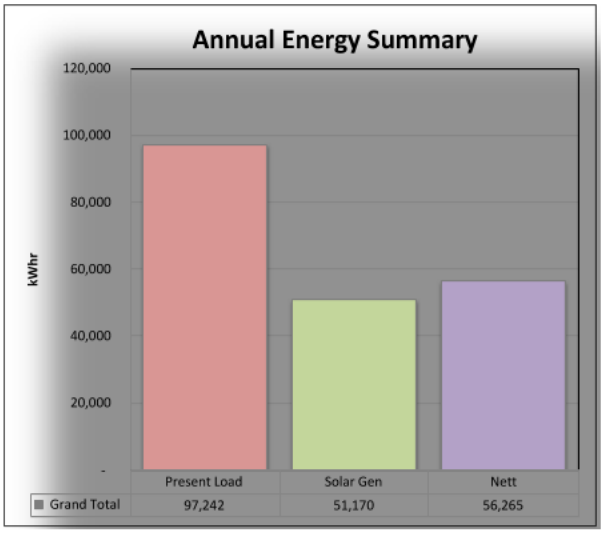


Figure 35 Source of energy with 31.8kW solar PV

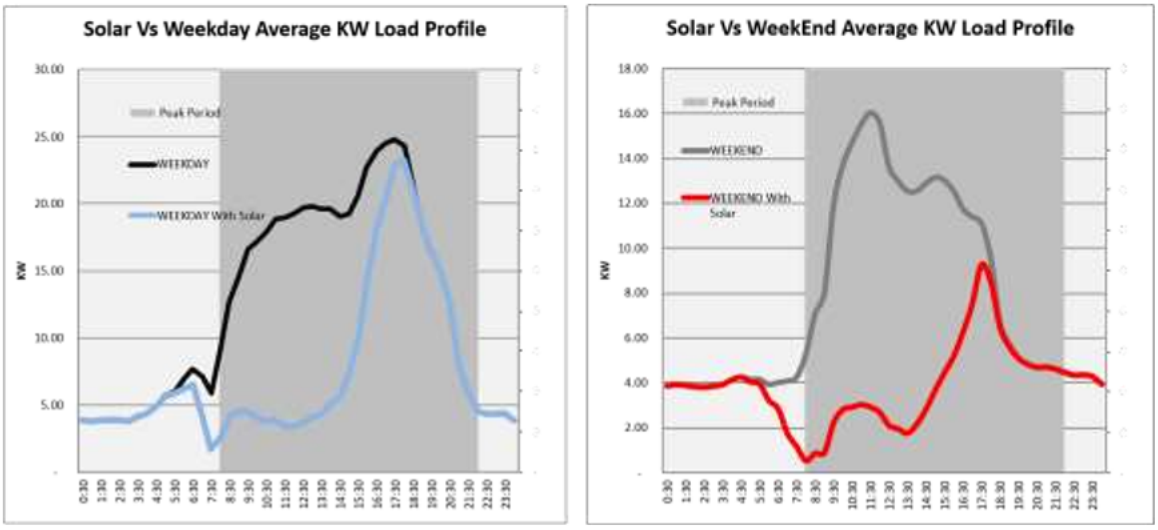


Figure 36 Annual Average Weekday Load profile with 31.8kW Solar

5.4.4 Comparison of Proposals

The table below compares the estimated cost, benefit and simple payback of the various sized systems with the following assumptions[9]:

f) The Quoted Gross Price from each supplier for the specified system size and
g) Calculating the number of STCs available (if installed by Dec 2018) and
h) Assuming the value of the rebate at $35 per STC and
i) Using the estimated savings calculated by H2 energy solutions.

[9] Note that suppliers estimates of STC rebates differ to those shown in the table below. Earlier system installation or higher STC price may have been assumed.

[redacted]

5.5 Equipment Audit

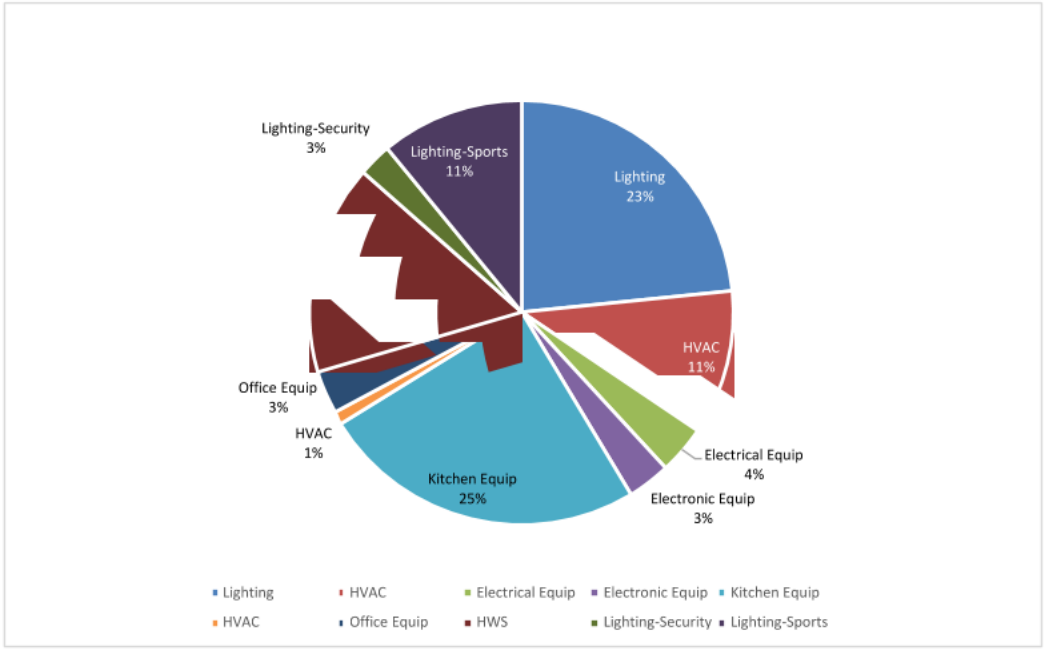
The purpose of the audit is to estimate the energy use attributed to different items and categories of equipment. This can be used to inform estimate of savings from energy conservation or efficiency retrofit (e.g. lighting or equipment upgrade).

The equipment audit uses measurement of equipment power or appliance rating data combined with estimated weekday and weekend hours of operation to determine average weekday and weekend energy use of equipment.

5.5.1 Energy Use by Equipment Type

The audit assumed opening hours stated in section 5.1 with selected kitchen equipment turned on during opening hours (espresso machine, pie warmer and fryer), gym lighting on continuously and court lighting typically from 3pm onward. The audit data and rating information is contained in Annexure 1 to this report.

The estimated contribution to the daily energy use of each equipment type are shown in the figure below. The largest contributors to energy use are kitchen equipment, general lighting, Hot Water Systems (HWS), sports lighting and Heating Ventilation and Air-Conditioning (HVAC).



Leisure Centre

Energy Use by Function

Figure 37 Energy use by equipment type total

5.5.2 Energy Use by Time of Day

The following figure shows the estimated profile of average daily energy use. The increase during the day is due to operation of jet and flow pumps in the leisure pool.

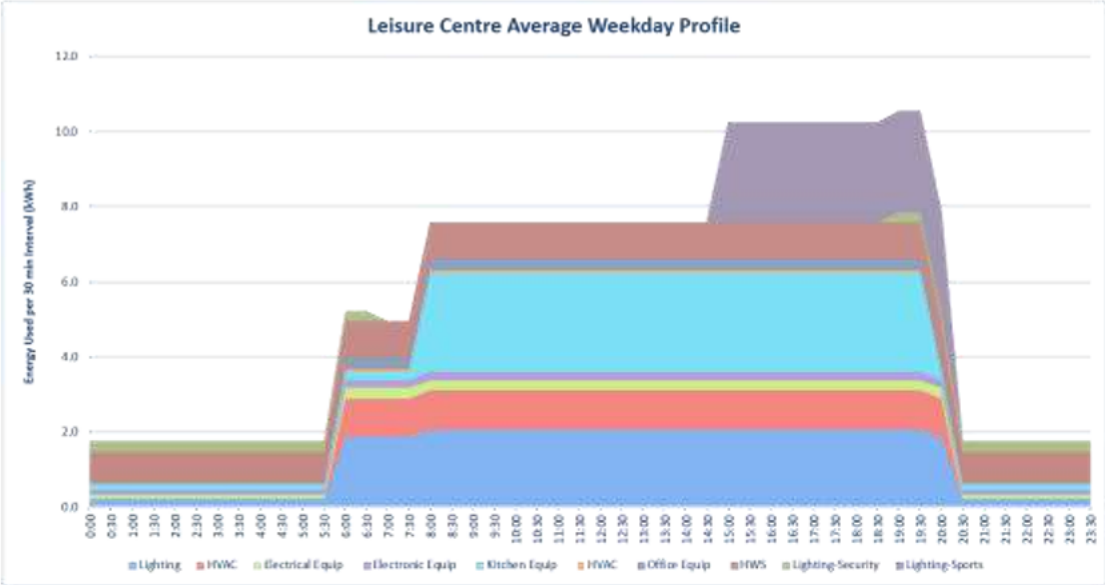


Figure 38 Energy Use by Equipment Type Weekday Time of Use

5.5.3 Energy Use by Area

The following table shows the energy use by area of the Leisure Centre based upon the audit assumptions.

27 Leisure Centre Energy Use by Area

Row Labels	Sum of Total WD kWhr/Day	Sum of Total WE kWhr/Day	Sum of Weekday On Peak kWhr	Sum of Weekday Off Peak	WD %	WE %
1st Floor	13.7	9.5	12.3	1.4		
Upper Gym	13.6	9.4	12.2	1.4	4.98%	3.83%
Upper Gym-Stairs	0.1	0.1	0.1	0.0	0.05%	0.04%
Ground	236.4	212.4	204.9	31.4		
Corridor	5.3	3.6	4.7	0.5	1.93%	1.49%
Male Toilet	2.5	1.7	2.2	0.3	0.91%	0.70%
Kitchen	70.4	60.8	65.5	5.0	25.81%	24.84%
Office	18.7	13.7	17.3	1.4	6.87%	5.59%
All Areas	2.6	2.6	1.6	1.0	0.97%	1.08%
Cafe Foyer	5.3	4.1	4.4	0.9	1.96%	1.66%
Cleaner Room	0.1	0.1	0.1	0.0	0.04%	0.03%
Double Court	0.5	0.4	0.5	0.1	0.19%	0.15%
Female Change Rm	5.6	3.9	5.0	0.6	2.06%	1.59%
Female Toilets	2.5	1.7	2.2	0.3	0.91%	0.70%
Lower Gym	21.8	18.0	16.8	5.1	7.99%	7.36%
Lower Gym - kitchen	6.7	5.1	5.6	1.1	2.46%	2.07%
Lower Gym -Toilet	0.2	0.1	0.2	0.0	0.08%	0.06%
Lower Gym-Store	1.4	1.3	0.9	0.5	0.50%	0.53%
Lower Gym-Store 2	0.1	0.0	0.0	0.0	0.02%	0.01%
Main Foyer	13.6	10.8	11.0	2.7	5.00%	4.39%
Male Change Rm	5.6	3.9	5.0	0.6	2.06%	1.59%
Outdoor	23.9	23.9	14.4	9.5	8.76%	9.77%
Single Court	0.2	0.2	0.2	0.0	0.09%	0.07%
Storage	0.2	0.1	0.2	0.0	0.08%	0.06%
Store	19.2	13.3	17.2	2.0	7.05%	5.42%

Double Court (1)	9.9	14.4	9.9	0.0	3.63%	5.89%
Double Court (2)	9.9	14.4	9.9	0.0	3.63%	5.89%
Single Court 1	9.9	14.4	9.9	0.0	3.63%	5.89%
Outdoor	22.8	22.8	11.3	11.4		
Building Perimeter	22.8	22.8	11.3	11.4	8.35%	9.31%
Grand Total	**272.9**	**244.6**	**228.6**	**44.3**	**100%**	**100%**

5.6 Summary and Recommendations

5.6.1 Tariffs

We recommend the Shire remain on the anytime energy tariff (L3).

5.6.2 Solar PV

We recommend installing up to 30kW of solar PV at the site.

5.6.3 Efficiency Upgrade

5.6.3.1 Compact Fluorescent Lighting Upgrade

The audit noted a prevalence of plug in compact fluorescent (CFL) lamps in recessed fittings which appeared to be 26W CFL (approx. 1800 lumens output).

GE manufacture direct replacement LED lamps which produce the same lumen output but use less power, either 9W (producing 1200 lumen) or 18.5W (producing 1800 lumen) instead of 26W, as shown in the figure Figure 18 GE LED Replacement to CFL Lamps. We have assumed replacement of 55 lamps with 18.5W however some areas may only require lower illumination and can be replaced with 9W to increase savings. The benefits of this upgrade are summarised below:

- Annual Saving (kWh): 2,225 kWh
- Annual Saving ($): $675 ex GST
- Power reduction (kW): 400W

The lamps can be either upgraded as part of a programmed retrofit or may be replaced as existing lamps fail. GE claim the LED lamps have at 50,000 hour rated life and typically last 2.5 time longer than the existing CFL.

The following table lists the CFL fittings, LED upgrade option, location and estimated weekday (WD) and weekend day (WE) energy savings. The annual savings are based upon the estimated operating hours of each lamp.

Table 28 Compact Fluoro Retrofit Savings

Area/Zone	Qty	Watts	Total WD kWhr/Day	Total WE kWhr/Day	LED Upgrade (W)	WD Energy Saving (kWh/day)	WD Saving ($/day)	WE Energy Saving (kWh/day)	WE Saving ($/day)
Cafe Foyer	6	26	1.8096	1.248	18.5	0.52	0.16	0.36	0.11
Corridor	10	26	3.016	2.08	18.5	0.87	0.26	0.60	0.18
Corridor	5	26	1.885	1.3	18.5	0.54	0.16	0.38	0.11
Female Change Rm	1	26	0.406	0.28	18.5	0.12	0.04	0.08	0.02
Female Toilets	1	26	0.377	0.26	18.5	0.11	0.03	0.08	0.02
Lower Gym	12	26	7.488	7.488	18.5	2.16	0.65	2.16	0.65
Main Foyer	18	26	6.786	4.68	18.5	1.96	0.59	1.35	0.41
Male Change Rm	1	26	0.377	0.26	18.5	0.11	0.03	0.08	0.02
Male Toilet	1	26	0.377	0.26	18.5	0.11	0.03	0.08	0.02
	55	**1,430**	**22.5**	**17.9**	**1,018**	**6.5**	**2.0**	**5.2**	**1.6**

Annual Saving (kWh): 2,225

Annual Saving ($): 675

Power reduction (kW): 0.4

Table 29 Simple Payback of CFL upgrade to LED

Measure	Saving $ p.a. (ex GST)	Qty	Replacement Product cost (ex GST)	Install cost (ex GST)	Unit Cost (ex GST)	Total Cost (ex GST)	Simple Payback
LED replacement of CFL	675	55	$15.00	$15.00	$30	$1,650	2.4

Note: the assessment is based upon a ground based visual inspection and light fitting sizes, quantities, plug type and ballast compatibility should be separately assessed by installers prior to ordering parts and materials. *5.6.3.2 Fluorescent Tube Upgrade*

The audit noted many fluorescent T8 style fittings throughout the facility. Each 1200mm T8 fluorescent tube has a 36W rating with double fittings requiring 80W (including ballast). These can be replaced with recessed or batten style equivalent LED fittings which typically use 50% less energy. Replacing all 54 fittings with LED equivalent would lead to estimated annual savings of at least $1,800 ex GST.

- Annual Saving (kWh): 5,989 kWh
- Annual Saving ($): $1,816 ex GST
- Power reduction (kW): 1.9kW

30 Fluorescent tube upgrade savings

Area/Zone	Description	Number	Watts	Total WD kWhr/Day	Total WE kWhr/Day	LED Upgrade (W)	WD Energy Saving (kWh/day)	WD Saving ($/day)	WE Energy Saving (kWh/day)	WE Saving ($/day)
Cleaner Room	Batten Mounted Double Fluro	2	72	0.1	0.1	36	0.05	0.02	0.04	0.01
Female Change Rm	Batten Mounted Double Fluro	5	72	5.2	3.6	36	2.61	0.79	1.80	0.55
Female Toilets	Batten Mounted Double Fluro	2	72	2.1	1.4	36	1.04	0.32	0.72	0.22
Lower Gym - kitchen	Double Fluro	1	72	1.0	0.7	36	0.52	0.16	0.36	0.11
Lower Gym -Toilet	Double Fluro	1	72	0.2	0.1	36	0.10	0.03	0.07	0.02
Lower Gym-Store	Double Fluro	2	72	0.1	0.1	36	0.05	0.02	0.04	0.01
Lower Gym-Store 2	Double Fluro	1	72	0.1	0.0	36	0.03	0.01	0.02	0.01
Male Change Rm	Batten Mounted Double Fluro	5	72	5.2	3.6	36	2.61	0.79	1.80	0.55
Male Toilet	Batten Mounted Double Fluro	2	72	2.1	1.4	36	1.04	0.32	0.72	0.22
Office	Double Fluro	2	72	2.1	1.4	36	1.04	0.32	0.72	0.22
Office	Double Fluro	6	72	5.2	4.3	36	2.59	0.79	2.16	0.65
Storage	Batten Mounted Double Fluro	2	72	0.2	0.1	36	0.10	0.03	0.07	0.02
Store	Batten Mounted Double Fluro	8	72	8.4	5.8	36	4.18	1.27	2.88	0.87
Upper Gym	Double Fluro	15	72	3.9	2.7	36	1.96	0.59	1.35	0.41
		54	**3,888**	**36**	**25**	**1,944**	**17.9**	**5.4**	**12.7**	**3.9**

Annual Saving (kWh): 5,989

Annual Saving ($): 1,816

Power reduction (kW): 1.9

Table 31 Simple Payback for LED upgrade

Measure	Saving $ p.a. (ex GST)	Qty	Replacement Product cost (ex GST)	Install cost (ex GST)	Unit Cost (ex GST)	Total Cost (ex GST)	Simple Payback
LED replacement of batten mount T8 fluoro	1,816	108	$8.55	$10.00	$18.55	$2,003	1.1

5.6.3.3 Court Lighting Upgrade

We were advised the 400W hi-bay halogen court lights (45 in total) are to be replaced with 250W LED fittings. We have estimated the savings from these measure below. Note that the audit assumes the lights operate 30% of the time between 3pm and 8.30pm on weekdays and between 10am and 6pm on weekends, a total of 13 hours per week. If the operating hours are significantly longer then the savings will be higher.

- Annual Saving (kWh): 1,389 kWh
- Annual Saving ($): $421 ex GST
- Power reduction (kW): 6.8kW

Table 32 LED upgrade to court lighting

Area/Zone	Number	Watts	Total WD kWhr/Day	Total WE kWhr/Day	LED Upgrade (W)	WD Energy Saving (kWh/day)	WD Saving ($/day)	WE Energy Saving (kWh/day)	WE Saving ($/day)
Double Court (1)	15	400	9.9	14.4	250	3.71	1.13	5.40	1.64
Double Court (2)	15	400	9.9	14.4	250	3.71	1.13	5.40	1.64
Single Court 1	15	400	9.9	14.4	250	3.71	1.13	5.40	1.64
	45	**18,000**	**30**	**43**	**11,250**	**11.1**	**3.4**	**16.2**	**4.9**

5.6.3.4 Air-conditioning Upgrade

The audit noted four Daikin FTXS71JVMA split system air conditioners and one Panasonic of unidentified model. The Daikin units provide 7.1kW cooling with input rating of 2.4kW yielding an EER of 3.0. As noted in section 2.6.3.3 there are more efficient newer models available (EER of 3.4 or higher, would provide approximately 10% reduction in energy use), however, the payback will be many years so this measure is prioritised below lighting, solar PV and energy conservation measures.

5.6.4 Energy Conservation

Other measures the Shire may wish to consider:

- The kitchen equipment uses significant amount of energy. We recommend reviewing the operating hours of the oil fryer, pie warmer and coffee machine as these are the major energy users.
- The gym lighting could be placed on a manual button timer after hours (say 1.5 hours of operation when pressed) with selected entrance lighting left permanently on.
- Installation of occupancy sensors onto lighting and ventilation fans in areas not requiring continuous lighting, such as change rooms and store rooms, where not already fitted will typically have a short payback period.

6 Visitor Centre

6.1 Overview of site:

The single storey Visitor Centre is located on the main street and operates 7 days a week. The weekday hours are 9-5, Saturday 9-3 and Sunday 9-12. The building consists of 3 Office areas, a large display area with a reception desk and 2 large galleries.

There is a staff kitchen and public bathrooms. One of the separate offices is staffed by the local Landcare Group and their rangers use this area during office hours. Access to this office is via the Visitor centre entrance or by a separate car park entrance. Another locked office on the northern most part of the building is used by the blues festival organisers. This area can only be accessed via an external door. All of these areas are monitored by the same electricity meter and paid for by the Shire.

6.2 Electricity Supply & Tariff:

Supply to the centre is via a three phase LV supply. The Visitor Centre uses on average 22,800 kWh p.a. and is not a contestable load.

- NMI 8001070812
- Meter 0530219341 – basic meter
- Tariff: Home Business Plan (K1)
- Rate: \$0.3055/kWh 1st 20 unit; \$0.266858 after
- Supply: \$0.4898/day

The centre is on a Home Business Plan (K1) tariff which gives a marginally lower rate than the L1 Tariff. The R1 tariff is marginally cheaper than the K1 tariff but if solar PV is installed then we recommend remaining on the K1 tariff.

Table 33 Tariff comparison Visitor Centre without and with 10kW solar PV

	L1	R1	K1
Without Solar	\$6,758	\$6,662	\$6,724
With Solar	\$2,676	\$2,957	*\$2,541*
Savings	4,082	3,705	4,183

6.3 Electrical Energy Profile:

From the basic meter reads above, we can observe the centre uses more energy in winter periods than the summer. The Centre uses a basic meter with one reading per bill cycle and the profile is derived from our analysis of the load patterns.

6.3.1 Energy Use by Season

The following figure shows the energy use by month based upon the Western Power bimonthly meter reads. The figure shows a noticeable increase in energy use during Winter, probably due to increase use of air-conditioning and radiator heaters.

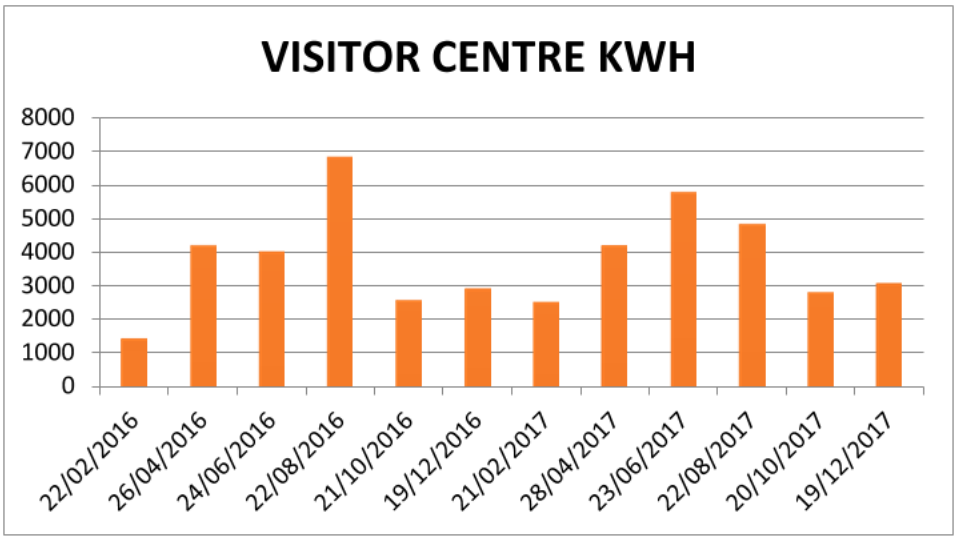


Figure 39- Visitor Centre Energy Use

6.4 Equipment Audit

6.4.1 Energy Use by Equipment Type

The following figure illustrates the energy use by equipment type. Air-conditioning (HVAC) is the largest load group followed by office equipment and lighting.

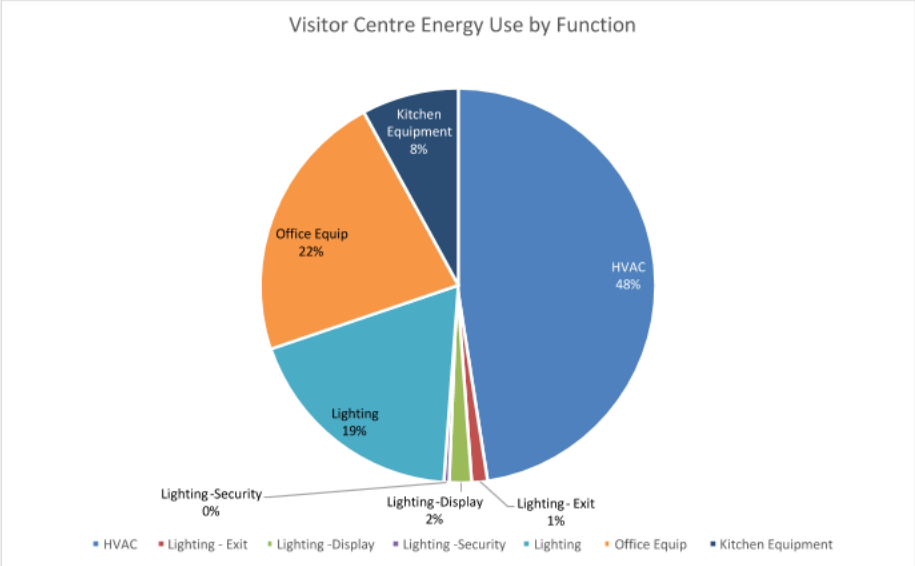


Figure 40 – Visitor Centre Energy use by Equipment type

6.4.1.1 HVAC

There is a large Ducted AC system that supports the main building area being the Display Area, museum, Gallery and Offices. We noted a dedicated split AC system for the separate Blues Office. There are no timer systems in place for the main AC system and is operated manually by the staff on arrival and exit.

In our audit, we noted the office and front reception staff have individual portable electric heaters. H2ES were advised these are turned on in the winter months early in the morning until the HVAC system heats the area evenly. These heaters contribute approx. 18% to the AC load group as shown in Figure 41 conservatively adding $350 p.a. to the energy Invoice.

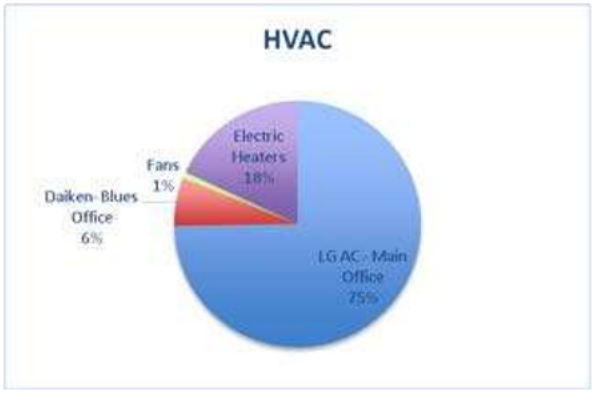


Figure 41 - HVAC allocation showing Electric Heaters

6.4.2 Energy Use by Time of Day

The following figure illustrates the energy used by time of day.

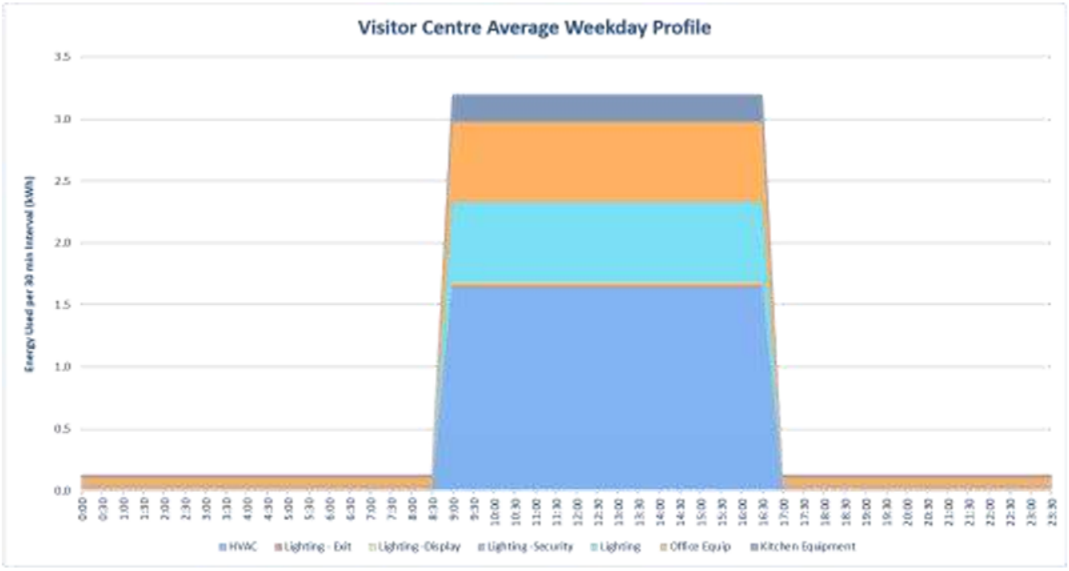


Figure 42 Energy Use by time of day

6.4.3 Energy Use by Area

The following table shows the energy use by area of the Visitor Centre. Note, All Area denotes energy use spread across areas, such as HVAC.

Table 34 Energy Use by Area

Row Labels	Sum of Total WD kWhr/Day	Sum of Total WE kWhr/Day	Sum of Weekday On Peak kWhr	Sum of Weekday Off Peak kWhr	WD %	WE %
Kitchen	4.5	3.2	4.0	0.5	8.1%	8.9%
Office	4.8	3.0	4.8	0.0	8.7%	8.2%
All Area	22.3	14.2	22.0	0.3	40.4%	38.8%
External Building	0.8	1.0	0.3	0.5	1.5%	2.6%
Jigsaw	2.9	1.8	2.9	0.0	5.2%	4.9%
Landcare Office	3.4	2.1	3.4	0.0	6.1%	5.8%
Main Display	3.0	1.9	3.0	0.0	5.4%	5.1%
Mens	0.2	0.1	0.2	0.0	0.3%	0.3%
Museum	2.6	1.6	2.6	0.0	4.7%	4.4%
Reception	9.5	7.0	8.3	1.2	17.1%	19.2%
Store	0.1	0.1	0.1	0.0	0.3%	0.2%
Womens	0.2	0.1	0.2	0.0	0.3%	0.3%

Blues Office	1.0	0.4	1.0	0.0	1.8%	1.1%
Grand Total	**55.3**	**36.6**	**52.9**	**2.4**	**100%**	**100%**

6.5 Solar Recommendation

6.5.1 Recommended System Size

The solar vendors submitted PV proposals ranging from 6.625 (2), 10.56 kW to 15 KW. We have used the vendors average gross system prices per kW, estimate of the STC rebate assuming installation by December 2018 and our estimate of annual savings to determine the savings and simple payback[10].

Figure 43 indicates an optimum payback period of 3.4 years for a system up to 12 kW. After that time, the PV system has paid for itself and should continue operating for another 20+ years.

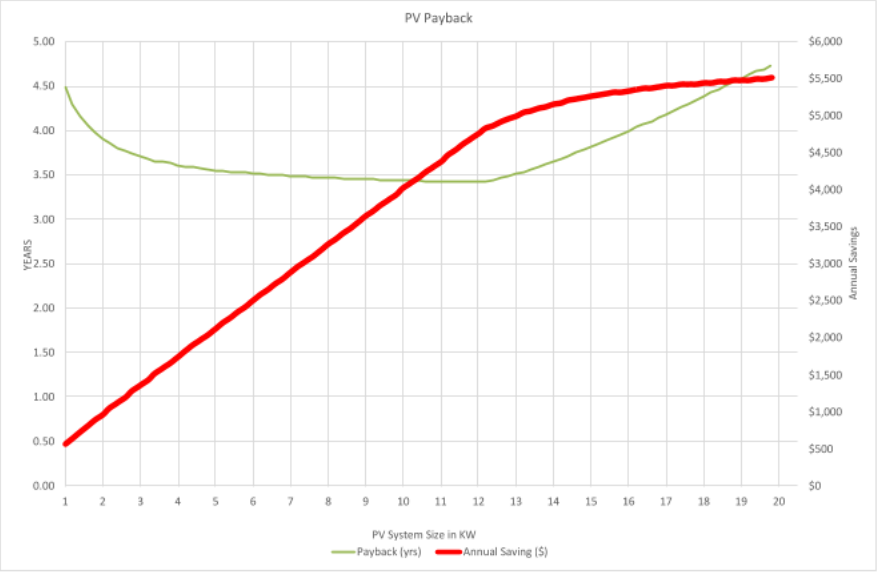


Figure 43 - Savings vs Payback period

6.5.2 Effect on Grid Import

The following charts show the existing load profiles with these PV system sizes applied and the impact on the energy used on site.
The figures below show the weekday and weekend energy-use profiles (grey line) derived from our audit. The weekend profile is similar to the weekday but has shorter working hours. The average output of a 10.5kW PV system is shown in Yellow. The Orange line is the resultant energy used by the Visitor centre. Energy saving is the difference between the Grey Trend and the Orange trend. Where the load is lower than the PV generation, the excess energy is exported to the network.

[10] We note vendors proposals assume all solar PV generated on site reduces the energy costs. H2ES estimate the amount of energy able to be used onsite for each system size and determine savings based upon the applicable tariff.

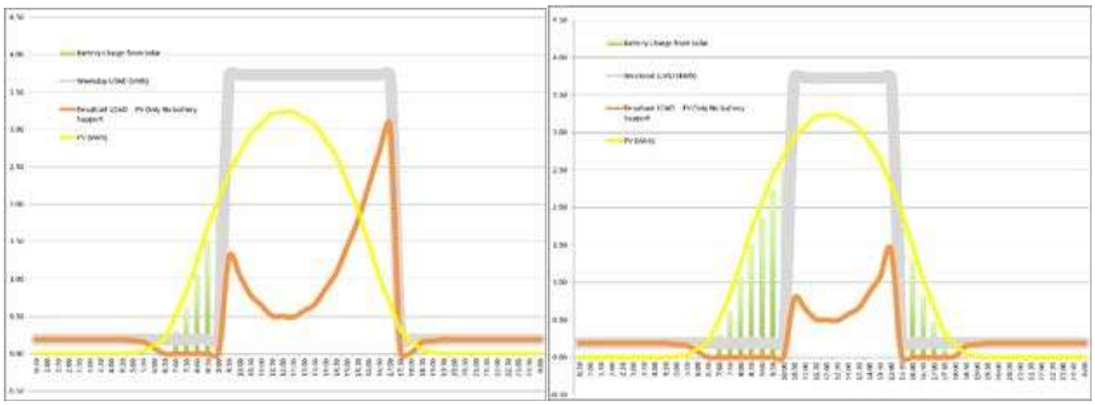


Figure 44 - Weekday and Weekend Profiles with 10.5kW PV system

6.5.3 Available Roof Space

The Visitor centre has a long north-facing roof line that can accomadate upto 10kW of PV. It may be possible to utilise other roof lines to increase the area but there are critical dependancies to consider:

- The roof structure is able to support the PV solar panels
- A shade analysis of the selected roof area needs to be perfromed to confirm PV effeciency through all seasons.

Figure 45 - PV roof area analysis

6.5.4 Comparison of Proposals

Each vendor has supplied a cost for each site. These costs are based on equipment purchase with a credit applied from the surrendered STC's. Our examination of each quote shows varying purchase costs and different refund amounts between each vendor and each site[11].

[11] A Small PV site costs more $/kW to install than a large site. This is because fixed costs such as design, travelling, site access and setup will apply to all sites. Larger sites however can take advantage of economies-of-scale etc. to reduce cost/kW.

Please note prices and payback period can vary due to:

- STC charges are market driven and typically vary between $40 to as low as $29 (in July last year) reducing the credit applied to the PV system charge.
- The number of STC's issued per kWh of renewable energy reduce every year. The PV quotes were obtained in 2017 whereas the work will probably be performed in 2018 or even 2019. As STC's are generated upon installation, fewer STC's will be generated and will impact the credit on the PV equipment. Our estimate
- Market prices for technology are constantly reducing although now starting to bottom out
- Energy price increases making the payback period shorter. Ie the installed system is paying itself off faster.

6.6 Recommendations

6.6.1 Tariffs

We recommend the Shire remain on the K1 tariff. The site is not contestable so cannot move to another retailer.

6.6.2 Solar PV

We recommend installing approximately 10kW[12] of solar PV at the site with estimated saving of $4K p.a. ex GST.

6.6.3 Efficiency Upgrade

6.6.3.1 Fluorescent Tube Upgrade

The lights in the museum, main display/office and Jigsaw exhibition areas are predominately magnetic ballast 1200mm fluorescents tubes (36W). These lights are on whenever the Visitor Centre is open. We recommend replacing these 26 luminaires with LED luminaires that will reduce consumption in these areas by approximately 50% $420 pa saving.

Table 36 Fluorescent tube Upgrade savings at Visitor Centre

Area/Zone	Description	Number	Watts	Total WD kWhr/Day	Total WE kWhr/Day	LED Upgrade (W)	WD Energy Saving (kWh/day)	WD Saving ($/day)	WE Energy Saving (kWh/day)	WE Saving ($/day)
External Building	Batten Mounted Fluro	2	72	0.2304	0.2736	36	0.12	0.03	0.14	0.04
Jigsaw	Fluro Batten twin fitting	5	72	2.88	1.8	36	1.44	0.43	0.90	0.27
Landcare Office	Fluro Batten Twin Fitting	1	72	0.576	0.36	36	0.29	0.09	0.18	0.05
Main Display	Fluro Batten single fitting	7	36	2.016	1.26	18	1.01	0.30	0.63	0.19
Main Display	Fluro Batten twin fitting	1	72	0.576	0.36	36	0.29	0.09	0.18	0.05
Museum	Fluro Batten single fitting	7	36	2.016	1.26	18	1.01	0.30	0.63	0.19
Museum	Fluro Batten twin fitting	1	72	0.576	0.36	36	0.29	0.09	0.18	0.05

[12] A roof inspection and shade analysis will need to be performed to confirm PV location on roof.

Office	Fluro Batten twin fitting	1	72	0.576	0.36	36	0.29	0.09	0.18	0.05
Blues Office	Fluro Batten twin fitting	1	72	0.0576	0.036	36	0.03	0.01	0.02	0.01
		26	**1,368**	**9.5**	**6.1**	**684**	**4.8**	**1.4**	**3.0**	**0.9**

- Annual Saving (kWh): 1,393
- Annual Saving ($): $420
- Power reduction (kW): 0.7

Table 37 Simple Payback of LED upgrade

Measure	Saving $ p.a. (ex GST)	Qty	Replacement Product cost (ex GST)	Install cost (ex GST)	Unit Cost (ex GST)	Total Cost (ex GST)	Simple Payback
LED replacement of batten mount T8 fluoro	420	38	$8.55	$10.00	$18.55	$705	1.7

6.6.3.2 CFL Upgrade

The small storeroom, kitchen and bathrooms all use bayonet CFL's. The exit signs could be replaced with LED types when they reach their end-of-life.

Table 38 CFL Upgrade savings at Visitor Centre

Area/Zone	Description	Number	Watts	Total WD kWhr/Day	Total WE kWhr/Day	LED Upgrade (W)	WD Energy Saving (kWh/day)	WD Saving ($/day)	WE Energy Saving (kWh/day)	WE Saving ($/day)
Kitchen	Compact Fluro	1	18	0.144	0.09	9.5	0.07	0.02	0.04	0.01
Mens	Compact Fluro	1	18	0.04752	0.0297	9.5	0.02	0.01	0.01	0.00
Store	Compact Fluro	1	18	0.144	0.09	9.5	0.07	0.02	0.04	0.01
Womens	Compact Fluro	1	18	0.04752	0.0297	9.5	0.02	0.01	0.01	0.00
		4	**72**	**0.4**	**0.2**	**38**	**0.2**	**0.1**	**0.1**	**0.0**

- Annual Saving (kWh): 53
- Annual Saving ($): $16

It is not recommended to upgrade these CFL as they are low utilisation with long payback.

6.6.3.3 Halogen Display Lighting Upgrade

A set of fifteen (15) 50W halogen downlights run along the internal windows to illuminate the street facing displays. The staff advise these are not used and they are in a dilapidated state with globes hanging down and some are missing. We suggest the total removal and replacement with approximately eight (8) 10W Led downlights – one per bay window. This will enhance the front of the Visitor centre, and give good overnight illumination with little energy cost

6.6.3.4 External Lighting

Consist of Wall mounted batten Fluros. Only two are left on overnight and because these lights are not utilised fully, replacing these lights with efficient LED equivalents will not be economical. However we do suggest an LED upgrade when these lights have reached end-of-life and need replacing.

7 Fire Control Centre

7.1 Overview of Site

The fire control centre is located on Woodhead Avenue and comprises a fire control administration building, adjoining vehicle storage and a separate shed.

The normal attendance hours are 8.30am to 5pm Mon to Fri with a skeleton staff. During these times only a small portion of the building is lit and air-conditioned. The centre may be attended at other times in case of emergency and would be more fully utilised. This site has been assessed for solar and energy efficiency based upon standby (non-emergency) operation.

7.2 Electricity Supply & Tariff

The site is supplied from a three phase Low Voltage (LV) electricity supply which is accumulation metered from a meter enclosure located on the pole on the road verge.

- NMI 80021605969
- Meter 0530116800
- Tariff: Anytime Energy Business Plan (L1)
- Rate: $0.3032/kWh (ex GST)
- Supply: $0.4613/day

The electricity supply doesn't meet the threshold for contestability (50,000 kWh p.a.) as its metered consumption for the 12 months from March 17 to February 18 was 12,887kWh.

The Fire Control Centre is presently on an anytime energy tariff (L1). It will be more cost effective to change to a time of use (R1) tariff with estimated annual savings of $300 p.a. The tariff rates are shown in Table 18 Anytime Energy Tariffs (inc GST) and Table 19 Time of Use Tariffs (inc GST).

The table below shows the expected cost for each of the Synergy energy tariffs based upon the past 12 months of metering data. The "With Solar" row denotes the estimated tariff and savings ($2,364 ex GST p.a.) that could be obtained with a 6.5kW solar PV system on the existing tariff and a further $265 ex GST p.a. that could be obtained on the R1 tariff.

Table 39 Synergy Tariff comparison Fire Control Centre as is and with 6.5kW solar PV

	L1	R1
Without Solar	*$4,606*	*$4,306*
With Solar	*$2,242*	*$1,977*
Saving	**2,364**	**2,329**

7.3 Electrical Energy Profile

7.3.1 Seasonal Profile

The figure below shows only slight seasonal variation in energy use with the exception of Feb 2017 which may have been due to an emergency event.

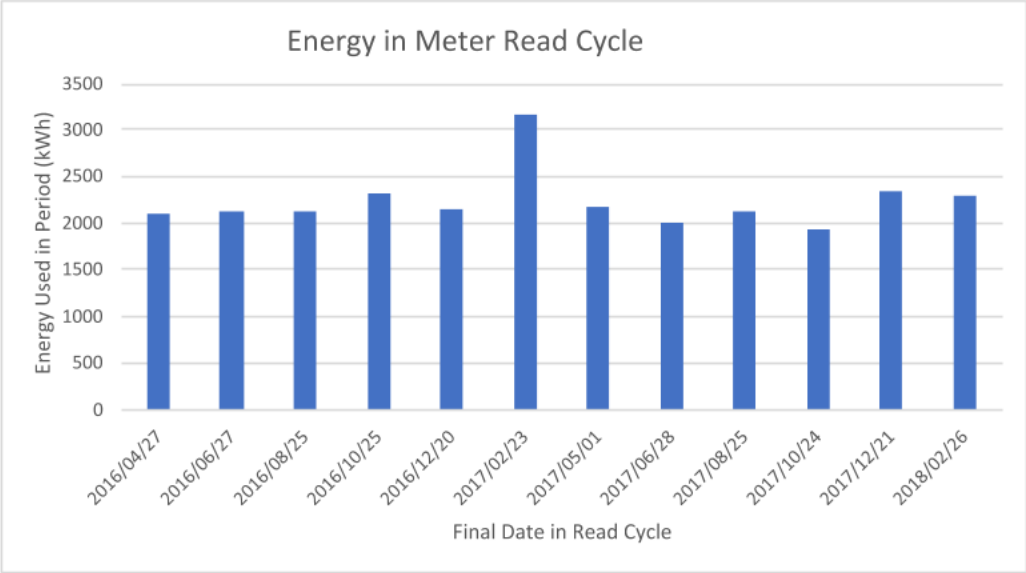


Figure 46 Monthly Energy Import for Fire Control Centre

7.3.2 Recommended System Size

The load profile is suited to a small to medium solar PV system. The graph below shows the estimated annual savings (RHS) and payback period (LHS) for various sized solar PV systems using the average per kW cost of the quoted systems, excluding GST and including STC rebates. The graph below shows the optimal size system to maximise RoI is between 4kW and 6kW which will achieve approx. 4.3 year payback. Note this is based upon an average price across quotations received. The energy savings rate tapers off above 6kW.

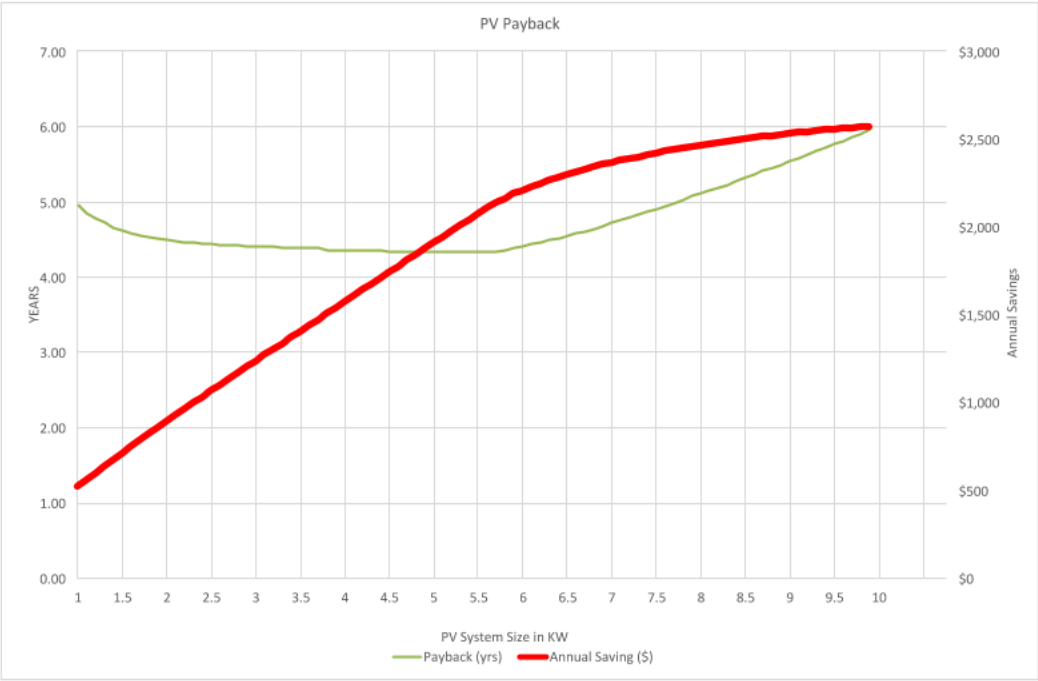


Figure 47 Solar PV savings and payback for Fire Control Centre

7.3.3 Available Roof Space

The fire control centre has plenty of available roof space to install solar PV. The orange shaded area is recommended. The shaded area is 100sqm and this would accommodate approximately 10kW of 250W panels.

Figure 48 Recommended Roof space for solar PV supplying Fire Control Centre

7.3.4 Effect on Grid Import

The figures below show the effect of a 6.5kW solar system (as proposed by Down South Solar) on average weekday and weekend grid import. Note that the solar PV output varies significantly by season and will result in a net export of energy to the grid during periods of peak solar output and low load (most weekend days). We estimate for a system of this size 74% of energy would be used on-site with the balance being exported during periods of low load (mainly weekends). The system will not be eligible for Renewable Energy Buyback Scheme (REBS) credit from Synergy for exported energy.

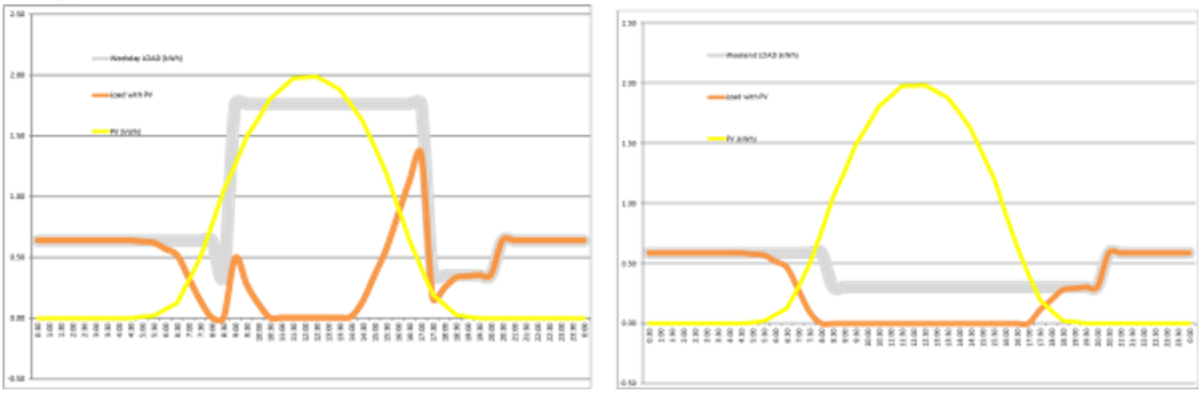


Figure 49 Annual Average Weekday and Weekend Load profile with 6.5kW Solar

7.3.5 Comparison of Proposals

The table below compares the estimated cost, benefit and simple payback of the various sized systems with the following assumptions[13]:

a) The Quoted Gross Price from each supplier for the specified system size and
b) Calculating the number of STCs available (if installed by Dec 2018) and
c) Assuming the value of the rebate at $35 per STC and
d) Using the estimated savings calculated by H2 energy solutions.

7.4 Equipment Audit

The purpose of the audit is to estimate the energy use attributed to different items and categories of equipment. This can be used to inform estimate of savings from energy conservation or efficiency retrofit (e.g. lighting or equipment upgrade).

The equipment audit uses measurement of equipment power or appliance rating data combined with estimated weekday and weekend hours of operation to determine average weekday and weekend energy use of equipment.

7.4.1 Energy Use by Equipment Type

The audit assumed opening hours from 8.30am to 5pm on weekdays where there is a skeleton staff. Emergency operation is likely to change the load profile significantly due to the operation of water pumps and occupation of the remainder of the building. This assessment is indicative of nonemergency use. The audit data and rating information is contained in Annexure 1 to this report.

The estimated contribution to the daily energy use of each equipment type are shown in the figure below. The largest contributors to energy use are kitchen equipment, HVAC, lighting and electronic equipment.

[13] Note that suppliers estimates of STC rebates differ to those shown in the table below. Earlier system installation or higher STC price may have been assumed.

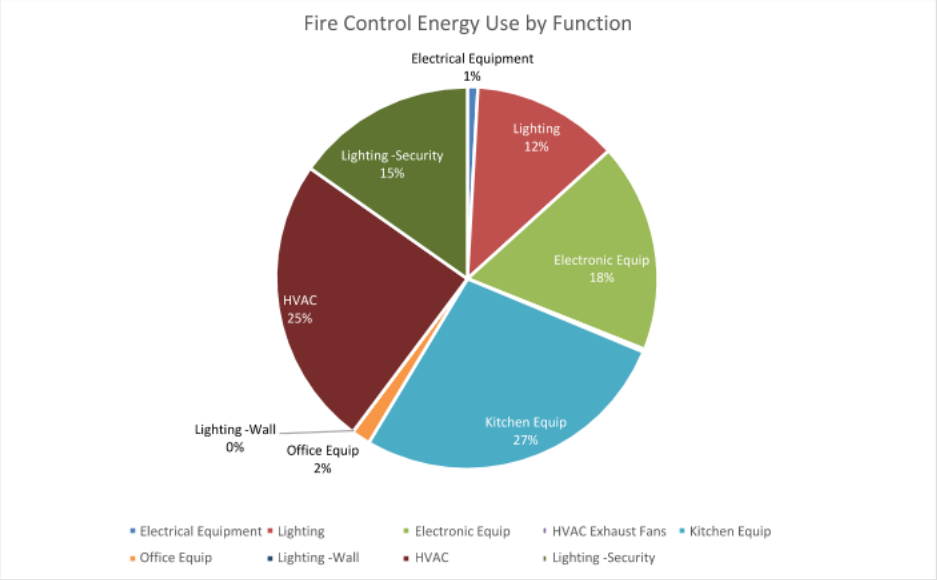


Figure 50 Energy use by equipment type total

7.4.2 Energy Use by Time of Day

The following figure shows the estimated profile of average daily energy use.

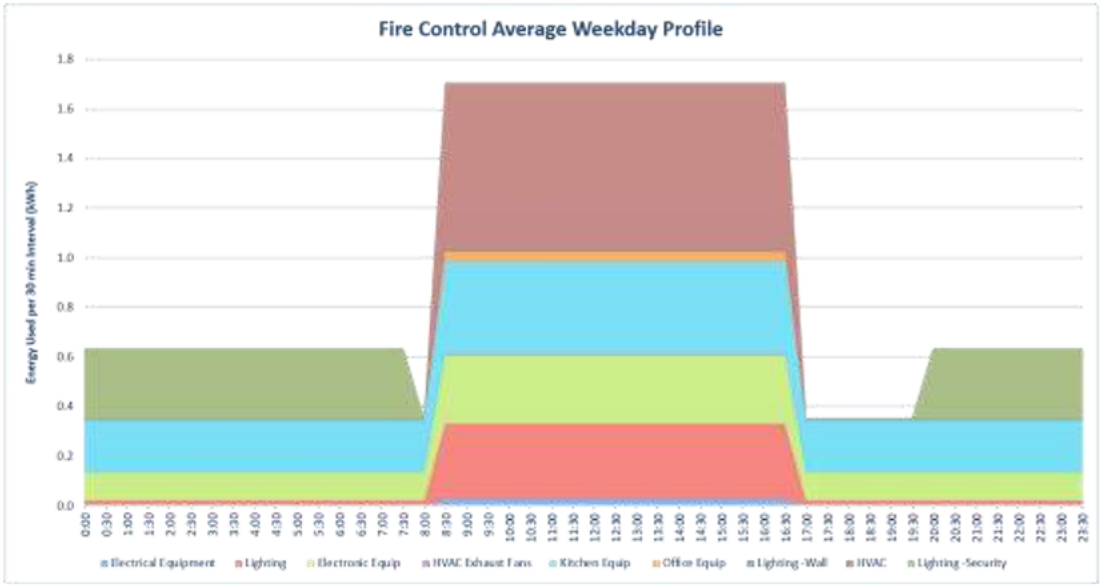


Figure 51 Energy Use by Equipment Type Weekday Time of Use

7.4.3 Energy Use by Area

The following table shows the energy use by area of the Fire Control Centre based upon the audit assumptions.

Table 41 Fire Control Centre Energy Use by Area

Row Labels	Sum of Total WD kWhr/Day	Sum of Total WE kWhr/Day	Sum of Weekday On Peak kWhr	Sum of Weekday Off Peak kWhr	WD %	WE %
Ground	28.2	11.8	21.6	6.6		

Female Toilet	0.1	0.0	0.1	0.0	0.18%	0.00%
Foyer	3.1	0.0	3.1	0.0	6.41%	0.00%
Male Toilet	0.1	0.0	0.1	0.0	0.18%	0.00%
Kitchen	9.4	1.7	6.8	2.6	19.65%	8.07%
Air Ops	0.0	0.0	0.0	0.0	0.04%	0.00%
All Area	1.0	1.0	0.6	0.4	2.01%	4.47%
Bush Fire	1.7	0.0	1.7	0.0	3.60%	0.00%
Communications	5.5	5.5	3.3	2.2	11.57%	25.73%
Incident Controller	1.7	0.0	1.7	0.0	3.60%	0.00%
Logistics	0.7	0.0	0.7	0.0	1.46%	0.00%
Open Area	0.2	0.0	0.2	0.0	0.49%	0.00%
Operations	0.3	0.0	0.3	0.0	0.72%	0.00%
Planning	1.2	1.1	0.7	0.4	2.44%	4.95%
Public Information	0.1	0.0	0.1	0.0	0.12%	0.00%
Store	2.5	2.5	1.5	1.0	5.26%	11.60%
Unisex Toilet	0.1	0.0	0.1	0.0	0.13%	0.00%
Vehicle Shed	0.6	0.0	0.6	0.0	1.23%	0.20%
External	18.8	7.9	13.3	5.5		
Outside Pad	11.8	0.9	11.8	0.0	24.72%	4.20%
Walls	6.9	6.9	1.4	5.4	14.39%	31.99%
Pole	0.1	0.1	0.1	0.0	0.25%	0.56%
Outdoor	0.7	1.8	0.7	0.1		
Pump Shed	0.6	1.6	0.6	0.0	1.18%	7.38%
New Shed	0.2	0.2	0.1	0.1	0.38%	0.84%
Grand Total	**47.7**	**21.5**	**35.6**	**12.1**	**100%**	**100%**

7.5 Summary and Recommendations

7.5.1 Tariffs

We recommend the Shire switch from the anytime energy tariff (L1) to the time of use tariff (R1) with expected savings of $300 p.a.

7.5.2 Solar PV

We recommend installing approx. 6kW of solar PV at the site.

7.5.3 Efficiency Upgrade

The building is quite modern and due to low utilisation the most cost effective method to reduce energy cost (other than through energy conservation) will be installation of a solar PV system and upgrade of selected lighting with high utilisation. Upgrade of equipment with low utilisation are likely to have a long payback.

7.5.3.1 LED lighting upgrade to regular use fluorescent lamps

The following table shows where energy efficiency savings can be made by upgrading fluorescent tubes to LED lighting. As only a portion of the building is used during midweek we recommend upgrading lamps (total of 9 tubes) in those areas in regular use (highlighted yellow) as this will achieve approx. 90% of the savings compared to upgrading all lights. We estimate the following savings:

- Annual Saving (kWh): 714 kWh
- Annual Saving ($): $217 ex GST

Table 42 LED lighting upgrade savings

Area/Zone	Description	Number	Watts	Total WD kWhr/Day	Total WE kWhr/Day	LED Upgrade (W)	WD Energy Saving (kWh/day)	WD Saving ($/day)	WE Energy Saving (kWh/day)	WE Saving ($/day)
Foyer	1200mm Fluoro Double	5	72	3.06	-	36	1.53	0.46	-	-

Walls	600mm Batten Mounted Fluoro	2	36	0.86	0.86	18	0.43	0.13	0.43	0.13
Bush Fire	1200mm Fluoro Double	1	72	0.61	-	36	0.31	0.09	-	-
Incident Controller	1200mm Fluoro Double	1	72	0.61	-	36	0.31	0.09	-	-
Kitchen	Fluoro Double	2	72	0.12	-	36	0.06	0.02	-	-
Open Area	Batten1200mm Fluoro Double	9	72	0.11	-	36	0.06	0.02	-	-
Vehicle Shed	Batten 1200mm Fluoro Double F	8	72	0.10	-	36	0.05	0.01	-	-
Vehicle Shed	Single Wall Mounted Fluoro with	1	36	0.04	0.04	18	0.02	0.01	0.02	0.01
Operations	1200mm Fluoro Double	2	72	0.02	-	36	0.01	0.00	-	-
Public Information	1200mm Fluoro Double	2	72	0.02	-	36	0.01	0.00	-	-
Planning	1200mm Fluoro Double	1	72	0.01	-	36	0.01	0.00	-	-
Public Information	1200mm Fluoro Double	1	72	0.01	-	36	0.01	0.00	-	-
Store	Fluoro Double	1	72	0.01	-	36	0.01	0.00	-	-
Logistics	Wall Mount Fluoro Single	1	72	0.01	-	36	0.01	0.00	-	-
		37	**2,556**	**5.6**	**0.9**	**1,278**	**2.8**	**0.9**	**0.5**	**0.1**

Annual Saving (kWh): 714

Annual Saving ($): 217

Table 43 Simple Payback of T8 fluoro upgrade

Measure	Saving $ p.a. (ex GST)	Qty	Replacement Product cost (ex GST)	Install cost (ex GST)	Unit Cost (ex GST)	Total Cost (ex GST)	Simple Payback
LED replacement of batten mount T8 fluoro	217	16	$8.55	$10.00	$18.55	$297	1.4

7.5.4 Energy Conservation

Other measures the Shire may wish to consider:

- Installation of occupancy sensors onto lighting and ventilation fans in areas not requiring continuous lighting, such as change rooms and store rooms, where not already fitted will typically have a short payback period.

8 Operations Depot

8.1 Overview of Site

The operations depot is located on Woodhead Avenue and comprises a number of offices, work shops and storage sheds. There is a single meter which supplies the sports ground and the depot. It is not possible to determine from metered data the amount of energy used by each site as there is no sub meter at either site (except to a communications shed). We have estimated the expected annual energy use at the operations depot from the audit result. We recommend the installation of an energy monitor at the depot which will provide information about energy use at both sites. The normal operations depot attendance hours are 7am to 3pm Mon to Fri.

8.2 Electricity Supply & Tariff

The site is supplied from a three phase Low Voltage (LV) electricity supply which is accumulation metered from a meter enclosure located on the pole at the turnoff to the sports ground.

- NMI 80011013952
- Meter 0540046911
- Tariff: Anytime Energy Business Plan (L1)
- Rate: $0.3032/kWh (ex GST)
- Supply: $0.4613/day

The electricity supply meets the threshold for contestability (50,000 kWh p.a.) as its metered consumption for the 12 months from March 17 to February 18 was 51,664kWh. This means the Shire is eligible to select an alternative electricity retailer for this site.

The depot is presently on an anytime energy tariff (L1) but is able to save approx. $412 ex GST p.a. by switching to the R1 tariff[14]. The tariff rates are shown in Table 18 Anytime Energy Tariffs (inc GST) and Table 19 Time of Use Tariffs (inc GST).

The table below shows the expected cost for each of the Synergy energy tariffs based upon the past 12 months of metering data. The "With Solar" row denotes the estimated tariff and savings ($5,225 ex GST p.a.) that could be obtained with a 15kW solar PV system on the existing tariff and a further $420 ex GST p.a. that could be obtained by switching to R1 tariff[15].

Table 44 Synergy Tariff comparison operations depot as is and with 15kW solar PV

	L1	L3*	R1	R3*
Without Solar	$8,504	$9,005	$8,092	$10,264
With Solar	$3,280	$3,473	$2,859	$3,828
Saving	5,225	5,532	5,233	6,437

* Applicable tariffs if site deemed contestable.

8.3 Electrical Energy Profile

8.3.1 Seasonal Profile

The figure below shows some seasonal variation in energy use with higher Summer time use.

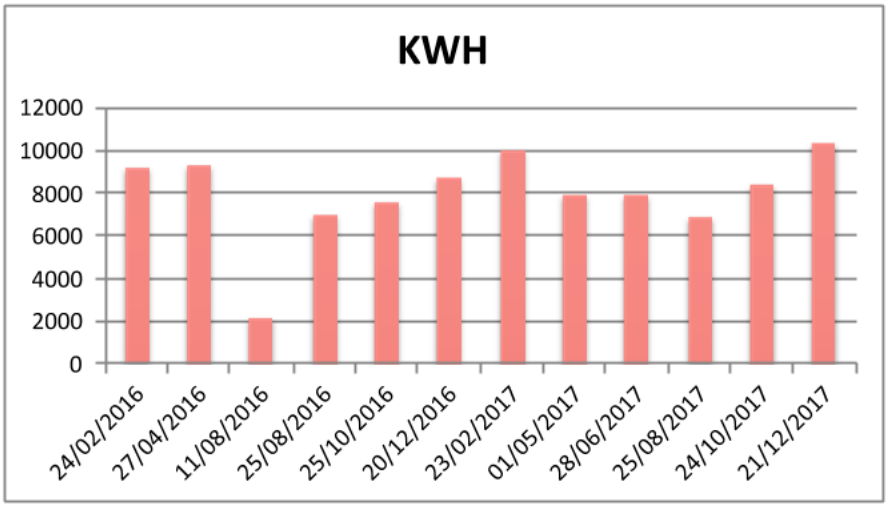


Figure 52 Monthly Energy Import for Depot

8.3.2 Recommended System Size

The load profile is suited to a small to medium solar PV system. The graph below shows the estimated annual savings (RHS) and payback period (LHS) for various sized solar PV systems using the average per kW cost of the quoted systems, excluding GST and including STC rebates. The graph below shows the optimal size system to maximise RoI is between 5kW and 15kW which will achieve

[14] If Synergy designate the service as contestable then the R1 tariff will not be available.

[15] Note that if the depot is designated as contestable by Synergy then it will need to select an L3 or R3 tariff in which case the L3 anytime energy is likely to be favourable.

approx. 3.5 year payback. Note this is based upon an average price across quotations received. The energy savings rate tapers off above 15kW.

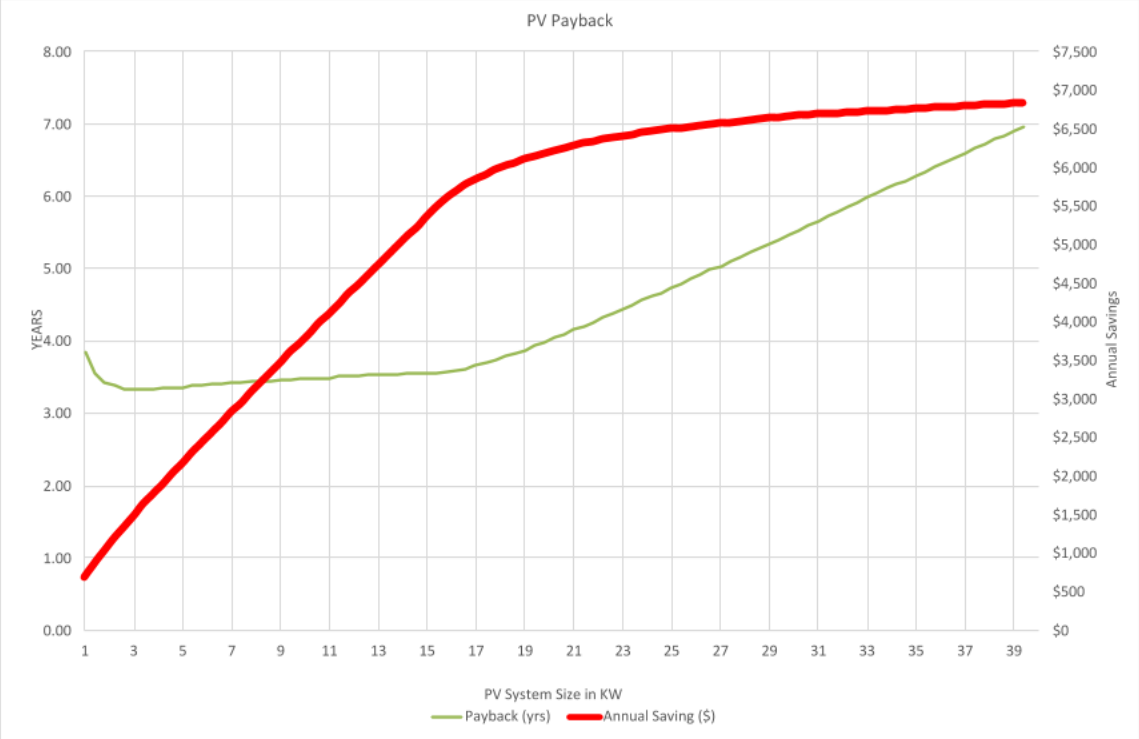


Figure 53 Solar PV savings and payback for Depot

8.3.3 Available Roof Space

The operations depot has adequate available roof space to install solar PV. The North East facing section of the newer shed (orange shaded area) is recommended as it will generate most output in the morning and midday coinciding best with depot operating hours. We estimate this roof would support approx. 8kW of 250W solar panels. Additional space is available on the other shed (green shaded area can support approx. 15kW of panels) and this could be used to obtain afternoon solar generation from the North-West facing roof section.

Figure 54 Recommended Roof space for solar PV supplying Operations Depot and Sportsground

8.3.4 Effect on Grid Import

The figures below show the effect of a 15kW solar system on average weekday and weekend grid import. Note that the solar PV output varies significantly by season and will result in a net export of energy during periods of peak solar output (Summer/Spring) and low load (most weekend days). We estimate for a system of this size 71% of energy would be used on-site by the operations depot with the balance being exported on weekends where it may offset some of the sports ground energy use. The system will not be eligible for Renewable Energy Buyback Scheme (REBS) credit from Synergy for exported energy (however some other retailers may purchase excess).

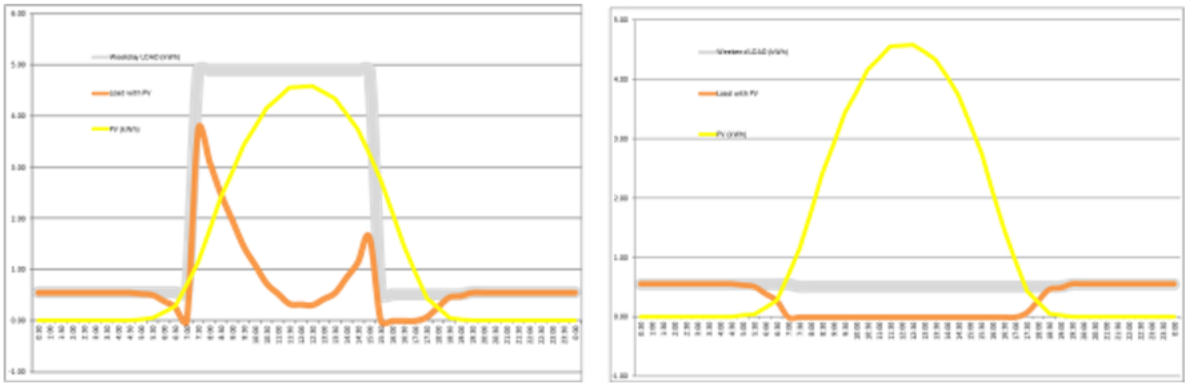


Figure 55 Annual Average Weekday and Weekend Load profile with 6.5kW Solar

8.3.5 Comparison of Proposals

The table below compares the estimated cost, benefit and simple payback of the various sized systems with the following assumptions[16]:

[16] Note that suppliers estimates of STC rebates differ to those shown in the table below. Earlier system installation or higher STC price may have been assumed.

a) The Quoted Gross Price from each supplier for the specified system size and
b) Calculating the number of STCs available (if installed by Dec 2018) and
c) Assuming the value of the rebate at $35 per STC and
d) Using the estimated savings calculated by H2 energy solutions.

[redacted]

8.4 Equipment Audit

The purpose of the audit is to estimate the energy use attributed to different items and categories of equipment. This can be used to inform estimate of savings from energy conservation or efficiency retrofit (e.g. lighting or equipment upgrade).

The equipment audit uses measurement of equipment power or appliance rating data combined with estimated weekday and weekend hours of operation to determine average weekday and weekend energy use of equipment.

8.4.1 Energy Use by Equipment Type

The audit assumed opening hours from 7am to 3pm on weekdays. The audit data and rating information is contained in Annexure 1 to this report.

The estimated contribution to the daily energy use of each equipment type are shown in the figure below. The largest contributors to energy use are HVAC, HWS and electrical equipment.

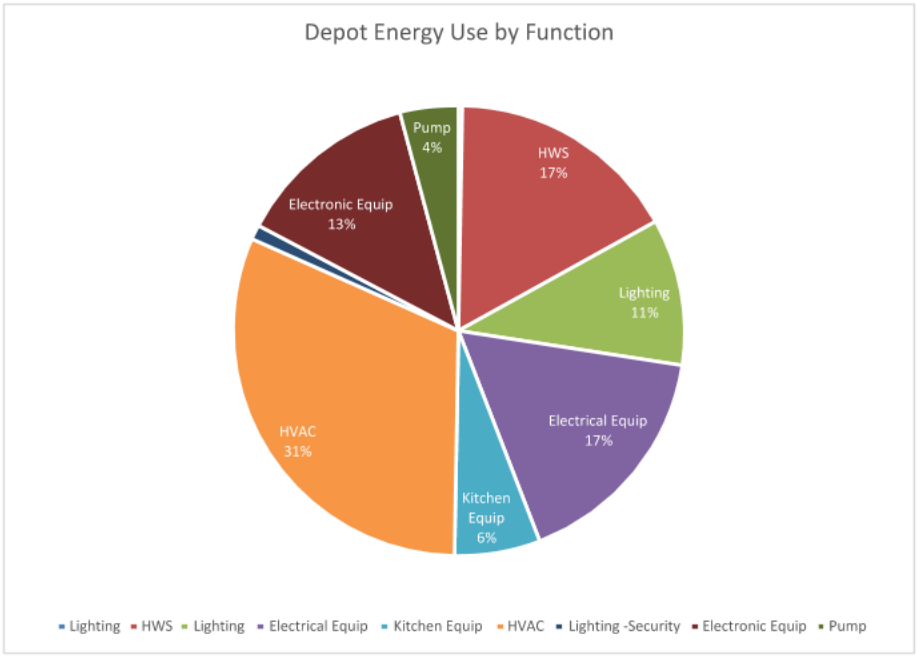


Figure 56 Energy use by equipment type total

8.4.2 Energy Use by Time of Day

The following figure shows the estimated profile of average daily energy use.

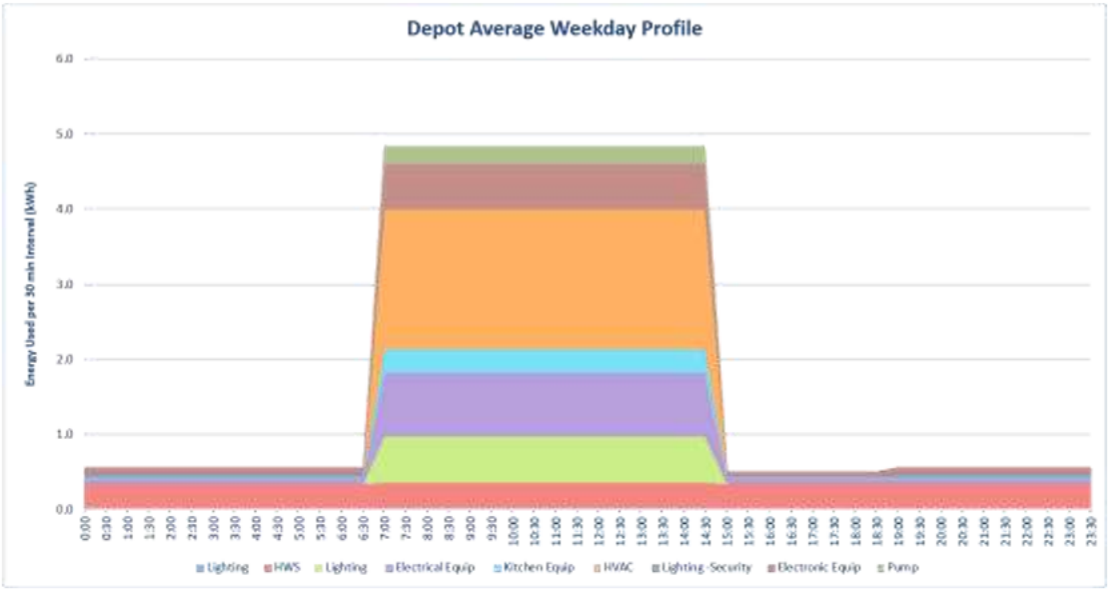


Figure 57 Energy Use by Equipment Type Weekday Time of Use

8.4.3 Energy Use by Area

The following table shows the energy use by area of the depot based upon the audit assumptions.

Table 46 Depot Energy Use by Area

Row Labels	Sum of Total WD kWhr/Day	Total WE kWhr/Day	Sum of Weekday On Peak kWhr	Sum of Weekday Off Peak kWhr	WD %	WE %
Ground	95.5	25.5	80.7	14.8		
Car Park	3.3	1.0	2.4	0.9	3.4%	3.8%
Kitchen	28.0	3.1	25.2	2.8	29.3%	12.2%
Office-Plant Supervisor	2.3	0.7	2.0	0.4	2.4%	2.8%
Toilet	0.9	0.0	0.8	0.1	0.9%	0.0%
Office-Parks & Gardens	4.3	1.2	3.6	0.7	4.5%	4.7%
Office-Works Supervisor	18.0	1.4	16.4	1.6	18.9%	5.6%
Breakout Area	1.5	1.0	1.0	0.4	1.6%	4.0%
Sign Shed	0.0	0.0	0.0	0.0	0.0%	0.0%
New Store (Large)	0.1	0.0	0.1	0.0	0.1%	0.0%
Workshop	13.8	0.0	12.9	0.9	14.4%	0.0%
Oil Store	0.1	0.0	0.1	0.0	0.1%	0.0%
Compressor Room	0.0	0.0	0.0	0.0	0.0%	0.0%
Plant Store	1.2	1.2	0.8	0.5	1.3%	4.7%
Store Shed	0.1	0.0	0.1	0.0	0.1%	0.0%
Fuel Area	0.1	0.0	0.1	0.0	0.1%	0.0%
Gardener Shed	0.0	0.0	0.0	0.0	0.0%	0.0%
Shed 2	0.1	0.0	0.1	0.0	0.1%	0.0%
Fuel Store	0.3	0.0	0.2	0.0	0.3%	0.0%
Washdown	1.6	0.0	1.5	0.1	1.7%	0.0%
Store	15.8	15.8	9.6	6.3	16.6%	62.1%
Watertank	4.0	0.0	3.8	0.3	4.2%	0.0%
Grand Total	**95.5**	**25.5**	**80.7**	**14.8**	**100%**	**100%**

8.5 Summary and Recommendations

8.5.1 Tariffs

We recommend remaining on the anytime energy tariff (L1) and switching to R1 (if available) when the solar PV system is installed

8.5.2 Solar PV

We recommend installing up to 15kW of solar PV at the site.

8.5.3 Efficiency Upgrade

8.5.3.1 LED lighting upgrade to regular use fluorescent lamps

The following table shows where energy efficiency savings can be made by upgrading fluorescent tubes to LED lighting. As only a portion of the lighting is regularly used we recommend upgrading lamps (total of 13 tubes) in those areas in regular use (highlighted yellow) as this will achieve approx. 90% of the savings compared to upgrading all lights. We estimate the following savings on the existing tariff:

- Annual Saving (kWh): 786 kWh
- Annual Saving ($): $238 ex GST

Table 47 LED lighting upgrade savings

Area/Zone	Description	Qty	Watts	Total WD kWhr/Day	Total WE kWhr/Day	LED Upgrade (W)	WD Energy Saving (kWh/day)	WD Saving ($/day)	WE Energy Saving (kWh/day)	WE Saving ($/day)
Car Park	Batten Mount Double Fluoro	4	72	2.30	-	36	1.15	0.35	-	-
Office-Works Supervisor	Batten Mount Double Fluoro	3	72	1.73	-	36	0.86	0.26	-	-
Kitchen	Single Fluoro Batten	3	36	0.86	-	18	0.43	0.13	-	-
Office-Plant Supervisor	Single Fluoro Batten	2	36	0.58	-	18	0.29	0.09	-	-
Workshop	Batten Mount Double Fluoro	1	72	0.58	-	36	0.29	0.09	-	-
Breakout Area	Batten Mount Double Fluoro	1	72	0.12	-	36	0.06	0.02	-	-
New Store (Large)	Batten Mount Double Fluoro	4	72	0.12	-	36	0.06	0.02	-	-
Store Shed	Batten Mount Double Fluoro	4	72	0.12	-	36	0.06	0.02	-	-
Sign Shed	Batten Mount Single Fluoro	4	36	0.02	-	18	0.01	0.00	-	-
		26	**1,548**	**6.4**	**0.0**	**774**	**3.2**	**1.0**	**0.0**	**0.0**

Annual Saving (kWh): 786

Annual Saving ($): 238

Table 48 Simple payback of LED upgrade

Measure	Saving $ p.a. (ex GST)	Qty	Replacement Product cost (ex GST)	Install cost (ex GST)	Unit Cost (ex GST)	Total Cost (ex GST)	Simple Payback
LED replacement of batten mount T8 fluoro	238	43	$8.55	$10.00	$18.55	$798	3.3

8.5.3.2 LED lighting upgrade to regular use Hi Bay lights

The following table shows where energy efficiency savings can be made by upgrading high pressure sodium high bay lights to an LED equivalent high bay lighting (as illustrated in the figure below). As only one of the lights is regularly used we recommend upgrading lamps (total of 2 fittings) in the workshop (highlighted yellow) as this will achieve approx. 90% of the savings compared to upgrading all lights.

Table 49 Hi Bay Lighting LED lighting upgrade savings

Area/Zone	Description	Number	Watts	Total WD kWhr/Day	Total WE kWhr/Day	LED Upgrade (W)	WD Energy Saving (kWh/day)	WD Saving ($/day)	WE Energy Saving (kWh/day)	WE Saving ($/day)
Workshop	HP Sodium	2	150	2.4	0	75	1.20	0.36	-	-
Oil Store	HP Sodium	1	150	0.06	0	75	0.03	0.01	-	-
Shed 2	HP Sodium	1	150	0.06	0	75	0.03	0.01	-	-
Fuel Store	HP Sodium	1	150	0.24	0	75	0.12	0.04	-	-
		5	**750**	**2.8**	**0.0**	**375**	**1.4**	**0.4**	**0.0**	**0.0**

Annual Saving (kWh): 312

Annual Saving ($): 95

Table 50 Simple payback of Hi Bay lighting upgrade

Measure	Saving $ p.a. (ex GST)	Qty	Replacement Product cost (ex GST)	Install cost (ex GST)	Unit Cost (ex GST)	Total Cost (ex GST)	Simple Payback
LED replacement of Hi bay lighting	95	2	$200.00	$150.00	$350.00	$700	7.4

Figure 58 LED Hi Bay light

8.5.3.3 HWS upgrade to Heat Pump

The following table shows energy efficiency savings that can be made by upgrading the existing electric element storage hot water system (HWS) to a heat pump system. The savings are based upon the estimated daily energy use of the existing system (15kWh per day) and replacement with a Stiebel Eltron WWK 222 heat pump (220L) with a Coefficient of Performance (CoP) of 3.9.

Table 51 HWS Upgrade Savings

	CoP	Energy Use (kWh p.a.)	Energy Cost ($ p.a.)
Electric Storage	1.0	5,475	1,660
Heat Pump	3.9	1,404	426
Saving			***1,234***

Heat pump hot water systems operate similar to a reverse cycle air conditioner, that is they transfer heat from the air to heat the water. A CoP of 3.9 means it will achieve 3.9 times the thermal heat

output as a comparable electric element storage system. They are also eligible for STC certificates (the same as a solar PV system). The WWK 222 would attract 29 STCs which at $35 would be a rebate of $1,015 off the system price. We note in the audit there are heat pump HWS installed at the Library, Pool and the Leisure Centre.

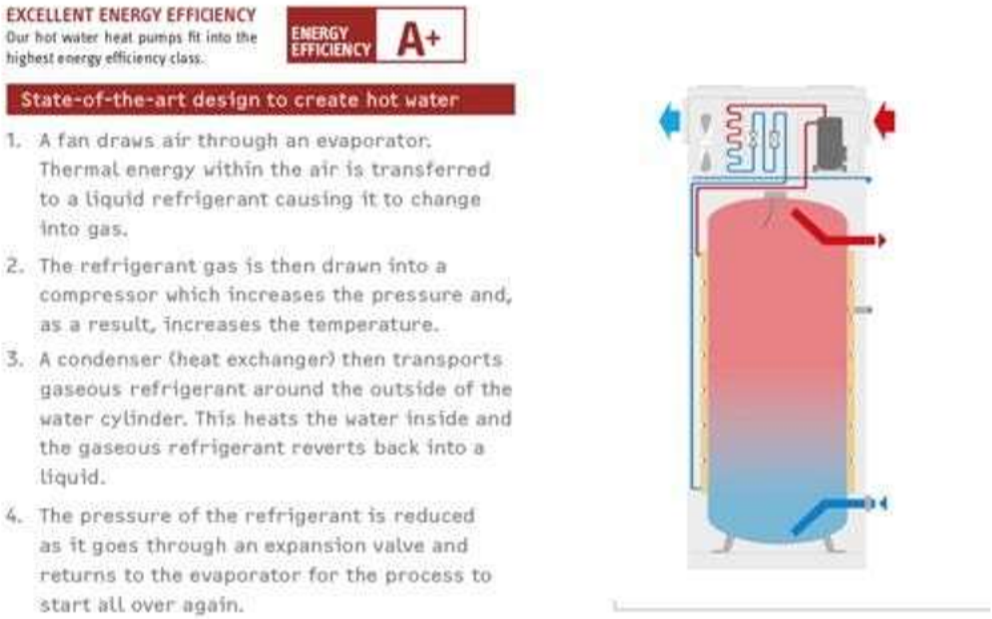


Figure 59 Heat Pump Hot Water System operation

8.5.4 Energy Conservation

Other measures the Shire may wish to consider:

- Installation of occupancy sensors onto lighting and ventilation fans in areas not requiring continuous lighting, such as change rooms and store rooms, where not already fitted will typically have a short payback period.

8.5.5 Energy Monitoring

We recommend the installation of an energy monitoring system at the depot as this will enable the Shire to determine actual use at the depot and by deduction the amount of energy being used at the sportsground.

Energy monitoring is also a useful energy management tool at other sites as it provides real time information about energy consumption and solar PV output allowing for better understanding and quantification of energy use by various appliances.

H2 Energy Solutions can supply and install:

- An energy only monitor for $1,000 ex GST, or
- An energy and solar export monitor for $1,200 ex GST

The above prices do not include travel to/from Bridgetown which will be an additional $350. The monitor requires WiFi internet access at the site. We propose the Smappee energy monitor, details of this product are shown in Appendix C.

9 Appendices

Appendix A: Pool Circulation Requirements

The following table is from "Code of Practice For The Design, Construction, Operation, Management & Maintenance Of Aquatic Facilities" (December 2015)

Table 4 - Water Body Loading Category Chart

Category	Loading Classification	Parameters	Water Depths	Examples	Maximum Permissible Turnover Times
1	Spas	Spa Pools		Spa Pools, Leisure Bubble Pools	15 mins
2	Extreme	Very High Bather Load, Very Shallow Water	"Very Shallow" 0m - 0.3m	Toddlers Pool, Water Slide Splashdown Pool	30 mins
3	Very High	Very High Bather Load, Heated Water, Shallow Water	"Shallow" 0.3m - 0.80m	Shallow Leisure Pool, Hydrotherapy Pool	1 hour
4	High	High Bather Load, Heated Water, Moderately Shallow Water		Medium Depth Leisure Pool, Learn to Swim, Wave Pool	1 ½ hours
5	Moderate	High Bather Load, Heated Water, Medium Depth Water	"Medium" 0.80m - 1.40m	Full Depth Heated Leisure Pool, Lazy River, Medium Depth Unheated Outdoor Leisure Pool	2 hours
6	Light	Medium Bather Load, Heated Water, Medium Depth Water		Heated School Pool, Health Club Pool, Body Corporate, Caravan Park, Motel Pools Full Depth Unheated Outdoor Leisure Pool	2 ½ hours
7	Low	Low Bather Load, Deep Water	"Deep" 1.40m - 2m	50m Competition Pool, Unheated Municipal/School/Motel etc Pool	3 ½ hours
8	Very Low	Very Low Bather Load, Very Deep Water	"Very Deep" >2m	Diving Pool, Water Polo Pool	5 hours

Appendix B: Electric Motor IEC Efficiency Standards

Minimum 50 Hz efficiency values defined in IEC/EN 60034-30-1:2014 (based on test methods specified in IEC 60034-2-1:2014)

Output	IE1				IE2				IE3				IE4			
kW	2 pole	4 pole	6 pole	8 pole	2 pole	4 pole	6 pole	8 pole	2 pole	4 pole	6 pole	8 pole	2 pole	4 pole	6 pole	8 pole
0.12	45.0	50.0	38.3	31.0	53.6	59.1	50.6	39.8	60.8	64.8	57.7	50.7	66.5	69.8	64.9	62.3
0.18	52.8	57.0	45.5	38.0	60.4	64.7	56.6	45.9	66.9	69.9	63.9	58.7	70.8	74.7	70.1	67.2
0.20	54.6	58.5	47.6	39.7	61.9	65.9	58.2	47.4	67.2	71.1	66.4	60.6	71.9	75.8	71.4	68.4
0.25	58.2	61.5	52.1	43.4	64.8	68.5	61.6	50.6	69.7	73.5	68.6	64.1	74.3	77.9	74.1	70.8
0.37	63.9	66.0	59.7	49.7	69.5	72.7	67.6	56.1	73.8	77.3	73.5	69.3	78.1	81.1	78.0	74.3
0.40	64.9	66.8	61.1	50.9	70.4	73.5	68.8	57.2	74.8	78.0	74.4	70.1	78.9	81.7	78.7	74.9
0.55	69.0	70.0	65.8	56.1	74.1	77.1	73.1	61.7	77.8	80.8	77.2	73.0	81.5	83.9	80.9	77.0
075	72.1	72.1	70.0	61.2	77.4	79.6	75.9	66.2	80.7	82.5	78.9	75.0	83.5	85.7	82.7	78.4
1.1	75.0	75.0	72.9	66.5	79.6	81.4	78.1	70.8	82.7	84.1	81.0	77.7	85.2	87.2	84.5	80.6
1.5	77.2	77.2	75.2	70.2	81.3	82.8	79.8	74.1	84.2	85.3	82.5	79.7	86.5	88.2	85.9	82.6
2.2	79.7	79.7	77.7	74.2	83.2	84.3	81.8	77.6	85.9	86.7	84.3	81.9	88.0	89.5	87.4	84.5
3	81.5	81.5	79.7	77.0	84.6	85.5	83.3	80.0	87.1	87.7	85.6	83.5	89.1	90.4	88.6	85.9
4	83.1	83.1	81.4	79.2	85.8	86.6	84.6	81.9	88.1	88.6	86.8	84.8	90.0	91.1	89.5	87.1
5.5	84.7	84.7	83.1	81.4	87.0	87.7	86.0	83.8	89.2	89.6	88.0	86.2	90.9	91.9	90.5	88.3
7.5	86.0	86.0	84.7	83.1	88.1	88.7	87.2	85.3	90.1	90.4	89.1	87.3	91.7	92.6	91.3	89.3
11	87.6	87.6	86.4	85.0	89.4	89.8	88.7	86.9	91.2	91.4	90.3	88.6	92.6	93.3	92.3	90.4
15	88.7	88.7	87.7	86.2	90.3	90.6	89.7	88.0	91.9	92.1	91.2	89.6	93.3	93.9	92.9	91.2
18.5	89.3	89.3	88.6	86.9	90.9	91.2	90.4	88.8	92.4	92.6	91.7	90.1	93.7	94.2	93.4	91.7
22	89.9	89.9	89.2	87.4	91.3	91.6	90.9	89.1	92.7	93.0	92.2	90.6	94.0	94.5	93.7	92.1
30	90.7	90.7	90.2	88.3	92.0	92.3	91.7	89.8	93.3	93.6	92.9	91.3	94.5	94.9	94.2	92.7
37	91.2	91.2	90.8	88.8	92.5	92.7	92.2	90.3	93.7	93.9	93.3	91.8	94.8	95.2	94.5	93.1
45	91.7	91.7	91.4	89.2	92.9	93.1	92.7	90.7	94.0	94.2	93.7	92.2	95.0	95.4	94.8	93.4
55	92.1	92.1	91.9	89.7	93.2	93.5	93.1	91.0	94.3	94.6	94.1	92.5	95.3	95.7	95.1	93.7
75	92.7	92.7	92.6	90.3	93.8	94.0	93.7	91.6	94.7	95.0	94.6	93.1	95.6	96.0	95.4	94.2
90	93.0	93.0	92.9	90.7	94.1	94.2	94.0	91.9	95.0	95.2	94.9	93.4	95.8	96.1	95.6	94.4
110	93.3	93.3	93.3	91.1	94.3	94.5	94.3	92.3	95.2	95.4	95.1	93.7	96.0	96.3	95.8	94.7
132	93.5	93.5	93.5	91.5	94.6	94.7	94.6	92.6	95.4	95.6	95.4	94.0	96.2	96.4	96.0	94.9
160	93.8	93.8	93.8	91.9	94.8	94.9	94.9	93.0	95.6	95.8	95.6	94.3	96.3	96.6	96.2	95.1
200	94.0	94.0	94.0	92.5	95.0	95.1	95.0	93.5	95.8	96.0	95.8	94.6	96.5	96.7	96.3	95.4
250	94.0	94.0	94.0	92.5	95.0	95.1	95.0	93.5	95.8	96.0	95.8	94.6	96.5	96.7	96.5	95.4
315	94.0	94.0	94.0	92.5	95.0	95.1	95.0	93.5	95.8	96.0	95.8	94.6	96.5	96.7	96.6	95.4
355	94.0	94.0	94.0	92.5	95.0	95.1	95.0	93.5	95.8	96.0	95.8	94.6	96.5	96.7	96.6	95.4
400	94.0	94.0	94.0	92.5	95.0	95.1	95.0	93.5	95.8	96.0	95.8	94.6	96.5	96.7	96.6	95.4
450	94.0	94.0	94.0	92.5	95.0	95.1	95.0	93.5	95.8	96.0	95.8	94.6	96.5	96.7	96.6	95.4
500-1000	94.0	94.0	94.0	92.5	95.0	95.1	95.0	93.5	95.8	96.0	95.8	94.6	96.5	96.7	96.6	95.4

Appendix C: Smappee Energy and Energy Plus Monitors

The Smappee technology is different to normal sub metering systems as it listens to the energy circuit and detects individual appliances and allows them to be labelled and individually tracked (described as similar to Shazam for electrical devices). Thus it is lower cost to install and provides greater discrimination between energy consuming devices compared to a traditional monitoring system which aggregates all devices on each circuit.

After initial installation and configuration the system learns and identifies different types of equipment which are then labelled so that they can be individually tracked.

The Smappee Energy monitor measures the total energy consumption of your home/business and the individual consumption of your most important appliances. Further information on the supplier's website: https://www.smappee.com/au/energy-monitor

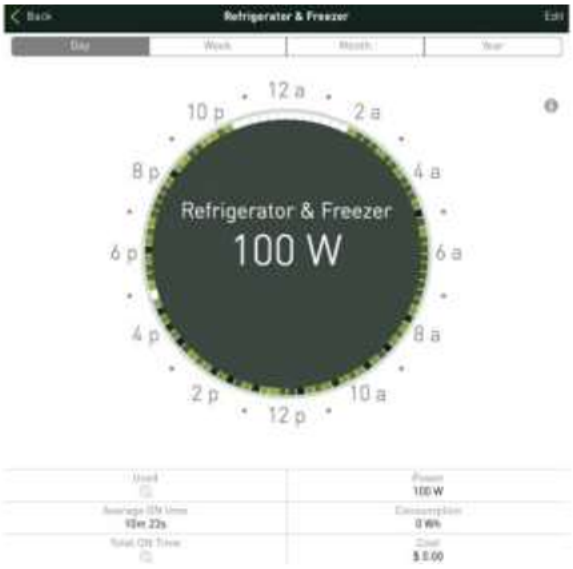
The Smappee Solar monitor also measures the output of your solar panels. Further information on the supplier's website: https://www.smappee.com/au/solar-energy-monitor

Main Display

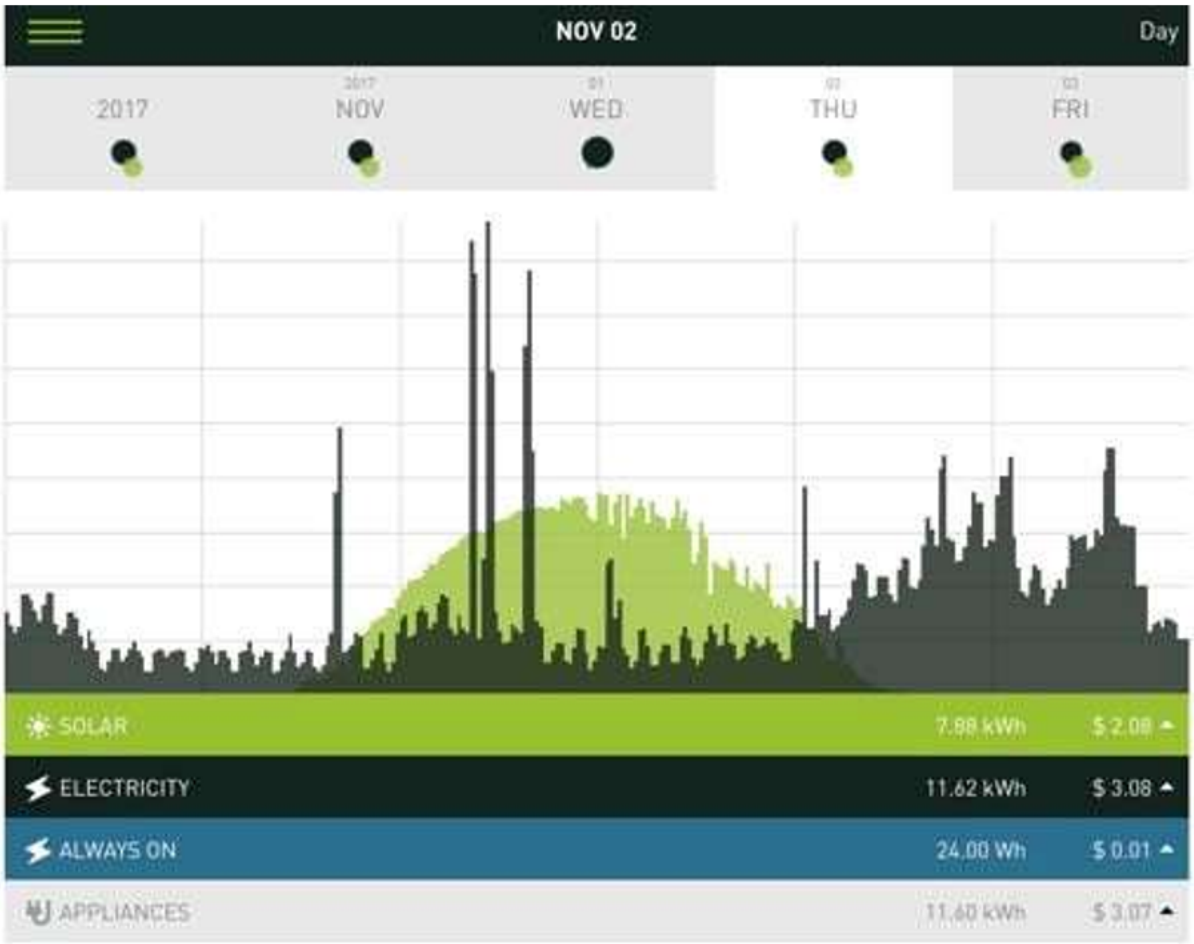
Energy monitoring data is accessible from an online and smart phone app.

The following figures from my home install shows the electrical load (black circle) and solar PV output (green circle) and always on appliance load (blue circle).

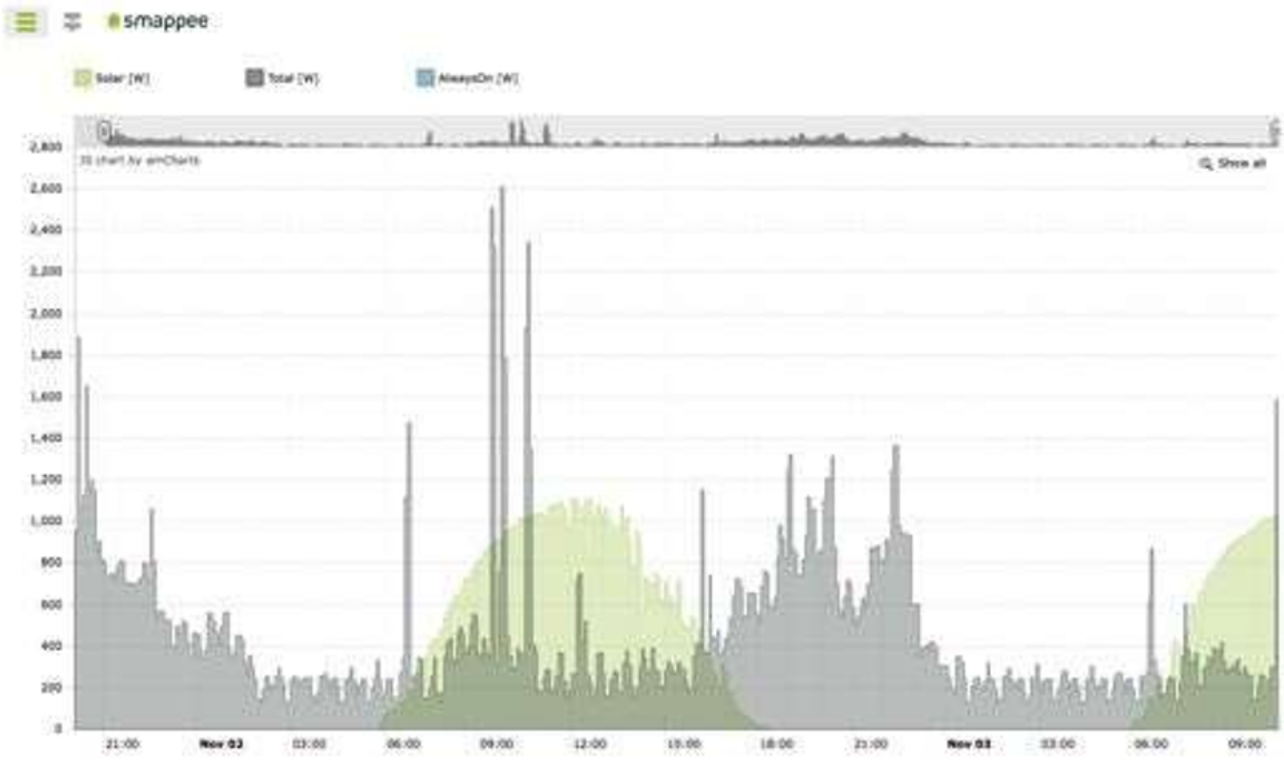
Appliance DNA – shows the frequency of use, total energy and cost for individual appliances



Summary Graph – shows the solar output (green) and appliance use (black) over a day



Detailed Graph – shows the solar output (green) and appliance use (black) over a specified period



Appendix D: LED Lighting Upgrade Options

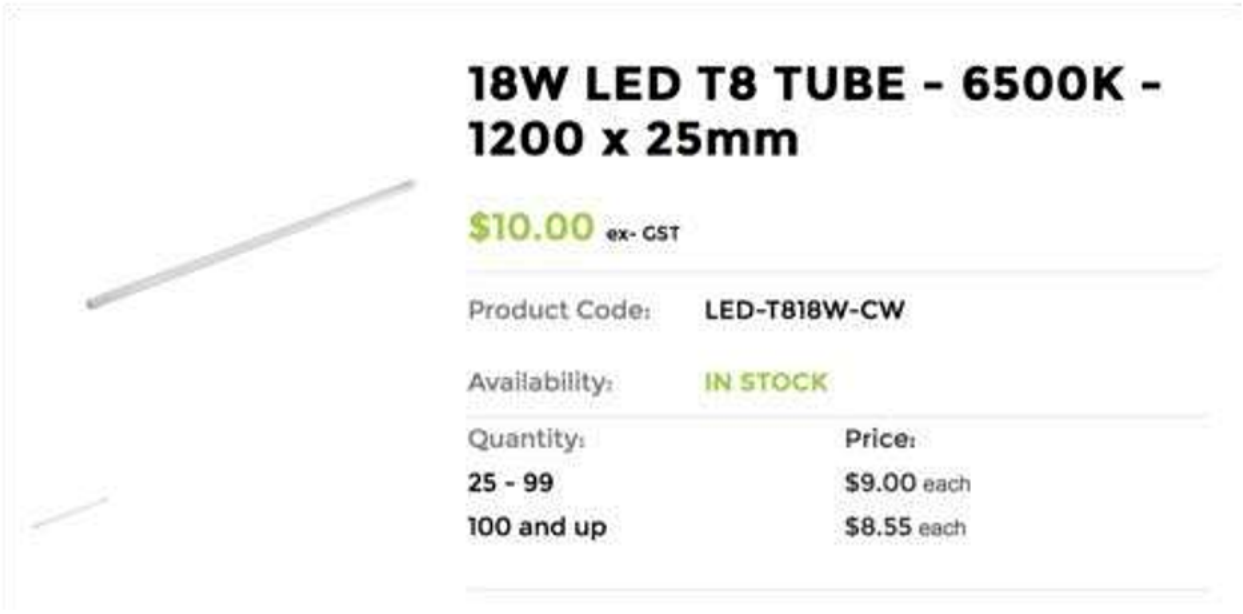
Below are a summary of some available LED lighting replacements. Prices shown are ex-Perth. Alternative brands or products may be used or preferred, these are for illustration purpose.

LED 600mm batten replaces 2 x 18W fluoro

LED 1200mm Batten replaces 2 x 36W fluorescent tube batten

(includes battery for emergency backup when power out)

LED 1200mm fluorescent T8 tube replacement



LED Troffer replaces 2 x 36W Fluorescent troffer

LED LIGHT PANEL - 36W - 1200mm X 300mm - 6000K - 120L/W

$79.00 ex- GST

Product Code: LED-LP36W-120/30-CW-A

Availability: IN STOCK

Quantity:	Price:
4 - 39	$76.50 each
40 and up	$75.05 each

LED 1200mm Batten replaces 2 x 36W

LED BATTEN - 40W - 6000K

$60.00 ex- GST

Product Code: LED-B40W-CW

Availability: IN STOCK

Quantity:	Price:
6 - 49	$58.00 each
50 and up	$57.00 each