100% renewables

Tweed Shire Council

Renewable Energy Study

October 2017

Contents

List of abbreviations used

AEMO	Australian Energy Market Operator
BAU	Business As Usual
BMS	Building Management System - computer-based control system installed in buildings that controls and monitors the building's mechanical and electrical equipment such as ventilation, lighting, power systems, fire, and security systems
c/kWh	Cents per kilowatt hour – energy unit costing metric
CST	Concentrating Solar Thermal – a renewable energy technology involving the use of mirrors or solar concentrators to heat conductors (salts or fluids) which super heats water to power steam turbines to generate electricity, day and night.
DNI	Direct Normal Insolation – a measure of the intensity of sunlight
DNSP	Distribution Network Service Provider – organisations that own and maintain the electricity grid (poles and wires)
DUOS	Distribution Use of System – charges paid to distribution network operator on whose network the meter is located
EE	Energy Efficiency
ESCo	Energy Service Company or retailer
EUA	Environmental Upgrade Agreement
EPC	Energy Performance Contract
GHG	Greenhouse gas
GWh	Gigawatt hour – a measure of energy (1 GWh=1000 MWh)
HVAC	Heating Ventilation Air Conditioning
HW	Hot Water
IRR	Internal Rate of Return
kWh	Kilowatt hour – a measure of energy
kW	Kilowatt – a measure of power
KWp	Kilowatt peak – amount of peak demand reduction potential
LCC	Lismore City Council
LCOE	Levelised Cost of Energy - indicates the cost at which each unit of electricity needs to be sold at in order for project/plant to break even
LED	Light-Emitting Diode - a semiconductor diode which glows when a voltage is applied
LGA	Local Government Area
MSW	Municipal Solid Waste

MWe Megawatts electric – a measure of electrical power

MWh Megawatt hours (1MWh = 1000kWh) – a measure of energy

MW Megawatts – a measure of power

NPV Net Present Value

NUOS Network Use of System

PPA Power Purchase Agreement

RE Renewable Energy

PV Photo-voltaic

REAP Renewable Energy Action Plan

ROI Return on Investment

SPS Sewer Pumping Station

STP Sewerage Treatment Plant

ToU Time of Use – refers to a particular electricity tariff structure

Tonnes CO2-e Tonnes of Carbon Dioxide equivalent – greenhouse gas measurement unit

VNM Virtual Net Metering – an electricity customer with on-site generation is allowed to assign their 'exported' electricity generation to another site

VSD Variable Speed Drive - a piece of equipment that regulates the speed and rotational force, or torque output, of an electric motor

WTP Water Treatment Plant

WWTP Wastewater Treatment Plant

1 Renewable Energy Study Summary

1.1 Elements of the study

There are five major elements to consider in a Renewable Energy Action Plan for Tweed Shire Council (TSC). These include:

1. **Efficiency and renewable energy projects**: A core group of 32 energy efficiency and renewable energy projects to be implemented over the period 2016-17 to 2024-25. These projects are expected to cost $10.64 million, will have a simple payback of 5.53 years, and will reduce Council's electricity consumption by an estimated 7,500 MWh per year. There are two sub-sets to this part of the plan:
    a. Projects focused on energy efficiency and behind-the-meter solar energy generation up to 2020-21, costing an estimated $6.99 million, and
    b. Phase 2 solar and battery storage projects at various sites, implemented from 2021-22 to 2023-24. At present these initiatives appear to only be marginally cost effective and a periodic review of the business case and timing for these projects is recommended.
2. **Equipment and project efficiency requirements**: Review of Council's equipment purchasing processes focused on maximising the energy efficiency of all new equipment purchases, and a review of specifications for refurbishment and major asset upgrade / development works to ensure that all major new work achieves high levels of energy efficiency and renewable energy.
3. **Renewable energy purchasing**: this is likely to form the major part of Council's efforts to be self-sufficient in renewable energy, and this is a rapidly evolving area. Through an existing or by joining a new buying group (e.g. of local councils), or by engaging directly with existing renewable energy projects, TSC may be able to source 20-30% of its electricity from renewable energy sources, based on current trends. The primary task at this time is for Council to engage with stakeholders to understand its opportunities and what the future market for direct renewable energy purchasing will be, so that decisions can be taken in future when energy agreements expire.
4. **Mid-scale renewable energy generation**: This review indicated that land owned by Tweed Shire Council may not be best suited to host mid-scale renewable energy generation with the capacity to meet Council's electricity needs. To the extent that Council wishes to continue to explore options for it to be a generator, engagement with other local councils in the region may be the appropriate next step.
5. **Governance**: Implementation of the REAP will require funding from internal sources, grants and incentives, and potentially from external sources such as via power purchase agreements. The plan will require resources to govern, manage, implement, monitor and maintain the rollout of initiatives. The plan itself should be renewed at say 2-3 year intervals so that future plans (e.g battery storage) can be re-assessed and new ideas or technologies can be considered. An overarching sustainable energy policy may also be a useful way to communicate Council's goals to staff and the community.

1.2 Recommendations on Tweed Shire Council's targets

In March 2013 Council set an aspirational goal of becoming self-sufficient in renewable energy, but without a specific timeframe or interim targets. The development of a REAP will help Council to consider and potentially set a timeframe and interim targets with an evidence basis.

1.2.1 'Self-sufficient' in renewable energy

Two approaches to defining this are outlined.

1. Self-sufficiency can be taken to mean that all of Council's electricity will be 100% renewable; that is, sourced from renewable energy generation projects and all 'green' attributes withheld by Council and not assigned or sold to others, for example through the sale of renewable energy certificates, or
2. Self-sufficiency can be taken to mean that all of Council's electricity will be sourced from renewable energy projects, however Council may choose whether or not to sell the renewable energy certificates from its own RE projects or whether to buy the 'green' attributes or power-only from external RE projects. Council may opt for a mix of both based on a case-by-case assessment of costs and benefits as well as its objectives in terms of creating new renewable energy – i.e. beyond the Renewable Energy Target (RET).

The analysis of projects includes the revenue from renewable energy certificates – i.e. as per option 2 above for all solar energy projects <100 kW, and for larger projects out to 2023-24. No explicit approach is assumed or recommended at this time for renewable energy purchasing. It is recommended that a view on this be informed by continuing developments in this area over the next few years. See Appendix E.

1.2.2 Interim targets

The implementation of all projects identified in this study can lead to a reduction in Council's grid or 'black' electricity use by up to 50%. Based on this a renewable energy target of 50% is feasible, and the program of work set out here suggests this could be achieved by 2025.

Many of the efficiency and renewable energy projects are scheduled to occur by 2020-21, leading to a 25% reduction in grid / black electricity consumption which would be fully seen in 2021-22. Accordingly a 25% renewable energy target by 2021-22 should also be considered.

1.2.3 Final target timing

The timing by which Council should achieve self-sufficiency in renewable energy could be left open or a timeframe set that allows for future changes in the electricity market and Council's situation (e.g. regional collaboration or the emergence of significant local renewable energy opportunities) that could bring the achievement of the target forward.

For other councils, target dates for such ambitious targets tend to be at 2030 or ten years from the commencement of a strategy to achieve the target.

1.3 Timing and cost-benefit analysis outcomes

The costs and timing of potential REAP projects is focused mainly on energy efficiency and behind-the-meter renewable energy generation initiatives over the period 2016-17 to 2024-25.

Timing is suggested for the procurement of renewable energy that will drive Council's renewable energy towards 100%, however the priorities for this aspect are engagement and the development of capacity and knowledge that will inform the precise timing and nature of future energy purchasing.

1.3.1 Capital costs and simple payback

A total of 32 initiatives form the core of potential REAP activities. The estimated costs and simple payback for these initiatives are summarised below.

Site & Project	Capital cost	Year 1 savings	Payback
WWTP operating / process control	$300,000	$85,025	1.85 Years
Murwillumbah Art Gallery 99.18 kW solar PV	$111,221	$24,464	4.55 Years
Murwillumbah Works Depot and Building C 91.26 kW solar PV	$67,264	$17,969	3.74 Years
Bray Park WTP 215 kW solar PV	$415,360	$61,923	6.71 Years
Tweed Regional Aquatic Centre Murwillumbah 165 kW solar PV	$313,500	$52,024	6.03 Years
Council facilities lighting upgrade to LED	$438,348	$109,013	4.02 Years
Kingscliff WWTP Sustainability Centre 99 kW solar PV	$126,361	$20,572	6.14 Years
Council facilities HVAC systems efficiency improvements	$80,000	$19,381	4.13 Years
Bray Park #2 pump 25 kW solar PV	$28,575	$4,413	6.48 Years
Tweed Heads Civic Centre and Library 20 kW solar PV	$22,860	$3,739	6.11 Years
Crematorium facility - roof of main office, 8 kW solar PV	$9,144	$1,803	5.07 Years
Mooball WWTP 5 kW solar PV	$5,715	$1,213	4.71 Years
Administration Centre Tweed Heads 95 kW solar PV	$108,082	$16,138	6.70 Years
Civic Centre Murwillumbah 98 kW solar PV	$113,996	$16,647	6.85 Years
Stotts Creek facility 50 kW solar PV on new FOGO shed	$56,886	$13,390	4.25 Years
Tweed Regional Museum 38.40 kW solar PV	$49,727	$7,672	6.48 Years
Mechanical & Electrical depot Kingscliff - augment current system with 30 kW solar PV	$34,131	$6,969	4.90 Years
Kingscliff Library 16.8 kW solar PV	$19,568	$4,499	4.35 Years
Tweed Heads depot 15 kW solar PV	$17,066	$3,484	4.90 Years
HACC Tweed Heads 6 kW solar PV	$6,826	$1,394	4.90 Years
Banora Point WWTP 700 kW solar PV	$1,597,178	$171,842	9.29 Years
Tweed Heads South Pool 55 kW solar PV	$62,374	$10,772	5.79 Years
Street lighting upgrade to LED	$2,960,692	$589,142	5.03 Years
Banora Point community centre - 23 kW solar PV + Battery Energy Storage	$64,594	$6,890	9.37 Years
Museum storage and Records storage Honeyeater Circuit - 17 kW solar PV + Battery Energy Storage	$47,744	$5,093	9.37 Years
South Tweed Community Hall - 12 kW solar PV + Battery Energy Storage	$33,701	$3,595	9.37 Years
Expansion of TRAC Murwillumbah / Civic Centre Murwillumbah with 150 kW solar PV + BESS on carpark awning	$379,907	$38,015	9.99 Years
Expansion of Murwillumbah Art Gallery with 100 kW solar PV + BESS	$253,271	$25,343	9.99 Years

Expansion of Kingscliff WWTP on west side with 500 kW solar PV + BESS	$1,151,771	$121,938	9.45 Years
Expansion of Banora Pt WWTP with 700 kW solar PV + BESS	$1,503,550	$136,371	11.03 Years
Expansion of Bray Park solar with 50 kW + BESS on #2 pump reservoir roof	$107,396	$8,048	13.34 Years
Hastings Point WWTP floating array on southern overflow, 60 kW	$152,830	$11,498	13.29 Years
All Efficiency & Behind-the-meter solar projects	**$10,639,641**	**$1,922,793**	**5.53 Years**

TABLE 1: ESTIMATED COSTS, SAVINGS AND PAYBACK FOR POTENTIAL REAP PROJECTS

The costs and savings estimates are based on feasibility assessment of many of the initiatives, and all supporting information (solar modelling, Excel analysis of all projects including assumptions and calculations) is provided with this plan. Council will conduct its own feasibility assessment of some major initiatives (e.g. Banora Point WWTP solar energy generation), and will review and revise estimates from time to time based on current information.

1.3.2 Timing of potential REAP projects

A suggested time schedule of investments was developed in consultation with Council stakeholders. The timing is based on a number of underpinning factors:

1. Early solar projects are across both the Water & Sewer sections and property,
2. Known capacity to fund projects in the early stage,
3. Focus on flat roof-mounted solar PV systems that are generally less expensive to implement than tilted or ground mounted systems,
4. Selection of both large and small projects to achieve some significant 'wins' as well as demonstrate benefits at smaller sites,
5. Defer work at sites where other works – e.g. roof assessment, repairs or replacement – are required,
6. Defer projects that require more detailed feasibility assessment and/or comparison of technologies that could be used (e.g. Banora Point WWTP),
7. Projects that require battery storage are deferred to 'phase 2' - to be re-evaluated ahead of 2020 and timing / budget revised on the basis of this review,
8. Staging of expenditure across several years so that the program of work is manageable both in terms of cost and Council resources

The proposed timing of investments is shown below.

Site & Project	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24
WWTP operating / process control		$150,000	$75,000	$75,000				
Murwillumbah Art Gallery 99.18 kW solar PV	$111,221							
Murwillumbah Works Depot and Building C 91.26 kW solar PV	$67,264							
Bray Park WTP 215 kW solar PV		$415,360						
Tweed Regional Aquatic Centre Murwillumbah 165 kW solar PV		$313,500						
Council facilities lighting upgrade to LED		$162,351	$162,351	$162,351				
Kingscliff WWTP Sustainability Centre 99 kW solar PV		$126,361						
Council facilities HVAC systems efficiency improvements		$40,000	$40,000					
Bray Park #2 pump 25 kW solar PV		$28,575						
Tweed Heads Civic Centre and Library 20 kW solar PV		$22,860						
Crematorium facility - roof of main office, 8 kW solar PV		$9,144						
Mooball WWTP 5 kW solar PV		$5,715						
Administration Centre Tweed Heads 95 kW solar PV			$108,082					
Civic Centre Murwillumbah 98 kW solar PV			$113,996					
Stotts Creek facility 50 kW solar PV on new FOGO shed			$56,886					
Tweed Regional Museum 38.40 kW solar PV			$49,727					
Mechanical & Electrical depot Kingscliff - augment current system with 30 kW solar PV			$34,131					
Kingscliff Library 16.8 kW solar PV			$19,568					
Tweed Heads depot 15 kW solar PV			$17,066					
HACC Tweed Heads 6 kW solar PV			$6,826					
Banora Point WWTP 700 kW solar PV				$1,597,178				
Tweed Heads South Pool 55 kW solar PV				$62,374				
Street lighting upgrade to LED					$2,960,692			
Banora Point community centre - 23 kW solar PV + Battery Energy Storage					$64,594			

Museum storage and Records storage Honeyeater Circuit - 17 kW solar PV + Battery Energy Storage					$47,744			
South Tweed Community Hall - 12 kW solar PV + Battery Energy Storage					$33,701			
Expansion of TRAC Murwillumbah / Civic Centre Murwillumbah with 150 kW solar PV + BESS on carpark awning						$379,907		
Expansion of Murwillumbah Art Gallery with 100 kW solar PV + BESS						$253,271		
Expansion of Kingscliff WWTP on west side with 500 kW solar PV + BESS						$1,151,771		
Expansion of Banora Pt WWTP with 700 kW solar PV + BESS							$1,503,550	
Expansion of Bray Park solar with 50 kW + BESS on #2 pump reservoir roof							$107,396	
Hastings Point WWTP floating array on southern overflow, 60 kW								$152,830
	$328,485	**$1,198,866**	**$683,633**	**$1,821,903**	**$3,106,732**	**$1,784,950**	**$1,610,947**	**$152,830**

TABLE 2: PROPOSED TIMING AND BUDGET FOR POTENTIAL REAP PROJECTS

A key premise of renewable energy purchasing, such as from new renewable energy projects directly or via a buying group, is that cost savings or a cost neutral outcome can be achieved compared with conventional energy purchasing, influenced by declining RE costs and rising energy prices.

The suggested timing to begin purchasing renewable energy towards Council's target is 2023-24 (5,000 MWh pa), rising to say 15,000 MWh pa from 2026-27. The nature and timing of renewable energy purchasing will evolve as Council engages with buying groups and potentially other consumers such as regional local governments.

1.3.3 Impact of potential REAP actions on Tweed Shire Council's electricity profile

Implementation of the REAP projects shown above will have a significant impact on council's future 'black' electricity purchases, with over 7,500 MWh saved in 2029-30. Added to potentially 15,000 MWh of electricity purchased from renewable energy sources by this time, Council's energy from 'black' sources will be much reduced, and potentially nil.

The two charts below illustrate the effect of these initiatives, with projects grouped into five key themes:

1. Energy efficiency
2. Solar Phase 1
3. Street lighting upgrade to LED
4. Solar & Battery Storage Phase 2
5. Renewable energy purchasing

In the first chart it is assumed that other recommended initiatives, including making sure all equipment purchases are energy efficient, and maximising energy efficiency in all plant, infrastructure and building upgrades / developments, serve to ensure that there is no underlying growth in energy demand – i.e. BAU growth stays at 0% pa.

In the second chart a BAU growth rate in energy consumption of 1% pa is assumed to occur, and REAP projects are implemented against this scenario.

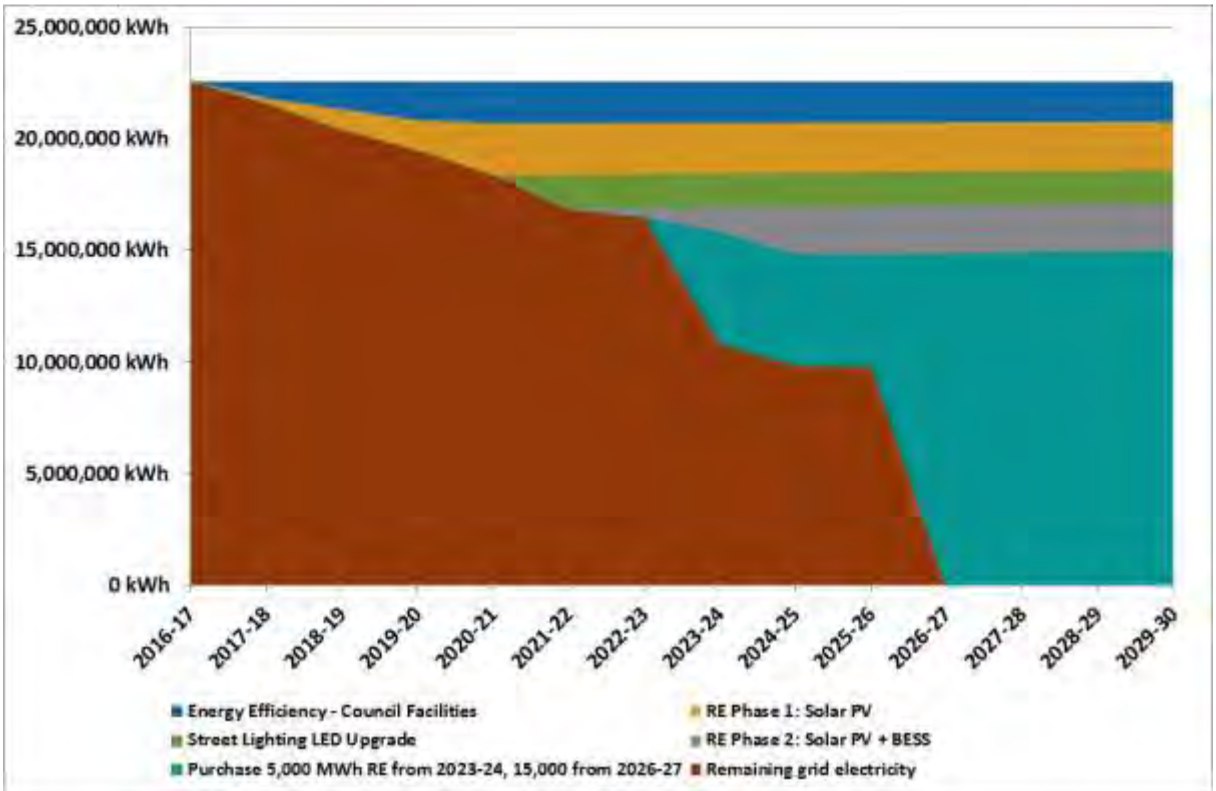

FIGURE 1: IMPACT OF REAP + 15,000 MWH RE PURCHASING UNDER A 0% PA BAU GROWTH SCENARIO

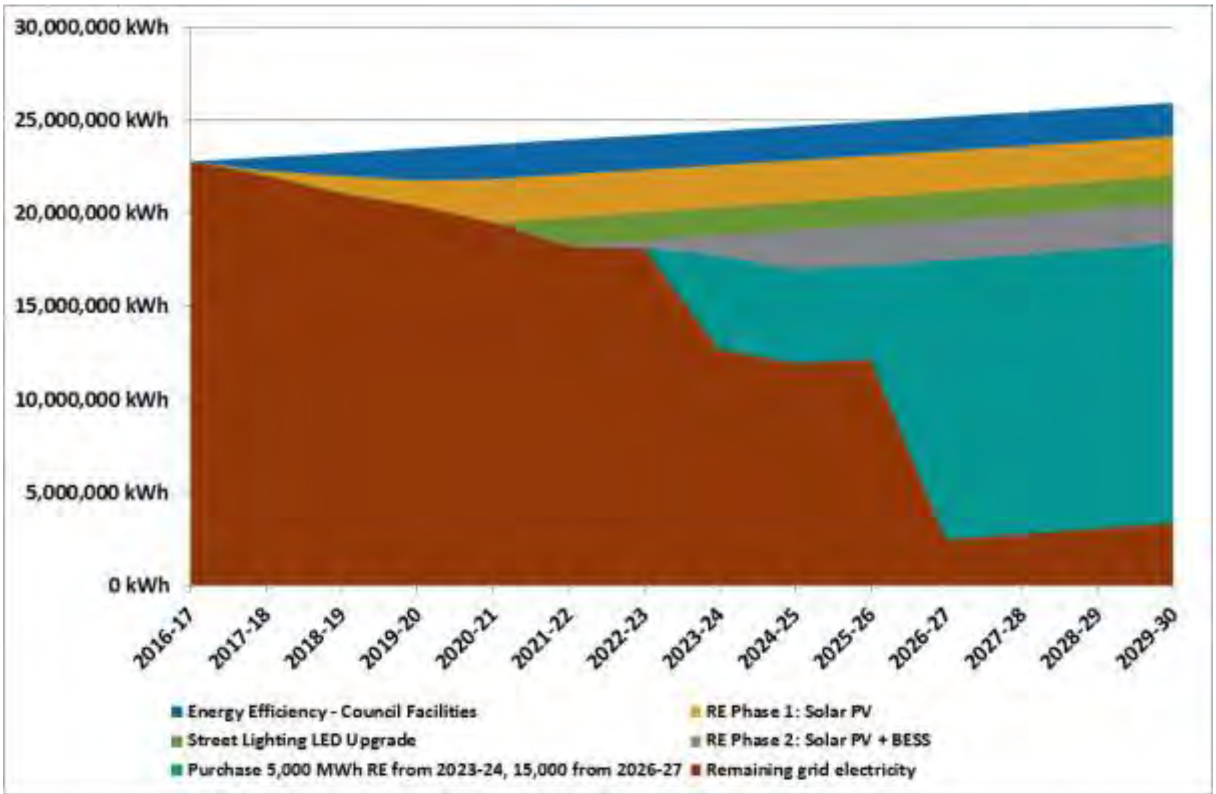

Figure 2: Impact of REAP + 15,000 MWh RE purchasing under a 1% pa BAU growth scenario

1.3.4 Cost-effectiveness of REAP

The simple payback data above highlight that most measures are currently cost effective, while there remains doubt about the returns for battery storage projects owing to uncertainty about the learning rate for batteries and hence the time at which this measure will be cost effective to Council.

All of the efficiency and solar projects will have factors that influence their financial outcomes, such as maintenance, parts replacement and changes to energy rates. As such simple payback is a useful but incomplete indicator of the financial attractiveness of REAP projects.

An analysis was carried out on all projects to estimate the value of energy savings in $/MWh in 2030 and to illustrate the relative cost of different energy saving measures. The approach mirrors that used to develop Marginal Abatement Cost (MAC) curves that help to illustrate the relative cost effectiveness and impact (abatement) of a series of initiatives at a future point in time. In this case the modelling is done to produce Marginal Energy-saving Cost (MEC) curves

The method used to develop the MEC curve included:

- Estimation of cost to implement projects in each year, noting that solar, storage and LED technologies will see continued price reductions; these are reflected in the modelling
- Estimation of future (significant) maintenance costs, such as inverter replacement for PV projects and LED replacements
- Estimation of cost savings from energy and maintenance with known rates used and with a simple assumed escalation in these prices in line with market trends
- Use of a discount rate of 7% for all measures, and discounting of cash flows and abatement to 2030 at this rate

- Ranking of all measures according to their discounted $/MWh at 2030, noting that a 'negative' cost (e.g. -$100/MWh) highlights a project that is more cost effective than a 'do nothing' scenario
- Presentation of ranked savings measures together with their forecast savings against 2030 business-as-usual (BAU) forecasts

Two curves are prepared, one covering the energy efficiency, street lighting and phase 1 solar projects. A second curve illustrates the estimated cost of the phase 2 solar and storage projects, with high costs validating the recommendation to adopt a wait-and-see approach and to review battery costs over time before committing to implementation.

The table below summarises the abatement initiatives that are included in the MEC curve, the year in which they are recommended for implementation, and the energy reduction that is expected to result.

Site & Project	**2030 energy saved**	**MEC (2030 $/MWh)**
Street lighting upgrade to LED	1,494 MWh	-$127 /MWh
WWTP operating / process control	1,250 MWh	-$110 /MWh
Stotts Creek facility 50 kW solar PV on new FOGO shed	57 MWh	-$93 /MWh
Council facilities HVAC systems efficiency improvements	124 MWh	-$90 /MWh
Council facilities lighting upgrade to LED	429 MWh	-$69 /MWh
Kingscliff Library 16.8 kW solar PV	19 MWh	-$63 /MWh
Crematorium facility - roof of main office, 8 kW solar PV	8 MWh	-$62 /MWh
Mooball WWTP 5 kW solar PV	5 MWh	-$61 /MWh
Mechanical & Electrical depot Kingscliff - augment current system with 30 kW solar PV	30 MWh	-$59 /MWh
Tweed Heads depot 15 kW solar PV	15 MWh	-$59 /MWh
Murwillumbah Works Depot and Building C 91.26 kW solar PV	91 MWh	-$56 /MWh
HACC Tweed Heads 6 kW solar PV	6 MWh	-$53 /MWh
Murwillumbah Art Gallery 99.18 kW solar PV	123 MWh	-$43 /MWh
Tweed Heads South Pool 55 kW solar PV	67 MWh	-$22 /MWh
Kingscliff WWTP Sustainability Centre 99 kW solar PV	124 MWh	-$22 /MWh
Tweed Regional Museum 38.40 kW solar PV	49 MWh	-$12 /MWh
Civic Centre Murwillumbah 98 kW solar PV	105 MWh	-$9 /MWh
Administration Centre Tweed Heads 95 kW solar PV	102 MWh	-$9 /MWh
Tweed Regional Aquatic Centre Murwillumbah 165 kW solar PV	204 MWh	-$1 /MWh
Tweed Heads Civic Centre and Library 20 kW solar PV	23 MWh	$0 /MWh
Bray Park #2 pump 25 kW solar PV	27 MWh	$2 /MWh
Bray Park WTP 215 kW solar PV	243 MWh	$22 /MWh
Banora Point WWTP 700 kW solar PV	850 MWh	$93 /MWh
South Tweed Community Hall - 12 kW solar PV + Battery Energy Storage	16 MWh	$106 /MWh
Banora Point community centre - 23 kW solar PV + Battery Energy Storage	30 MWh	$107 /MWh
Museum storage and Records storage Honeyeater Circuit - 17	22 MWh	$116 /MWh

kW solar PV + Battery Energy Storage		
Expansion of TRAC Murwillumbah / Civic Centre Murwillumbah with 150 kW solar PV + BESS on carpark awning	196 MWh	$155 /MWh
Expansion of Murwillumbah Art Gallery with 100 kW solar PV + BESS	130 MWh	$157 /MWh
Expansion of Kingscliff WWTP on west side with 500 kW solar PV + BESS	652 MWh	$170 /MWh
Expansion of Banora Pt WWTP with 700 kW solar PV + BESS	932 MWh	$184 /MWh
Expansion of Bray Park solar with 50 kW + BESS on #2 pump reservoir roof	57 MWh	$251 /MWh
Hastings Point WWTP floating array on southern overflow, 60 kW	73 MWh	$361 /MWh

TABLE 3: 'MARGINAL ENERGY-SAVING COST' (MEC) OF REAP PROJECTS

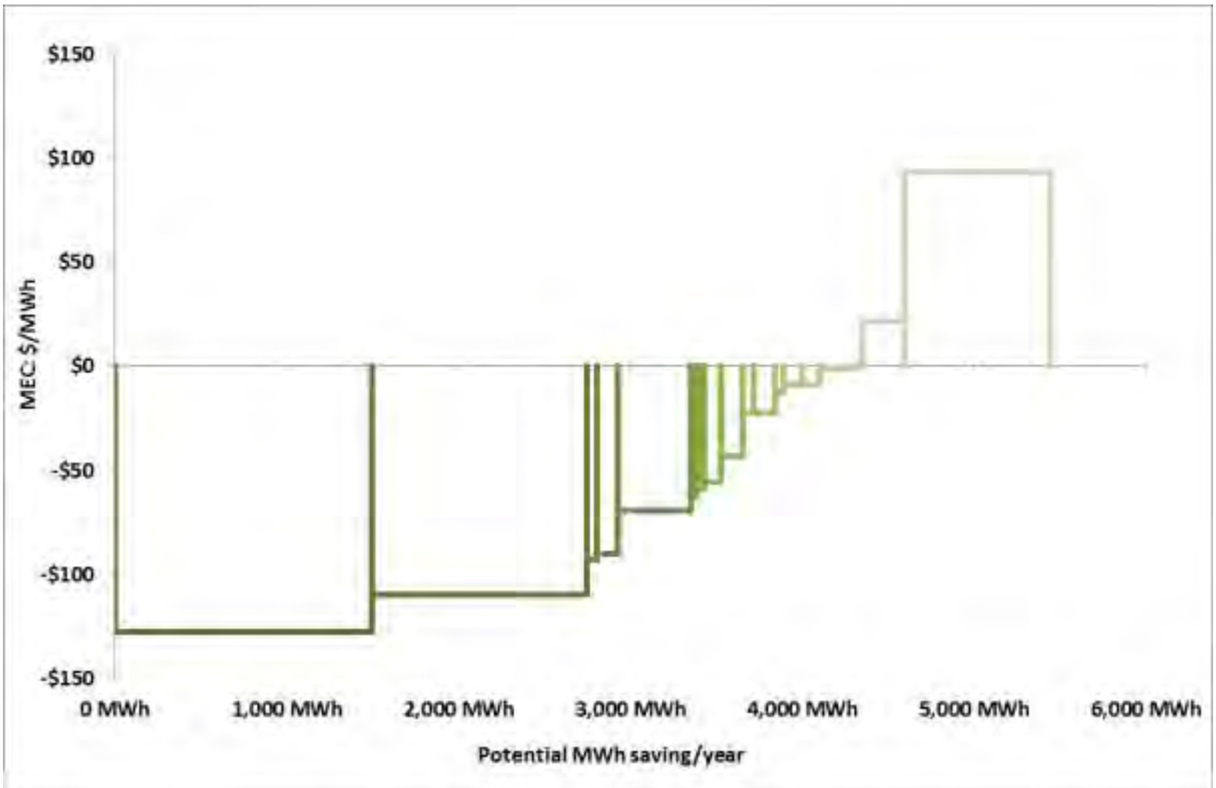

FIGURE 3: MEC CURVE AT 2030 FOR TWEED SHIRE COUNCIL – EFFICIENCY, STREET LIGHTING & PHASE 1 SOLAR

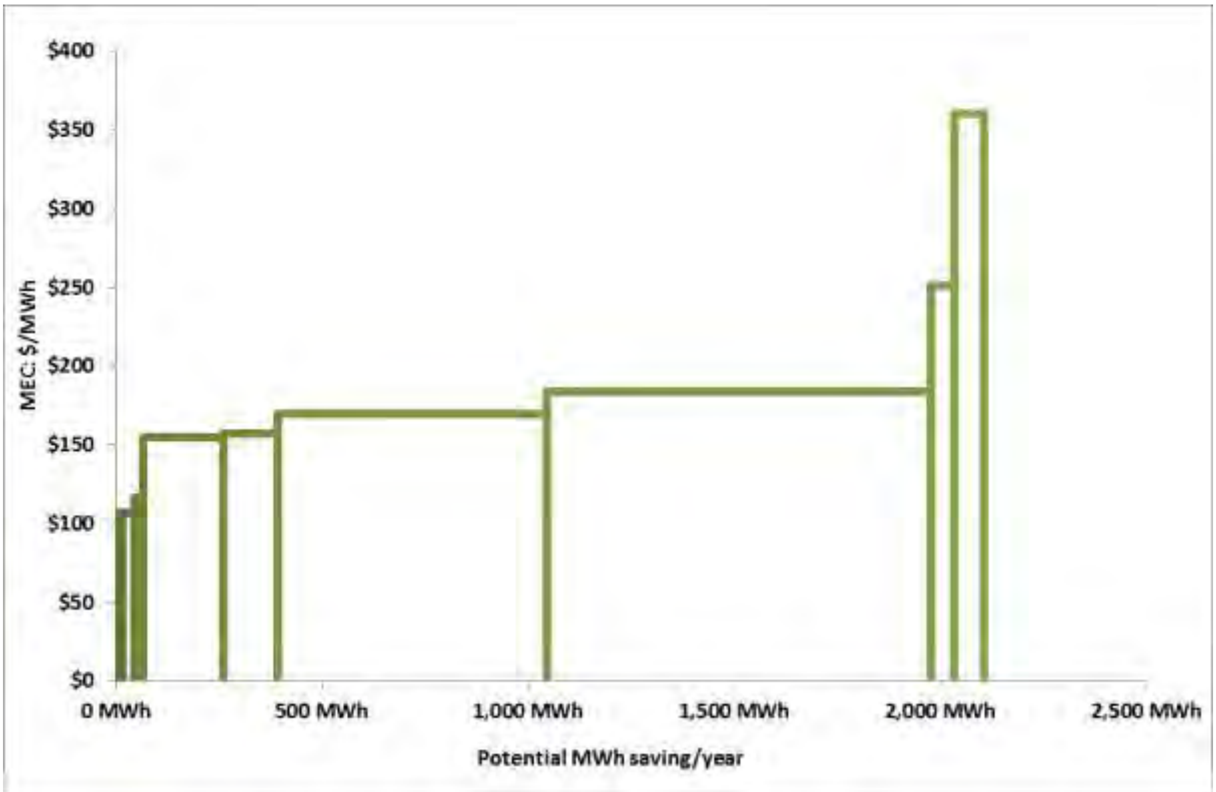

FIGURE 4: MEC CURVE AT 2030 FOR TWEED SHIRE COUNCIL –PHASE 2 SOLAR & BATTERY STORAGE

2 Context

Tweed Shire Council's aspirational goal of becoming self-sufficient in renewable energy was set in 2013. Since that time efforts at global, national and local levels have accelerated, as has the scale and pace of development of renewable energy technologies and projects. It is useful to look briefly at this progress, which highlights how Council's aspiration is becoming an increasingly necessary and achievable goal.

2.1 What is the global consensus?

At a global level nations committed at the Conference of the Parties at Paris in 2015 (COP21) to work to limit global temperature increases to no more than 2 degrees Celsius above pre-industrial times, and urged greater efforts to limit the increase to under 1.5 degrees Celsius. A summary of some key outcomes from COP21 is shown below.

FIGURE 5- SUMMARY OF SOME KEY COMMITMENTS FROM COP21[1]

[1] Source: World Resources Institute

2.2 What is Australia doing?

At Commonwealth and States / Territories levels a range of initiatives and targets are in place relating to greenhouse gas (GHG) emissions and renewable energy. These include:

- The Renewable Energy Target or RET has been in place since 2001 (at 9,500 GWh of RE by 2020), and was expanded to a 20% target (45,000 GWh) in 2009. It has since been modified and currently stands at a target of 33,000 GWh by 2020. This is split into two components, the Large-scale RET and the Small-scale RE Scheme (SRES). The SRES underpins the installation of RE projects of <100 kW, by providing an up-front discount to the installed cost of these systems. The Large-scale RET is applicable for installation sizes equal to or greater than 100kW.
- The Australian Renewable Energy Agency (ARENA) was established to help make renewables more affordable through the provision of grants and incentives, particularly for innovative projects. Its objectives are to increase both the competitiveness and supply of renewables. A key initiative recently supported was the funding of solar PV projects that can demonstrate unsubsidised costs of under $130/MWh (on a levelised cost, or lifecycle cost of electricity (LCOE)-basis). On 8th September 2016 a total of twelve projects were announced as successful applicants for ARENA grants, and these will see close to 500 MW of large PV capacity built in the near future. Five of these projects are to be located in New South Wales. Since this funding round costs for solar have continued to drop sharply.

FIGURE 6- SUMMARY OF ARENA LARGE-SCALE SOLAR FUNDING PROJECTS[2]

- The Clean Energy Finance Corporation (CEFC) invests on a commercial basis to increase funds for clean energy initiatives, including renewables. Their primary objective is to accelerate the transition to a 'clean energy economy'.

[2]Sourced from: https://arena.gov.au/funding/programs/advancing-renewables-program/large-scale-solar-photovoltaics-competitive-round/

- ARENA and CEFC are jointly managing a $1 billion 'Clean Energy Innovation Fund' since July 2016, whereby ARENA-assessed and recommended proposals are forwarded to CEFC and supported via a $100m per year commercialisation fund[3].
- Australia's 2030 emissions reduction target of 26-28% reduction on 2005 levels (50-52% reduction per capita and 64-65% reduction in economy emissions-intensity) is underpinned by a $2.55bn Emissions Reduction Fund (ERF).
- Several States and Territories have announced GHG and/or renewable energy targets and are well on the path towards achieving these. These include:
    - ACT: 100% renewable electricity by 2020, underpinned by a reverse auction process and feed-in-tariffs that are passed on to consumers in the ACT.
    - South Australia: 50% renewable electricity by 2025, target net-zero emissions by 2050.
    - NSW and Victoria: target of net zero emissions by 2050, and Victoria is commencing a series of reverse auctions in 2017 that will see a significant rise in the amount of renewables in that state.
    - Queensland has accepted the vast majority of recommendations put forward by its Renewable Energy Expert Panel inquiry into credible pathways to a 50 per cent renewable energy target in Queensland by 2030[4] resulting in the release of its *Powering Queensland* Plan on 5 June 2017.

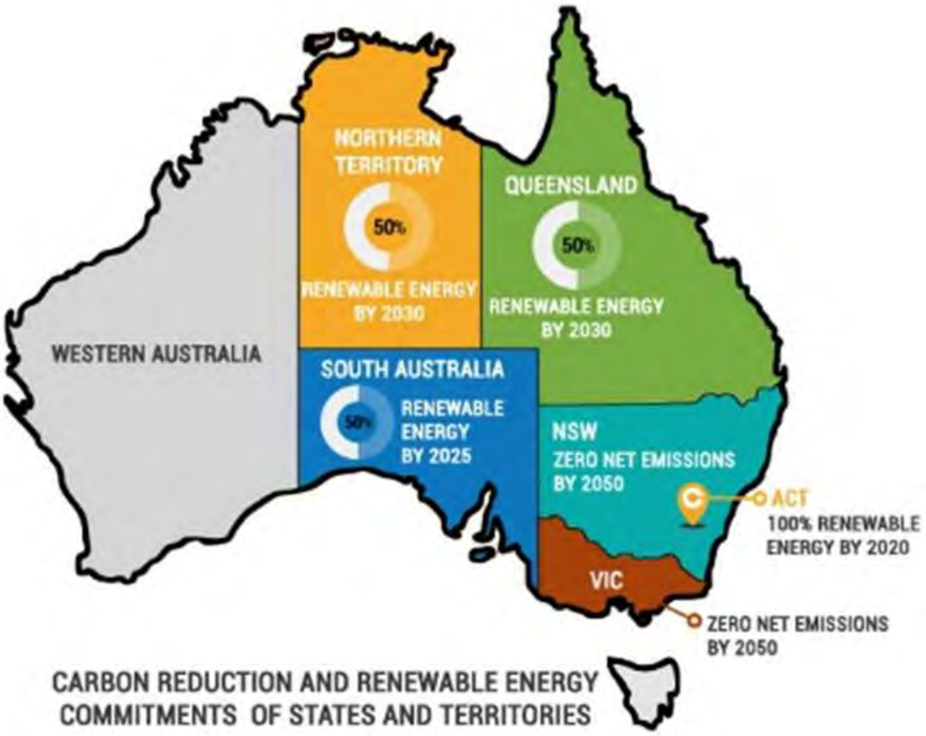

FIGURE 7- OVERVIEW OF STATES AND TERRITORIES RENEWABLES AND / OR CARBON TARGETS, JULY 2017

[3] Sourced from http://www.environment.gov.au/news/2016/03/23/clean-energy-innovation-fund
[4] Sourced from: https://www.dews.qld.gov.au/__data/assets/pdf_file/0003/1253811/qg-responce-renewable-energy-inquiry.pdf

2.3 Renewable energy in Tweed Shire and other councils and towns

Tweed Shire Council's renewable energy aspiration arises out of many years' efforts to manage energy use and reduce greenhouse gas emissions in a growing region. Past work and strategic directions have included:

- 2003 Tweed Shire Climate Change Action Plan, which aimed to reduce community and Council emissions by 20% below 1996 levels by 2010,
- Council's pursuit of a 2% annual reduction in energy use through energy efficiency since 2013-14,
- Assessment by Council of the feasibility of a range of renewable energy initiatives, including wind energy and micro-hydro electricity generation,
- In March 2013 Council set an aspirational goal of becoming self-sufficient in renewable energy, but without a specific timeframe or interim targets,
- In February 2014, Council passed the 'Large Scale Solar Investment' resolution to note the investment by Sunshine Coast Council in a large scale solar farm expected to provide $10 million in savings to the Council over 30 years, and required officers to bring forward a report which gives consideration to investment in large scale solar energy systems and energy efficiency initiatives and possible options for funding.

Council's intent to prepare a Renewable Energy Action Plan (REAP) arises out of these past efforts and directions, and puts Tweed Shire Council among a small but growing number of local governments and towns that have taken a leading position in terms of progressing local action to respond to climate change. This is illustrated below.

FIGURE 8- OVERVIEW OF LEADING COUNCILS AND TOWNS RENEWABLES AND CARBON TARGETS, JULY 2017

Further context to these targets is provided by local communities, with local government objectives often led by high levels of acceptance and uptake of renewable energy by residents and businesses alike. The Tweed Shire sits in the top five LGAs in NSW in terms of solar PV uptake by residents, with Australian Photovoltaic Institute (APVI) figures indicating that 31.3% of homes have solar across the Shire.

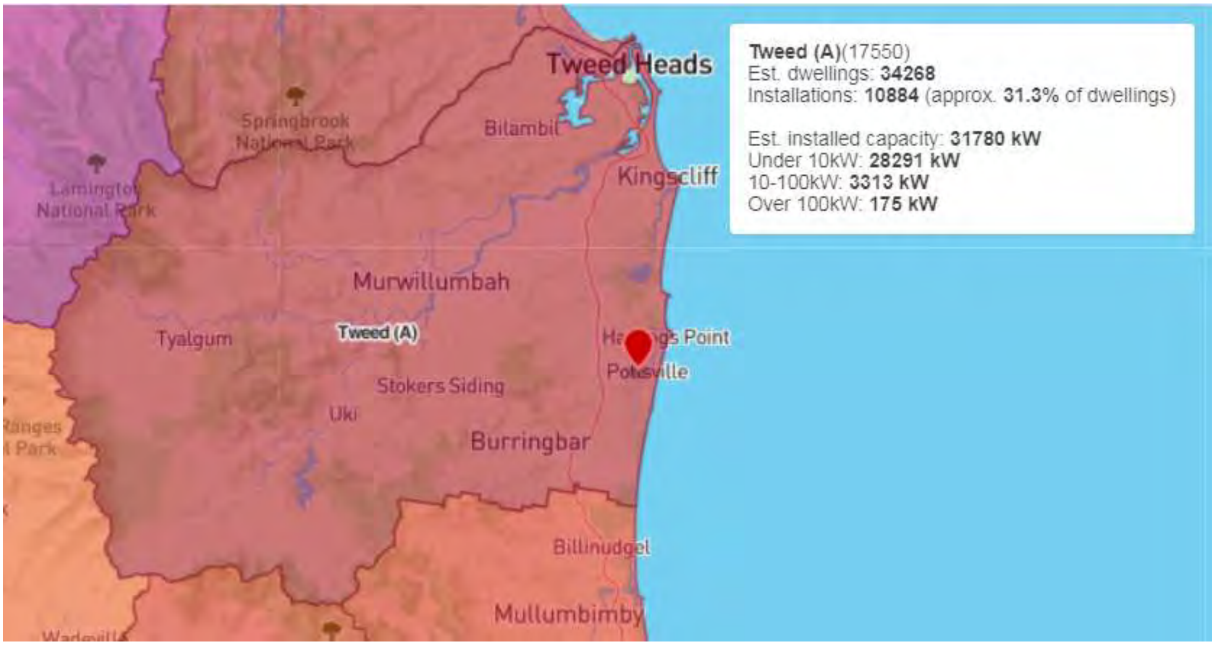

Figure 9- Uptake of solar PV in Tweed Shire Council, July 2017[5]

[5] http://pv-map.apvi.org.au/historical#10/-28.5013/153.2401

3 Understanding Council's renewable energy task

TSC's renewable energy aspiration relates to electricity consumed by Council's operational assets, including street lighting. An initial task was to understand the scale of energy consumed today, and to project what this consumption will be in future under a business-as-usual scenario.

3.1 Electricity baseline by asset type

TSC reports on electricity use and cost via its zEUS database. The years 2012-13 to 2015-16 form a basis for forecasting future electricity. Council's electricity consumption over these four years is virtually unchanged, notwithstanding changes within each section over this time.

Section	2012-13	2013-14	2014-15	2015-16
Wastewater treatment	6,307,649 kWh	6,703,227 kWh	6,975,319 kWh	6,448,450 kWh
Water pumping	4,916,177 kWh	5,136,474 kWh	4,838,342 kWh	4,515,734 kWh
Street lighting[6]	2,845,529 kWh	2,845,529 kWh	2,845,529 kWh	2,941,441 kWh
Community & Natural Resources	2,079,926 kWh	2,115,910 kWh	2,233,358 kWh	2,506,203 kWh
Sewer pumping	2,338,624 kWh	2,137,560 kWh	2,387,086 kWh	2,173,767 kWh
Recreation Services	2,050,183 kWh	1,970,758 kWh	1,628,795 kWh	2,029,963 kWh
Water treatment	966,703 kWh	965,823 kWh	971,981 kWh	956,868 kWh
Community & Cultural Services	157,656 kWh	155,781 kWh	322,185 kWh	302,848 kWh
Other	765,749 kWh	688,597 kWh	699,180 kWh	687,113 kWh
Total Electricity Use	**22,428,195 kWh**	**22,719,660 kWh**	**22,901,774 kWh**	**22,562,386 kWh**

TABLE 4: TSC'S ELECTRICITY CONSUMPTION FROM 2012-13 TO 2015-16

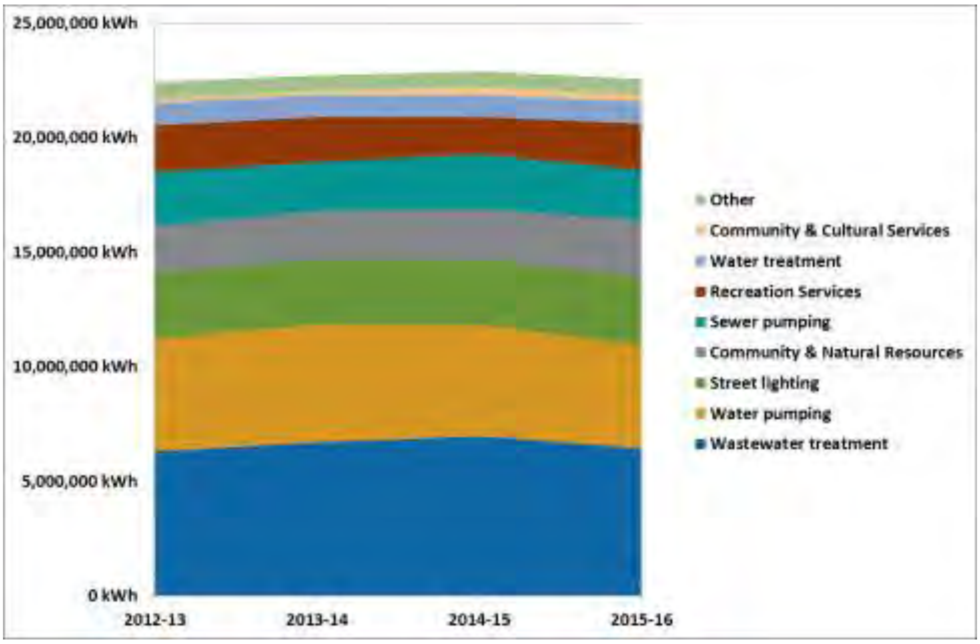

FIGURE 10: TSC'S ELECTRICITY CONSUMPTION FROM 2012-13 TO 2015-16

The sections above can be grouped up into three main sections of water & sewer, property, plus street lighting. Monthly consumption data and charts for these sections in 2015-16 are shown below.

[6] Note that Council's data only has street lighting consumption from 2014-15, so prior years were assumed to have the same consumption and cost as 2014-15

Property (incorporating Community & Natural Resources, Recreation Services, Community & Cultural Services)

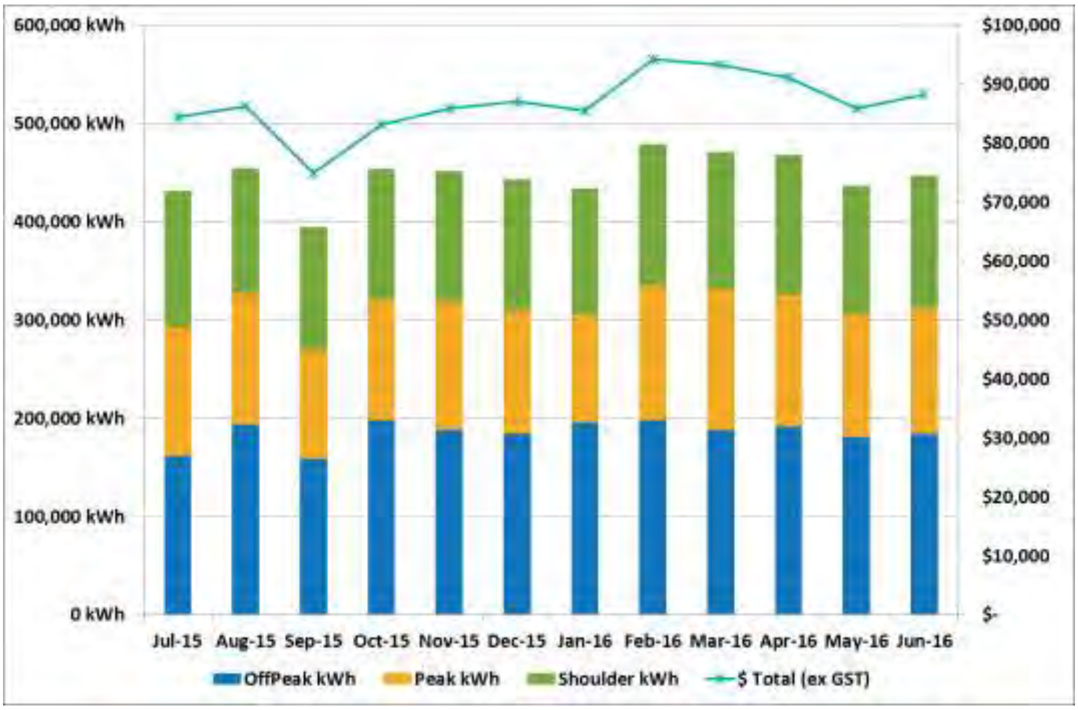

FIGURE 11: MONTHLY ELECTRICITY TIME-OF-USE CONSUMPTION AND COSTS FOR TSC PROPERTIES FY 2015-16

Month	Off Peak kWh	Peak kWh	Shoulder kWh	Total kWh	$Total (ex GST)
Jul-15	161,643 kWh	131,543 kWh	137,974 kWh	431,160 kWh	$84,462
Aug-15	193,468 kWh	133,529 kWh	127,744 kWh	454,740 kWh	$86,223
Sep-15	158,379 kWh	110,588 kWh	125,646 kWh	394,613 kWh	$74,901
Oct-15	198,109 kWh	123,324 kWh	132,550 kWh	453,982 kWh	$83,079
Nov-15	187,719 kWh	130,890 kWh	133,018 kWh	451,627 kWh	$85,897
Dec-15	184,036 kWh	126,292 kWh	132,768 kWh	443,097 kWh	$87,075
Jan-16	195,890 kWh	109,118 kWh	128,736 kWh	433,745 kWh	$85,448
Feb-16	198,170 kWh	137,881 kWh	142,918 kWh	478,969 kWh	$94,201
Mar-16	187,500 kWh	144,123 kWh	139,318 kWh	470,941 kWh	$93,225
Apr-16	191,181 kWh	134,763 kWh	142,205 kWh	468,149 kWh	$91,148
May-16	180,922 kWh	125,594 kWh	130,352 kWh	436,868 kWh	$85,888
Jun-16	184,223 kWh	127,990 kWh	134,213 kWh	446,426 kWh	$88,283
Totals	**2,221,240 kWh**	**1,535,635 kWh**	**1,607,443 kWh**	**5,364,318 kWh**	**$1,039,829**

TABLE 5: MONTHLY ELECTRICITY TIME-OF-USE CONSUMPTION AND COSTS FOR TSC PROPERTIES FY 2015-16

While a modest summer peak usage trend is seen this is not pronounced, and will reflect the fact that facilities such as leisure centres have lower summer demand while office accommodation demand at this time is higher. September is typically a month of low heating and cooling and this is reflected in the data. Electricity costs generally follow consumption, suggesting that peak demand for large sites in this category is generally predictable.

Street Lighting

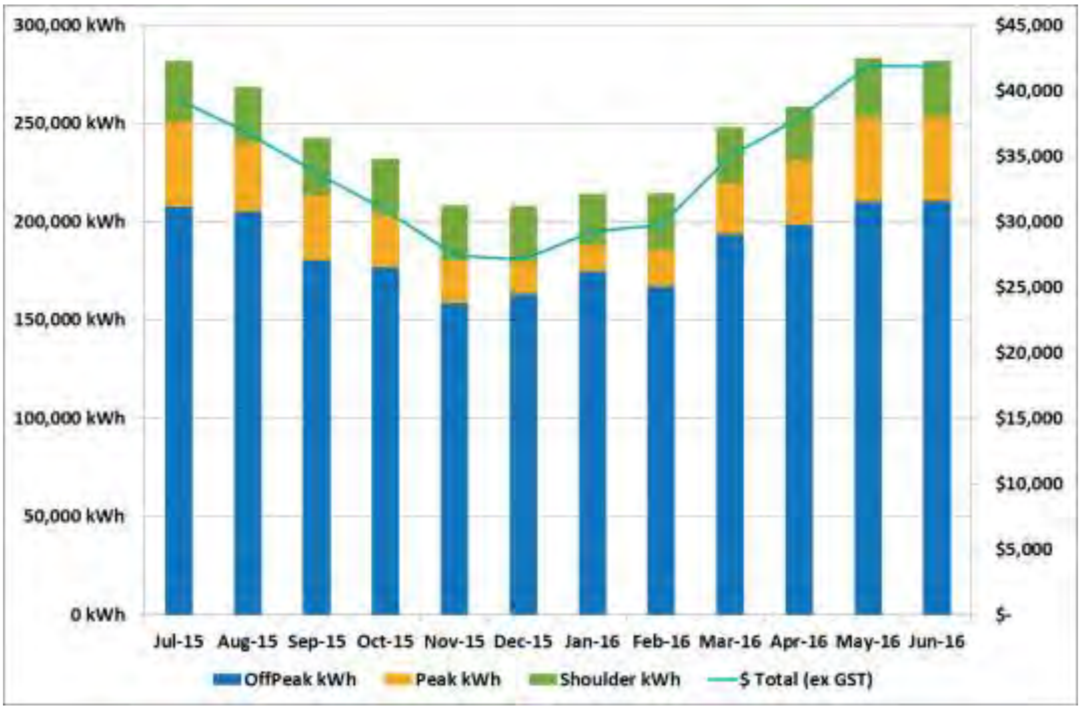

FIGURE 12: MONTHLY ELECTRICITY TIME-OF-USE CONSUMPTION AND COSTS FOR TSC STREETLIGHTING FY 2015-16

Month	Off Peak kWh	Peak kWh	Shoulder kWh	Total kWh	$Total (ex GST)
Jul-15	207,782 kWh	43,324 kWh	30,700 kWh	281,806 kWh	$39,308
Aug-15	205,070 kWh	35,431 kWh	28,051 kWh	268,552 kWh	$36,763
Sep-15	180,476 kWh	32,996 kWh	29,430 kWh	242,902 kWh	$33,749
Oct-15	176,860 kWh	27,080 kWh	28,117 kWh	232,056 kWh	$30,881
Nov-15	158,387 kWh	21,689 kWh	28,131 kWh	208,208 kWh	$27,417
Dec-15	163,115 kWh	16,440 kWh	28,370 kWh	207,924 kWh	$27,105
Jan-16	174,822 kWh	13,214 kWh	25,883 kWh	213,919 kWh	$29,255
Feb-16	167,191 kWh	18,444 kWh	28,637 kWh	214,272 kWh	$29,751
Mar-16	193,499 kWh	26,081 kWh	28,638 kWh	248,217 kWh	$35,008
Apr-16	198,176 kWh	33,194 kWh	27,228 kWh	258,598 kWh	$37,899
May-16	210,153 kWh	43,045 kWh	29,944 kWh	283,142 kWh	$41,899
Jun-16	210,397 kWh	42,755 kWh	28,692 kWh	281,844 kWh	$41,862
Totals	2,245,928 kWh	353,692 kWh	341,821 kWh	2,941,441 kWh	$410,897

TABLE 6: MONTHLY ELECTRICITY TIME-OF-USE CONSUMPTION AND COSTS FOR TSC STREETLIGHTING FY 2015-16

Street lighting is unmetered, and consumption is based on an agreed lighting 'load table' with default hours of use applied that reflects seasons. Hence there is much lower consumption and cost in summer when there are more daylight hours.

Water & Sewer (incorporating Wastewater treatment, Water pumping, Sewer pumping, Water treatment)

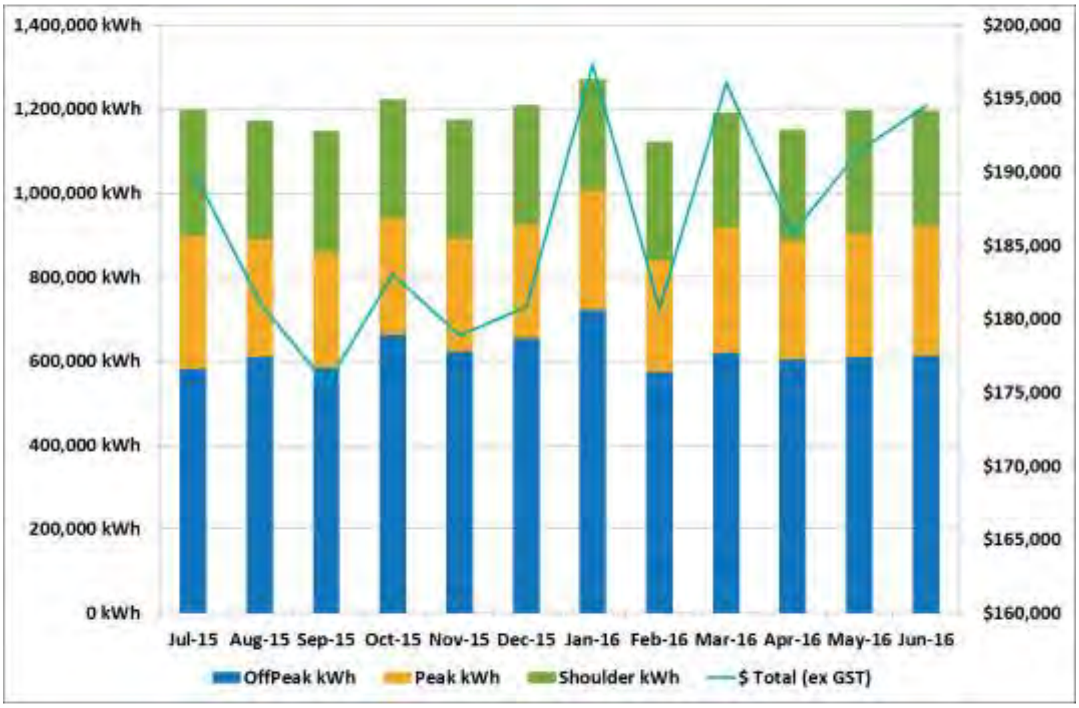

FIGURE 13: MONTHLY ELECTRICITY TIME-OF-USE CONSUMPTION AND COSTS FOR TSC WATER & SEWER FY 2015-16

Month	Off Peak kWh	Peak kWh	Shoulder kWh	Total kWh	$ Total (ex GST)
Jul-15	580,360 kWh	318,869 kWh	298,392 kWh	1,197,621 kWh	$190,107
Aug-15	609,171 kWh	281,417 kWh	283,098 kWh	1,173,686 kWh	$181,120
Sep-15	584,163 kWh	274,491 kWh	289,252 kWh	1,147,905 kWh	$175,542
Oct-15	662,134 kWh	278,678 kWh	282,105 kWh	1,222,916 kWh	$183,047
Nov-15	622,706 kWh	269,342 kWh	282,909 kWh	1,174,957 kWh	$178,902
Dec-15	655,217 kWh	267,852 kWh	287,125 kWh	1,210,194 kWh	$180,843
Jan-16	721,190 kWh	285,133 kWh	265,423 kWh	1,271,746 kWh	$197,313
Feb-16	574,274 kWh	263,798 kWh	284,644 kWh	1,122,716 kWh	$180,704
Mar-16	619,140 kWh	298,316 kWh	273,330 kWh	1,190,786 kWh	$196,093
Apr-16	604,998 kWh	279,949 kWh	266,221 kWh	1,151,168 kWh	$185,829
May-16	609,305 kWh	296,622 kWh	290,697 kWh	1,196,624 kWh	$191,458
Jun-16	612,770 kWh	307,137 kWh	276,401 kWh	1,196,308 kWh	$194,513
Totals	**7,455,426 kWh**	**3,421,604 kWh**	**3,379,597 kWh**	**14,256,627 kWh**	**$2,235,471**

TABLE 7: MONTHLY ELECTRICITY TIME-OF-USE CONSUMPTION AND COSTS FOR TSC WATER & SEWER FY 2015-16

Monthly electricity consumption is almost identical, evidencing no real seasonality of demand. Differences are more likely to arise during wet periods when there is more demand on WWTP facilities. However the cost of electricity is seen to 'spike' regularly, suggesting that peak demand management can be refined, though the effect on energy consumption would be negligible.

Whole-of-Council summary by asset type

When we look at all three of these sections together for 2015-16 the dominance of Water & Sewer is evident.

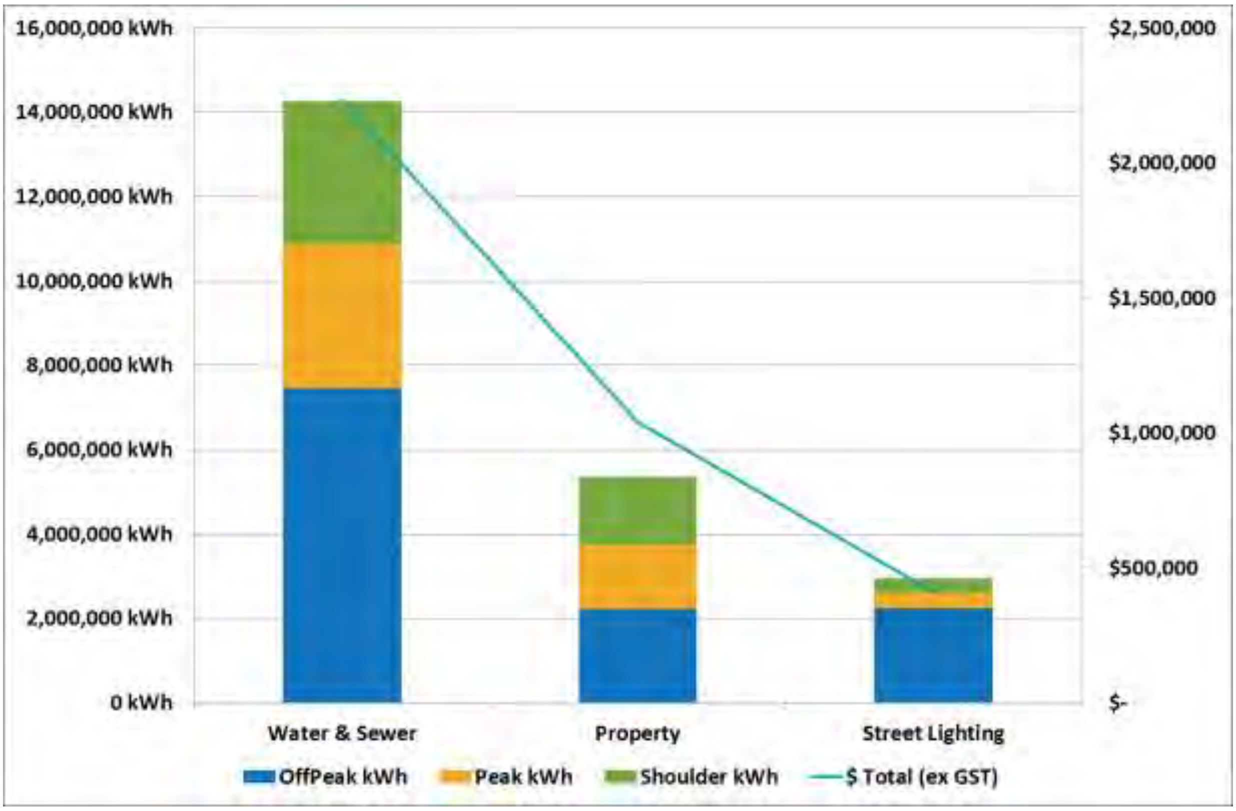

FIGURE 14: TSC'S COMPARATIVE ELECTRICTY USE AND COST ACROSS W&S, PROPERTY AND STREET LIGHTING

2015-16	Off Peak kWh	Peak kWh	Shoulder kWh	Total kWh	$ Total (ex GST)
Water & Sewer	7,455,426 kWh	3,421,604 kWh	3,379,597 kWh	14,256,627 kWh	$2,235,471
Property	2,221,240 kWh	1,535,635 kWh	1,607,443 kWh	5,364,318 kWh	$1,039,829
Street Lighting	2,245,928 kWh	353,692 kWh	341,821 kWh	2,941,441 kWh	$410,897
Total	**11,922,595 kWh**	**5,310,932 kWh**	**5,328,860 kWh**	**22,562,386 kWh**	**$3,686,197**

TABLE 8: TSC'S COMPARATIVE ELECTRICTY USE AND COST ACROSS W&S, PROPERTY AND STREET LIGHTING

The highest average electricity rates were seen for property assets (19.4¢/kWh), mainly reflecting the higher peak and shoulder periods electricity consumption for these facilities as a proportion of total energy use. Water & sewer sites' average electricity rate was 15.6¢/kWh, while street lighting electricity rates were 13.9¢/kWh and have the highest amount of offpeak consumption as a proportion of total consumption.

3.2 Electricity baseline – major facilities and equipment

We can also look at electricity use by individual TSC facilities, where we can see a small number of sites dominate consumption. In 2015-16 the top 10 sites (17 individual accounts) consumed 74% of Council's total electricity. These sites and their 2015-16 electricity consumption are tabulated below.

Site / account name	2015-16 kWh	Percent of TSC
Banora Point WWTP (4 accounts)	4,199,656 kWh	18.6%
Banora WWTP (No1)	*2,116,448 kWh*	*9.4%*
Banora WWTP (No2)	*1,962,742 kWh*	*8.7%*
*Banora Pt WWTP Sunshine Ave Effluent Pump^*	*80,134 kWh*	*0.4%*
Banora Pt WWTP Belt Press	*40,331 kWh*	*0.2%*
Bray Park WTP & WP (5 accounts)	3,779,219 kWh	16.8%
WPS 02 (clear water pumping)	*1,821,552 kWh*	*8.1%*
WPS 01 (Weir to WTP)	*1,000,799 kWh*	*4.4%*
Bray Park WTP (No2)	*726,529 kWh*	*3.2%*
Bray Park WTP (no1)	*222,161 kWh*	*1.0%*
Bray Park WTP, Backwash Lagoons	*8,178 kWh*	*0.0%*
Street Lighting (treated as a single 'site')	2,941,441 kWh	13.0%
Tweed Regional Aquatic Centre (TRAC) Murwillumbah	1,205,259 kWh	5.3%
Kingscliff WWTP	1,088,656 kWh	4.8%
Art Gallery Murwillumbah	1,022,453 kWh	4.5%
Civic Centre Murwillumbah	989,380 kWh	4.4%
Hastings WWTP	596,077 kWh	2.6%
Murwillumbah WWTP	508,465 kWh	2.3%
Water Pumping Station 03	361,327 kWh	1.6%
Sub-total	**16,691,933 kWh**	**74.0%**

TABLE 9: TSC'S TOP 10 ELECTRICITY CONSUMING SITES

Water and wastewater treatment and pumping sites dominate this list, indicating that the majority of Council's electricity use is to supply electric motors driving pumps, blowers and aerators. A simple equipment electricity-use model was developed based on sites visited and on estimates of energy end use at all other sites based on the predominant activities carried out. The outcome from this model is shown below.

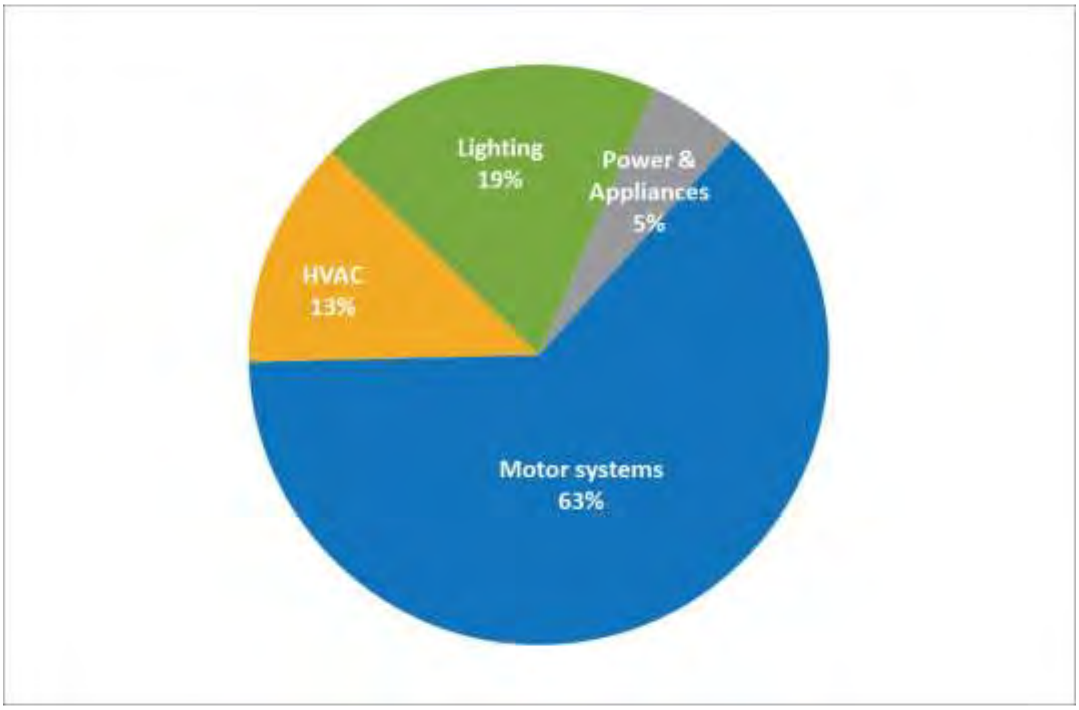

FIGURE 15: END USES FOR ELECTRICITY

This end-use breakup of electricity is developed by making informed assumptions about energy use in various types of facilities, such as:

- In water and wastewater treatment it is assumed that motor systems (aerators, blowers, pumps) account for over 90% of total electricity use. Lighting (external, offices, laboratories, plant rooms), air conditioning (offices, laboratories, switch rooms) and general power (computers, control systems) are taken to account for less than 10%,
- Water and sewer pump stations energy demand is also dominated by pumps. Lighting, air conditioning and power use are assumed to contribute just 1% each to overall electricity use,
- Street lighting, public amenities and many parks energy use is dominated by lighting, with BBQ facilities accounting for a small fraction of consumption,
- Aquatic facilities' energy use is dominated by HVAC (heat pumps for water heating as well as space heating / cooling) and pumping systems (cold and hot water recirculating pumps). Lighting and power use are small by comparison,
- Office accommodation ranges from Council's administration facilities to small community centres and halls. Across all of these sites air conditioning is assumed to consume 50% of electricity, lighting 20% and general power 30% (office equipment and appliances, servers),
- Art galleries and museums usually have higher air conditioning demand due to 24/7 operation and the need to maintain humidity, so this is reflected in assumptions for these sites,
- Depots have motor systems such as compressors that are required in addition to typical office energy use for lighting, air conditioning and general power, so this is reflected in assumptions for these sites.

This end use breakup provides a useful way of looking at the capacity for Council to reduce energy consumption as part of its shift towards greater use of renewable energy.

3.3 Electricity rates and the value of energy savings

From 1 July 2017 Tweed Shire Council's largest sites, consuming 75% of Council's electricity use, commenced a three year electricity agreement. This will see significant increases in contestable electricity costs. Energy rates also rise for use of the Essential Energy distribution network for 2017-18. Energy rates for sites on the small sites contract are expected to increase significantly as well.

In order to carry out cost and benefits analysis of energy saving and renewable energy options, known energy cost rates for large sites, street lighting and small sites were taken and assumed to escalate at 2.5% per year.

Rates were then used to develop estimates for the value of savings from different size users (e.g. small users on General Supply tariff rates and small-sites contract v Large Site contract facilities on demand-based tariffs), and for different types of projects (e.g. savings from solar PV will be valued differently from say savings from an LED lighting upgrade, since the benefits will generally occur at different times and have different impacts on peak demand.

The analysis results in the following valuation of energy savings, with rates shown for the five year period from 2017-18 to 2021-22.

Type of site and savings measure	**2017-18**	**2018-19**	**2019-20**	**2020-21**	**2021-22**
Large Sites (excluding street lighting)					
Value of solar PV savings (cents/per-kWh)	17.77	14.91	14.25	14.60	14.97
Value of solar PV demand savings ($/kW of max PV capacity per month)	4.13	4.23	4.34	4.45	4.56
Value of operating / control improvements (c/kWh, no demand saving valuation)	15.61	13.22	12.31	12.62	12.93
Average value of lighting & HVAC technology changes (c/kWh)	18.53	15.53	14.94	15.31	15.70
Value of lighting technology changes ($/kW of maximum lighting demand change per month)	10.67	10.94	11.21	11.49	11.78
Value of HVAC technology changes ($/kW of maximum HVAC demand change per month)	4.57	4.69	4.81	4.93	5.05
Street lighting					
Value of street lighting savings (c/kWh)	20.14	18.18	17.27	17.70	18.14
Small sites					
Value of small sites energy savings (c/kWh efficiency and solar projects)	24.14	24.74	25.36	25.99	26.64

TABLE 10: ESTIMATE VALUE OF ENERGY AND SOLAR PV SAVINGS AT TSC SITES 2017-18 TO 2021-22

For future reviews of the REAP, Council should re-examine energy rates and revise the value of savings accordingly.

3.4 Tweed Shire Council energy projection to 2030

A range of factors will influence energy demand, both to increase it and decrease it. These include:

- Population change: according to http://forecast.id.com.au/tweed/home the population of the Tweed Shire Council is a little over 92,000 in 2017 and will grow to nearly 126,000 by 2036. Taking a straight-line growth path this would imply a population of 114,000 by 2030, which is a 24% increase and 1.65% per year,
- Growth in Council services to meet population changes: this will not be a linear relationship with just a marginal change likely across most Council services. For example:
    - Street lighting services will grow in new development areas whereas infill developments in existing areas may see no or minimal increase in street lighting,
    - There is capacity in water and wastewater treatment systems to accommodate growth, so only marginal growth would be expected, for example in water pumping and sewer pumping stations,
    - Changes in energy requirements for Council administration and large leisure facilities would be minimal
- Step changes in demand are more likely to occur, for example when the capacity of a water or sewerage treatment works is upgraded to meet a future population, or when an unheated swimming pool is upgraded to be heated year-round with heat pumps,
- Change in responsibility for electricity use of assets – for example some community facilities and sporting fields are managed by tenants / occupants and electricity accounts and billing are the responsibility of the tenant. This is an increasing trend, which serves to reduce the consumption of electricity by Council. Based on a review of existing accounts, Council's energy consumption could reduce by more than 75 MWh and $26,000 per year with the transfer of 12 sporting field electricity accounts to clubs,
- Acquisition and divestment of assets: Council periodically reviews its assets and their suitability to meet future community needs. This may see some facilities be sold, while others may be purchased or have a change of use that alters their future energy demand,
- Continuing business-as-usual upgrade to equipment and facilities may see both increases and decreases in energy demand. For example new air conditioning systems may be installed where there was no air conditioning, which will increase energy use. Conversely if air conditioning units are replaced it is often with energy efficient models. IT systems are increasingly digital and some services may be virtualised, potentially decreasing power demand by these systems. However as records are increasingly digitised the amount of server space required can increase

The most useful indicator of future demand is likely to be past demand which, as noted, has been largely unchanged in the past four years. For planning purposes it is prudent to assume some rate of increase, so future needs for renewable energy generation or purchasing are not understated.

The suggested approach is to assume three potential paths:

- Zero growth in energy demand to 2030,
- Modest straight increase of say 0.5% per year to 2030 assuming no step-change events, and
- 1% per year growth to 2030, which could reflect modest underlying growth plus one or more step changes in demand resulting from, say an increase in water and/or wastewater treatment capacity. This is shown as an average annual trend but in reality may be 'lumpy'

Each of these potential paths are shown below.

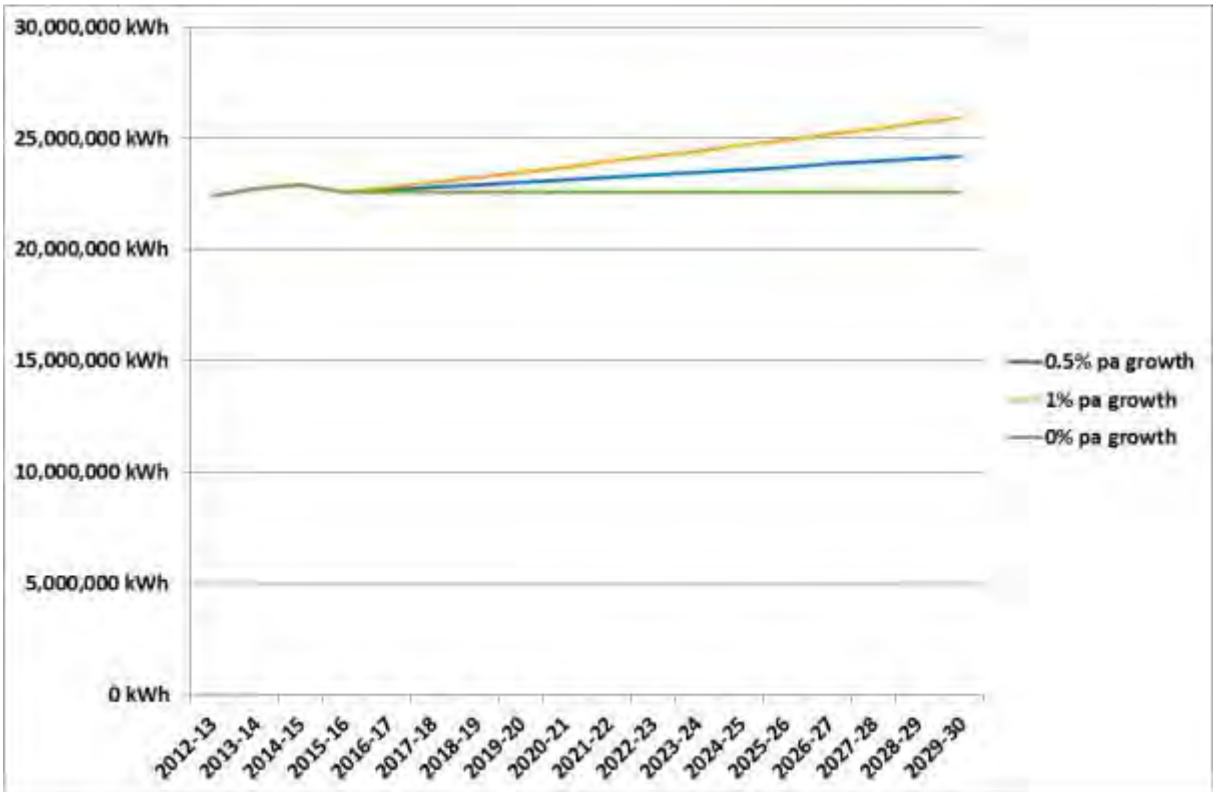

FIGURE 16: POSSIBLE GROWTH PATHS FOR ELECTRICITY BY TSC TO 2030

Section	Electricity Use at 0.5% pa growth	Electricity Use at 1.0% pa growth
2016-17	22,675,198 kWh	22,788,010 kWh
2017-18	22,788,574 kWh	23,015,890 kWh
2018-19	22,902,517 kWh	23,246,049 kWh
2019-20	23,017,030 kWh	23,478,510 kWh
2020-21	23,132,115 kWh	23,713,295 kWh
2021-22	23,247,776 kWh	23,950,428 kWh
2022-23	23,364,014 kWh	24,189,932 kWh
2023-24	23,480,835 kWh	24,431,831 kWh
2024-25	23,598,239 kWh	24,676,150 kWh
2025-26	23,716,230 kWh	24,922,911 kWh
2026-27	23,834,811 kWh	25,172,140 kWh
2027-28	23,953,985 kWh	25,423,862 kWh
2028-29	24,073,755 kWh	25,678,100 kWh
2029-30	24,194,124 kWh	25,934,881 kWh

TABLE 11: 0.5% PA AND 1.0% PA POSSIBLE GROWTH PATHS FOR ELECTRICITY BY TSC TO 2030

At a simple level then, Tweed Shire Council could consume 22,500 MWh at 0% growth, 24,000 MWh at 0.5% pa growth, and 26,000 MWh at 1% pa growth by 2030.

4 Tweed Shire Council's past and current initiatives

Tweed Shire Council has implemented a range of energy efficient solutions and solar PV systems in recent years. These include:

- Several small solar PV systems were installed on a range of community facilities when the Feed-in-tariff rates were 40-60¢/kWh,
- Street lighting: upgraded local road lighting to compact fluorescent lamps from mercury vapour,
- Upgraded pool facilities at Murwillumbah (TRAC) to install variable speed drive control on pool pumps, implemented solar hot water for shower heating, use of covers / blankets on indoor pools at night, and control of air conditioning so that it only operates when the indoor facility doors are closed,
- Installing a 100 kW solar PV system on the Regional Art Gallery in Murwillumbah in 2017, with grant assistance,
- Installed a new energy efficient chiller (2016) and trialled LED lighting in selected areas of the Council administration building and carpark in Murwillumbah, and installed solar film on several windows to reduce heat gain,
- Implemented a range of energy efficient features in Council's new administration building in Tweed Heads, including an energy efficient air-cooled chiller, solar film, LED lighting and controls,
- All major water pumping assets have rules governing how and when they operate, with the objective being to limit or avoid operation in peak and shoulder periods to reduce demand charges,
- Wastewater treatment plants are high users of energy, and studies have been carried out at larger plants to identify potential energy and process efficiencies in recent months. Implementation of modifications to A-Recycle pumps and on-site air conditioning systems in 2015 resulted in a saving compared with the previous year of 13% at Council's largest site, Banora Point WWTP,
- The Tweed Heads South pool was refurbished in 2015 and new heat pumps and air conditioning installed, as well as VSD control of pool pumps and LED lighting. The pool has an unglazed solar array on the roof for pool water heating,
- The Kingscliff pool uses an unglazed solar array to pre-heat pool water so that the heat pump does not have to run as often as would otherwise be the case,
- The Works depot in Murwillumbah installed two grant-assisted solar PV systems (60 kW and 30 kW) on the main facility and on the 'Pizza Hut' building fronting Buchanan Street in 2017. Previously several high bay lights in the main depot building were replaced with LED lights,
- The new Tweed Regional Museum building in Murwillumbah has a range of energy efficient features built into the design, including energy efficient air cooled AC systems, humidity controls and LED lighting

As seen in the baseline description above, Council's overall electricity consumption has changed little over the last four years, although overall services have increased in this time.

Some of the initiatives noted above will have contributed to this trend. Planned solar PV systems and the recent installation of new chillers at Murwillumbah and Tweed Heads will have an impact on future trends in electricity consumption.

5 Tweed Shire Council's strategies for renewable energy

5.1 Self-sufficiency in renewables

Council's March 2013 goal of becoming 'self-sufficient' in renewable energy is not accompanied by a clear definition of what this means. It is clear that Council's intent is not to 'go off grid' and develop its own energy generation and distribution infrastructure, which would be both expensive and lead to lower reliability of supply. It is equally clear that Council's intent is not to simply buy '100% GreenPower®' as a way of achieving this goal, which would be expensive, costing Council an additional $1.24m - $1.8m per year, and would ignore the many opportunities Council has to develop its own renewable energy solutions.

A preferred and recommended approach is for Council to pursue opportunities to reduce its energy use through efficiency and onsite renewables, and to then look at existing and emerging purchasing and offsite generation opportunities that are cost effective compared with other options for meeting the goal. This strategy of "Reduce, Produce and Purchase" is illustrated below.

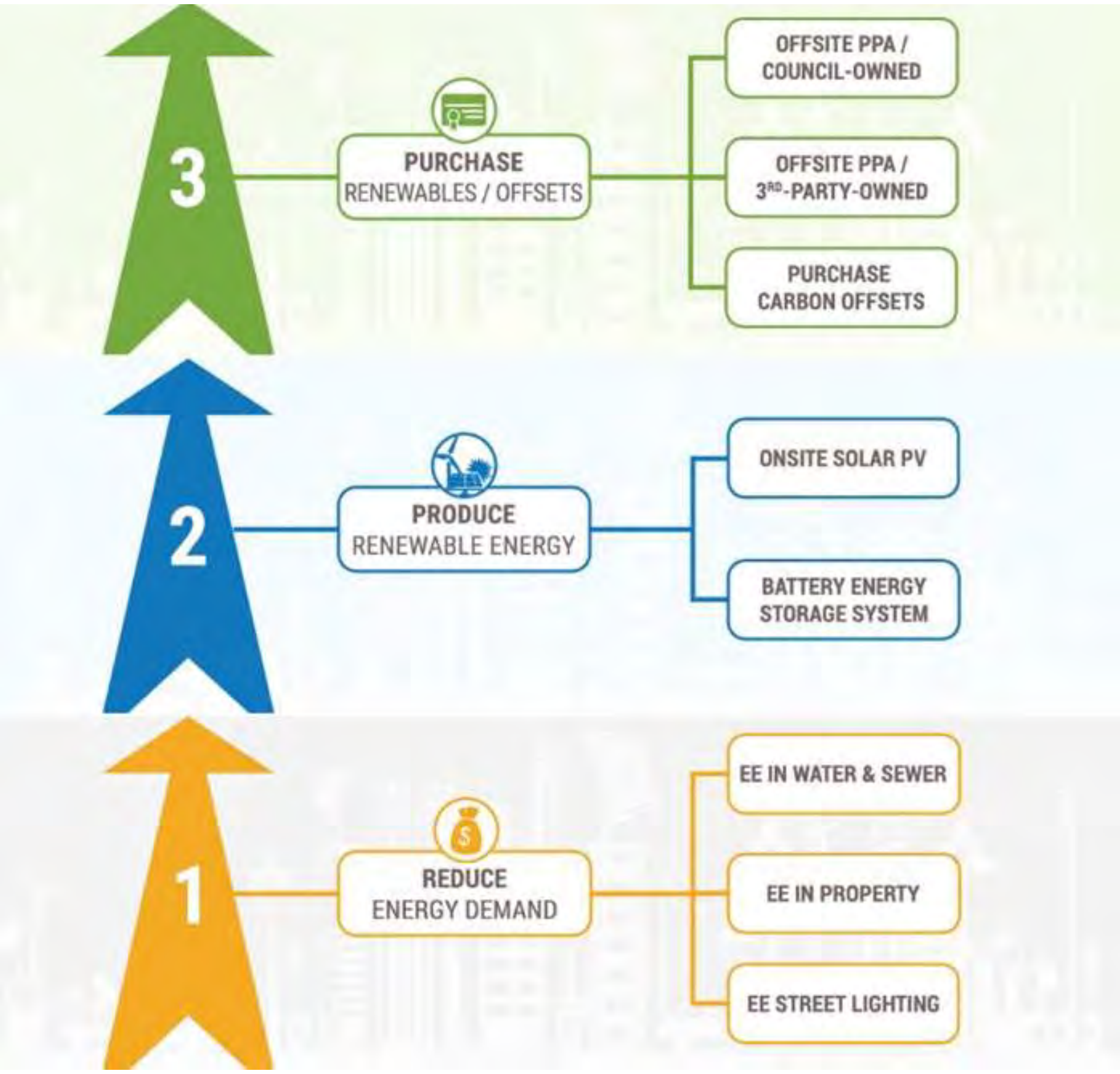

FIGURE 17: "REDUCE, PRODUCE & PURCHASE" APPROACH TO SELF-SUFFICIENCY IN RENEWABLES

This approach helps organisations to build a practical plan towards greater use of renewable energy, and to stage actions over time that are cost effective, can be funded or financed, and can be resourced so that actions are implemented as scheduled.

However the question of what is 'self-sufficiency' in renewables remains unanswered, and in this regard Council can choose between two broad approaches:

1. Self-sufficiency can be taken to mean that all of Council's electricity will be 100% renewable; that is, sourced from renewable energy generation projects and all 'green' attributes withheld by Council and not assigned or sold to others, for example through the sale of renewable energy certificates, or
2. Self-sufficiency can be taken to mean that all of Council's electricity will be sourced from renewable energy projects, however Council may choose whether or not to sell the renewable energy certificates from its own RE projects or whether buy the 'green' attributes or power-only from external RE projects. Council may opt for a mix of both based on a case-by-case assessment of costs and benefits as well as its objectives in terms of creating new renewable energy – i.e. beyond the Renewable Energy Target (RET).

The choice is both an economic one and an environmental one. The financial case for renewables is strengthened via the sale of renewable energy certificates for example, while the overall amount of renewable energy could grow if renewable energy certificates are withheld.

The REAP strategies described below assume that Council will adopt the second approach, and will word its targets to reflect this. Council will therefore:

- Take the Small-scale Technology Certificate (STC) discount for small onsite RE systems less than 100 kW,
- Include revenue from Large-scale Generation Certificates (LGCs) in the analysis for onsite RE systems greater than 100 kW, but may choose at any future time to cease selling these,
- Consider both power-only and power + green attributes when evaluating options to purchase offsite renewable energy, and re-evaluate its preferred strategy at all contract renewal points,
- Consider both withholding and selling LGCs for future Council-owned offsite RE generation projects

5.2 REAP strategies

Five strategies are identified that will help Tweed Shire Council meet its aspirational target of being self-sufficient in renewable energy. These are:

1. Energy efficiency: being more energy efficient helps to cost-effectively reduce the amount of energy that needs to be sourced from renewables, and can return funds to be re-invested in further efficiency and renewable energy initiatives,
2. Solar energy and battery storage on Council facilities: the installation of solar energy technology on Council sites maximises the financial savings, with both contestable energy and network energy costs being reduced. This strategy is organised into two phases, firstly to install solar energy that can be consumed directly on site, and secondly to install additional solar with battery storage in future to maximise the amount of on-site renewable energy generation,
3. Upgrade street lighting to LED technology at the next bulk lamp upgrade, and commit to all new street lighting needs being met with LED technology,
4. Investigate renewable energy purchasing strategies to be implemented at or after the end of Council's current three-year energy agreement: in particular opportunities to enter into a Power Purchase Agreement (PPA) to source a fraction of Council's energy needs from renewables either alone or in conjunction with other local governments,
5. Investigate 'offsite' renewable energy generation opportunities that could be developed to complement other renewable energy strategies and meet any shortfall to Council's self-sufficiency objective

A summary of these five strategies is presented below. A more detailed assessment of each strategy is included as Appendices A to E of this study.

5.2.1 Energy efficiency

Council's efforts to improve energy efficiency are described above, and these have helped to stabilise electricity consumption in recent years. Energy efficiency is part of how Council 'does business', and many opportunities for improvement have been adopted.

Additional energy efficiency gains will be achieved in three main ways. These are summarised below and described in greater detail in Appendix A.

- Implementation of cost effective operational and technology / control upgrades to selected lighting, air conditioning and water and wastewater treatment plants as part of this REAP, over the next 3 years ,
- Ongoing improvements to ensure energy efficiency is built into new and major upgrade works, such as building energy systems (passive as well as mechanical & electrical), pumping system upgrades in the water and sewer network, selection of efficient technologies when upgrading IT systems, and specification of LED street lighting in all new housing developments,
- Review and modification of specification and procurement processes that help to ensure efficient technologies and controls are required in future energy-using equipment purchases such as appliances, office equipment and small air conditioning system replacement

Operational and technology / control upgrades

The REAP includes the following measures that can be implemented in the next three years:

- Upgrade to LED lighting across high-use buildings in Council
  - Investment of $487,000 over three years to upgrade almost 3,250 luminaires to LED technology, with a focus on indoor lighting – in particular single and twin linear fluorescent lamps and CFL and halogen downlights
  - Access to Energy Saving Certificates to reduce upfront costs by close to $50,000
  - Electricity savings of 428,708 kWh per year following upgrade of all lights to LED
  - Annual cost savings including maintenance of almost $110,000 with a simple payback of less than 5 years
- Continued HVAC control systems optimisation at the Administration and Civic Centre building at Murwillumbah, and optimisation of HVAC settings at other sites
  - Building on chiller upgrade and other improvements, further investment in BMS, chilled water control and air handling systems optimisation will continue to improve the efficiency of the HVAC system at the Murwillumbah administration centre. Optimising air conditioning controls / settings at other sites can lead to further modest improvements. A 5% HVAC saving is estimated for key sites
  - This equates to savings of 124,475 kWh per year, with a typical payback of up to 4 years indicating a budget of $80,000
- Assessment and implementation of operational and minor capital improvements at major treatment works, drawing on an assessment of efficiency improvements at the Banora Point WWTP
  - Significant energy savings potential has been identified at the Banora Point WWTP via a detailed assessment of operations by Council and GHD, with some measures implemented and other works planned
  - It is proposed that approximately half of what has been achieved at Banora Point WWTP could be achievable at other treatment works across Council, focused on larger energy users

Efficiency in new and major upgrade works

For many existing systems it is not cost effective to replace or retrofit energy efficient solutions based on energy cost savings alone. For example it is generally not cost effective to replace water and sewer pumping systems before end-of-life or to retrofit them with variable speed drive (VSD) control, due to off peak and/or intermittent operation. In buildings it is generally not viable to replace an air conditioning system until it has reached the end of its life.

When buildings, pumping systems or IT systems are due to be built or upgraded it is appropriate to assess energy efficient opportunities, such as VSDs, high efficiency motors, best practice technology and system design options. For example:

- When SPS' and WPS' are being upgraded opportunities for system and pump re-design and efficiency will be routinely investigated,
- Building upgrades such as the Tweed Heads administration centre and the Tweed Heads Civic Centre and Library incorporate numerous efficiency considerations and initiatives,
- When major IT systems are being upgraded it is the norm to investigate low-energy systems, efficient HVAC systems to cool servers, and to consider options such as virtualisation,

- When new housing developments are planned it should be routine to include LED street lighting as well as plan for energy efficient water and sewer services systems

It is recommended that Council continue to review and refine its processes for design and equipment selection for major projects such as pump systems, IT systems and building upgrades, and for new housing developments. The primary benefit of this will be to minimise growth in energy demand and minimise the amount of electricity that needs to be sourced from renewable energy in future.

Specification and procurement processes

Council can make incremental gains in energy efficiency every time new equipment is purchased, such as appliances (refrigerators, TVs, dishwashers), IT / office equipment (printers, copiers, computers, screens, tablets, phone systems), and replacement air conditioners (typically small split systems). The purchase of least-cost devices often comes with high running costs for electricity.

It is recommended that Council's specifications / requirements for new equipment purchases be reviewed, and minimum efficiency requirements set at least for high-use equipment. This should include:

- Air conditioners – in particular high efficiency requirements in cooling mode, e.g. minimum 5-Star,
- Refrigerators, which run on a 24/7 basis,
- Computers, laptops, screens, copiers – including requirements for energy saving mode,
- Dishwashers

The availability as well as the energy use and cost of various appliances can be estimated via reference to the Commonwealth Government's Equipment Energy Efficiency (E3) program website (www.energyrating.gov.au).

It is also recommended that Council review and refine operating and control processes for appliances and equipment, so that operational energy use is not excessive. Measures that Council may be able to take include:

- Set-up of all new air conditioning units to align with manufacturer's in-built energy efficient features, including for time settings (e.g. 365-day settings), temperature range (including lockout features), occupancy control (on/off or setback control) and heat recovery,
- include energy efficiency as part of a balanced evaluation criteria to achieve the best outcome for IT equipment, including in right-sizing the devices we use,
- Education and awareness programs or training for staff on the use of appliances

The benefits from individual purchases and control measures for appliances and office equipment will be very small. The primary benefit of this will be to minimise growth in energy demand and minimise the amount of electricity that needs to be sourced from renewable energy in future.

5.2.2 Solar energy and battery storage on Council facilities

Solar energy represents an opportunity for Tweed Shire Council to make significant cuts to its grid electricity demand, with 28 solar energy projects identified across 23 individual NMIs. The maximum energy offset (grid saving) for these projects is estimated to be 4,619,372 kWh per year. With degradation of output over time the expected offset in 2029-30 is 4,255,697 kWh. This equates to 16.4% of projected electricity use in 2029-30 under a 1% pa growth forecast (18.8% if growth is limited to 0% pa).

This is a significant saving in grid electricity, and it will require an investment of $6.86 million over the period 2016-17 to 2024-25. This assumes that solar photovoltaic power will be the selected technology, together with battery storage in future, however other options may be available and will be considered by Council in its further feasibility assessments (refer below). The proposed investment is split into two phases of work as outlined below.

Phase 1: solar PV

The first phase of work includes solar-only systems and aims to install systems that can be near-fully absorbed on site with minimal energy export. Given declining prices in solar technology and rising energy rates a target level of 90%+ self-consumption was sought in modelling.

The work involves the installation of 19 solar systems, of which two are underway at the end of 2016-17. The work is expected to have a capital cost of $3.166 million. Payback for all systems ranges from 4 to 7 years, with details of all costs and benefits included in Appendix B. The 19 sites with estimated capital costs are tabulated below.

Site & Project	Timing	Capital cost
Murwillumbah Art Gallery 99.18 kW solar PV	2016-17	$111,221
Murwillumbah Works Depot and Building C 91.26 kW solar PV	2016-17	$67,264
Bray Park WTP 215 kW solar PV	2017-18	$415,360
Tweed Regional Aquatic Centre Murwillumbah 165 kW solar PV	2017-18	$313,500
Kingscliff WWTP Sustainability Centre 99 kW solar PV	2017-18	$126,361
Bray Park #2 pump 25 kW solar PV	2017-18	$28,575
Tweed Heads Civic Centre and Library 20 kW solar PV	2017-18	$22,860
Crematorium facility - roof of main office, 8 kW solar PV	2017-18	$9,144
Mooball WWTP 5 kW solar PV	2017-18	$5,715
Administration Centre Tweed Heads 95 kW solar PV	2018-19	$108,082
Civic Centre Murwillumbah 98 kW solar PV	2018-19	$113,996
Stotts Creek facility 50 kW solar PV on new FOGO shed	2018-19	$56,886
Tweed Regional Museum 38.40 kW solar PV	2018-19	$49,727
Mech & Elec depot Kingscliff - augment system with 30 kW solar PV	2018-19	$34,131
Kingscliff Library 16.8 kW solar PV	2018-19	$19,568
Tweed Heads depot 15 kW solar PV	2018-19	$17,066
HACC Heads 6 kW solar PV	2018-19	$6,826
Banora Point WWTP 700 kW solar PV	2019-20	$1,597,178
Tweed Heads South Pool 55 kW solar PV	2019-20	$62,374

Table 12: List of Phase 1 solar energy systems for Tweed Shire Council

Phase 2: Solar PV & Battery Energy Storage Systems (BESS)

The second phase of work mostly involves the implementation of energy storage in conjunction with solar PV. As such it is targeted principally at two types of facility:

- Large sites where there is ample room for expansion of solar PV systems, and where battery storage will serve to significantly reduce peak and shoulder period energy use and peak demand,
- Small sites with daily intermittent load and good roof space to accommodate solar technology. In TSC these tend to be community facilities. Given the high cost of electricity and the lack of peak demand charges, the value of solar energy stored and used at these sites is high. These projects will also be highly visible to the community and will demonstrate the use of solar & energy storage at commercial scale

In addition to solar and storage, this phase of work includes a floating solar array at the Hastings Point WWTP. Two such systems are operational in Australia at this time, with more expected to be developed in coming years.

These projects are timed in the REAP to be implemented in the period 2020-21 to 2024-25, with an estimated investment of $3.695 million. Current modelling suggests that these projects are marginally cost effective, with paybacks in the order of 8 to 12 years estimated.

Details of all estimated costs and benefits for these projects are included in Appendix B. The nine sites with estimated capital costs are tabulated below.

Site & Project	Timing	Capital cost
Banora Point community centre - 23 kW solar PV + Battery Energy Storage	2020-21	$64,594
Museum storage and Records storage Honeyeater Circuit - 17 kW solar PV + Battery Energy Storage	2020-21	$47,744
South Tweed Community Hall - 12 kW solar PV + Battery Energy Storage	2020-21	$33,701
Expansion of TRAC Murwillumbah / Civic Centre Murwillumbah with 150 kW solar PV + BESS on carpark awning	2021-22	$379,907
Expansion of Murwillumbah Art Gallery with 100 kW solar PV + BESS	2021-22	$253,271
Expansion of Kingscliff WWTP on west side with 500 kW solar PV + BESS	2022-23	$1,151,771
Expansion of Banora Pt WWTP with 700 kW solar PV + BESS	2023-24	$1,503,550
Expansion of Bray Park solar with 50 kW + BESS on #2 pump reservoir roof	2023-24	$107,396
Hastings Point WWTP floating array on southern overflow, 60 kW	2024-25	$152,830

Table 13: List of Phase 2 solar energy & BESS systems for Tweed Shire Council

Battery costs and re-evaluation timing

Owing to uncertainty regarding the future cost of battery storage, it may be that these projects are cost effective sooner than anticipated. As such it is recommended that Council review costs for commercial-scale battery storage systems, and carry out a review of the costs and benefits of these opportunities at regular intervals.

Technology options – concentrating solar thermal at Banora Point WWTP and Kingscliff WWTP

Phase 1 and Phase 2 costs and benefits are based on solar PV technology being deployed for all 28 projects tabulated above. This reflects the current position of solar PV in the market compared with other technologies, and costs and benefits can be estimated with reasonable accuracy.

Council has received preliminary competing offers for a proprietary concentrating solar thermal (CST) energy generation system for two sites, Banora Point WWTP and Kingscliff WWTP. Both of these sites have large areas of land potentially available to host solar energy generation systems. The proposed solution is based on parabolic trough collectors which heat a transfer fluid that then super-heats stored water. This is used to drive steam turbines and generate electricity. Storage built into the system allows for continuous operation of the plants, which is claimed as a benefit that battery storage systems do not provide cost-effectively at this time.

For the CST options the indicated return is sufficiently attractive to warrant investigation alongside solar PV options for these sites. Some key aspects that would need to be explored include:

- Firming of all project costs for both PV and CST options,
- Potential for incentives, e.g. through the NSW Climate Change Fund,
- Comparison of CST and PV systems performance using the same underlying assumptions,
- Conduct a thorough risk assessment of options (e.g. PESTLE), in particular economic and technological risks associated with both options.
    - The technological risk with PV is minimal, however no comparable CST installations have been built in Australia, so this will be the primary focus of this assessment.
    - On the economic risk, solar thermal is reported to lag those of solar PV (Clean Energy Council, ARENA), though CST is noted to have great potential. The performance of CST systems in Australia and future prospects would be explored as part of a next-stage analysis, with comparisons to the proposed technology.

Solar maintenance

Solar PV and battery systems generally have low maintenance requirements. Nonetheless this is taken into account in financial modelling and Council should adopt an approach to maintain all systems under a single or small number of agreements rather than an ad hoc approach.

Solar PV systems should be maintained in accordance with Australian Standard AS/NZS 5033:2014, and approaches to service providers should seek responses that align with the recommendations in this Standard. Recommended maintenance procedures are described at quarterly, 1-year and 5-year intervals for:

- Site level (shading and cleanliness),
- PV modules,
- Wiring installation,
- Electrical,
- Protective devices, and
- Mounting structures

ACCESS TO FINANCIAL INCENTIVES

Council has successfully gained grant funding for PV at the Tweed Regional Gallery, demonstrating the value of exploring all grant opportunities when they arise. These could include the NSW Climate Change Fund, or could come from Commonwealth or State grants for local or regional areas. In particular, battery energy storage systems, innovative systems such as floating PV on Hastings Point WWTP, or complex projects such as solar at Banora Point WWTP may be good candidates for incentives.

For all PV systems that are less than 100 kW in capacity, the value of Small-scale Technology Certificates (STCs) has been deducted from the cost of PV systems to 2020. Council should seek prices with and without the STC discount applied when tendering for all systems of under 100 kW.

Solar energy generation systems that are larger than 100 kW are treated as power stations and are required to be accredited by the Clean Energy Regulator (CER).

FIGURE 18: CER APPLICATION PROCESS FOR ACCREDITING POWER STATIONS[7]

The basic process for Council to follow to access annual credits for electricity generated includes:

- Completion of the application process: this is to be started a minimum of 10 weeks prior to commissioning of the system and there are small fees involved,
- In order to create Large scale Generation Certificates (LGCs) Council will need to install a suitable metering device approved by the CER and annually (31st December) submit generation figures to create certificates,
- Once certificates have been created Council will seek to sell to a suitable LGC trader or party looking to purchase LGC's (e.g. potentially Council's retailer).

SOLAR MONITORING

Council can only verify the success of installed solar energy systems if monitoring is installed to capture output information and compare it with design or expected performance. Monitoring should be a specified requirement of tenders, including the ability for a supervisory system to extract data from different inverters to be centrally monitored and evaluated. Council should investigate suitable monitoring approaches as part of the post-implementation processes for PV systems installed at the Tweed Regional Gallery and the Murwillumbah depot.

[7] http://www.cleanenergyregulator.gov.au/RET/Scheme-participants-and-industry/Power-stations/Applying-for-accreditation

5.2.3 Upgrade street lighting to LED technology

In 2016 a range of LED luminaires were approved for local roads (Category P) within the Essential Energy network and agreements were reached on the Street Lighting Use-Of-System (SLUOS) charges to be applied for all approved LEDs. As such, from early 2017 LED technology is available for use on Category P roads. Trials are continuing on major road lighting (Category V) LED technology, and it is expected that similar approvals and SLUOS agreements will be in place for LEDs for major roads in due course.

Tweed Shire Council received an offer from Essential Energy in early 2017 to upgrade all eligible Category P lighting to LED, however was unable to take up the offer at the time. An analysis has been performed to determine the costs and benefits to TSC, which shows that a payback would be achieved within five years.

The analysis included an estimate of the likely costs and benefits of upgrading Category V lights to LED in future based on current costs and expected benefits of these LEDs. This suggests a payback will be achievable in around 5-6 years.

The next major opportunity for Council to consider an LED upgrade while availing of a potential discount for a bulk lamp upgrade to existing technology that would ordinarily occur, is 2020-21. At this time it is anticipated that Council will have the option to upgrade all of its street lighting to LED. The expected business case for this upgrade is summarised below, with both Category P and Category V lighting included.

LED Upgrade (all Category P and V)	Amount
Timing	2020-21
Capital cost (payable to Essential Energy) – net of any discounts	$3,169,681
Energy Savings Certificate (ESC) discount	$208,988
Net cost to TSC	$2,960,692
Annual energy saving	1,493,627 kWh
Annual energy cost saving (in 2020-21)	$271,751
Annual SLUOS saving (in 2020-21)	$317,392
Simple payback	4.79 years
Net present value benefit compared with doing nothing, to 2030 at 7% discount rate	$1,237,946
Net present value benefit compared with doing nothing, to 2040 at 7% discount rate	$4,344,148

TABLE 14: SUMMARY OF EXPECTED LED BUSINESS CASE FOR LED STREET LIGHING IN TSC IN 2020-21

A full description of the 2017 offer and analysis, and the case for LED in 2020-21 is provided in Appendix C. it is recommended that Council begin to set aside funding to deliver this project at this time. Ahead of this Council should engage with Essential Energy so that a re-assessment of the business case can be performed. This will consider the impacts of a range of factors, including:

- Up-to-date SLUOS charges for different lamp types, and up-to-date energy rates,
- Changes in available LED technologies for Category P & V roads and the change in energy demand compared with the existing technologies in use,
- The potential to omit of assets with high residual value to reduce the capital cost, and
- Incentives available as ESCs and/or through the NSW Climate Change Fund if applicable

5.2.4 Investigate 'offsite' renewable energy generation

One of the strategies that Council can pursue is to become a generator of electricity at a scale that can meet all or part of its needs. Such an approach is being pursued by other Councils:

- Sunshine Coast Council: development of a 15 MWp solar PV farm to supply all of Council's electricity requirements and export surplus electricity to the market. This project will commence generation in 2017 and is owned and operated by Sunshine Coast Council. The project is projected to deliver a benefit to Council of $30 million over the project's life, with benefits from avoided rising wholesale electricity rates, LGC revenue and export income.
- Newcastle City Council: Council is considering the implementation of a 5MW solar farm over a closed waste facility, with the generation covering most of the total council renewable energy target for all their sites. The council owns the land and would own the renewable energy plant, effectively becoming both the generator and the off-taker. Potential arrangements for the plant are yet to be finalised.

An overview of previously investigated renewable energy generation opportunities on Council land is provided in Appendix D. These included wind energy and micro-hydro. The focus of this assessment has been solar energy generation. Some 10.71-18.57 MW of solar PV generation would equal Council's electricity consumption, depending on growth trends and implementation of efficiency and onsite renewable energy systems. Criteria that were applied to Council's Geographic Information System (GIS) to identify sites that could potentially host solar energy generation systems included:

- Flat or near-flat land (e.g.<5% slope) or water body,
- Council-owned that currently has no other committed future use (could be WWTP land, old landfill, other owned land, dam, tertiary pond),
- Generally a north-facing aspect but N-E to N-W also to be included,
- Buffer to residents or highlighting nearby residential areas,
- Flood status (indicating flood level),
- Highlight if areas are subject to a vegetation management plan or similar constraint,
- Proximity to the electricity grid with LV/HV overlaid,
- Note of (total plus flat) land size in Ha, with a focus on land parcels or continuous land parcels with an area exceeding 10 Ha (10.71-18.57 MW of PV could occupy 25-50 Ha of land)

The results of this analysis indicate that this strategy may be challenging to develop locally. Most of the land identified that fits most of the criteria is subject to flooding, is preserved Koala habitat or is in hilly areas. Just three sites were identified that could be considered further, including:

Site	Area	PV capacity at 2 Ha/MWp	PV capacity at 3 Ha/MWp
Uki wastewater treatment plant	28 Ha (total is 56 Ha, say 50% is potentially useable)	14 MW	9.3 MW
Land near Tweed Valley Cemetery & Stotts Creek Waste Facility	30 Ha (est – parts of 2 contiguous parcels that make up >73 Ha)	15 MW	10 MW
Kingscliff wastewater treatment plan	4 Ha (est – part of WWTP land, some may be used for a behind-the-meter system)	2 MW	1.3 MW

Table 15: First-pass identification of TSC land that could potentially host offsite solar generation

One key issue that appears to apply to all three of these sites relates to electrical infrastructure, with just 11 kV lines appearing to be proximate to the three sites. The load on these systems will be an important factor in determining if it is feasible to connect solar generation to the grid, and these systems may be lightly and/or intermittently loaded.

On balance the investigations are inconclusive but do not appear to indicate clearly 'good' sites for solar energy generation. Further investigation to confirm the load on these lines and potentially to identify smaller parcels of land that could be suitable may be warranted, and any engagement with other local councils should include the possibility of working together to develop Council-owned generation. For the purpose of this plan no contribution to Council's renewable energy goal is taken to be supplied via this approach.

5.2.5 Investigate renewable energy purchasing strategies

Tweed Shire Council entered into a new electricity agreement commencing in 2017-18. This agreement will run for three years and contains minimum / maximum consumption levels expressed as a percentage of electricity use estimates in the agreement. It is unlikely that the minimum consumption level will be reached in aggregate for contestable sites, based on the expected savings and timing of efficiency and solar PV projects.

The three-year agreement period provides Council with an opportunity to investigate and plan for its future electricity agreements from a position of knowledge about market trends, in particular emerging trends in renewable energy purchasing that can help it to meet its goals in a cost-effective manner that minimises risk.

Of particular relevance may be the opportunity for TSC to engage and work with other local governments to develop a renewable energy buying strategy.

Core reasons for the establishment of buying groups and for organisations to be looking at alternative ways to source renewable energy include both the environmental benefits and the fact that renewable energy is becoming cheaper than conventional sources. In particular high and volatile wholesale prices and forecasts in several States means that sourcing some power directly from renewable energy projects may provide some long term price certainty, and cost savings compared with conventional energy purchasing.

Based on emerging trends such as the formation of buyers groups it appears that many participants are committing some, but not all of their power consumption to be sourced from renewable energy projects (a 20-30% commitment appears to be common), and this may reflect both customer risk management as well as retailers' willingness to accommodate this type of project within their overall offer to customers. However this type of opportunity is rapidly evolving and it is plausible that much higher levels of renewable energy purchasing will be feasible in future at rates that make it attractive compared with conventional energy purchasing.

At this time it is suggested that Council could target 20-30% energy purchasing from renewable energy, which is taken here to equal 5,000 MWh per year[8]. This could possibly be achieved by the time of Council's next energy agreement in 2020-21 if Council were to join an existing buying group

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[8] Depending on implementation of REAP projects and implementation of energy efficiency purchasing and new build / upgrade requirements to limit growth, 20-30% renewable energy could equate to 3,000 MWh up to 8,000 MWh by 2030.

with a renewable energy project in development. Alternatively it may be more practical to target say 2023-24 if Council were to join a buying group that has to then go to the market seeking interest from developers for a new project.

This second scenario is assumed to be implemented in this plan. For the purposes of illustrating a pathway towards 100% renewables, and based on a continuing evolution of renewable energy purchasing, it is assumed that Council would lift this level to say 15,000 MWh per year from 2026-27.

It is recommended that Council take action to investigate existing buying groups, potential for local government buying groups particularly in the Northern NSW region, and other approaches to RE purchasing. This should be initiated in the short term, particularly if purchasing from a new RE project is considered where the lead time to generation can be several years.

Council should also investigate the potential to source renewable energy directly from pre-existing renewable energy projects, as this may provide a pathway to sourcing power from renewable sources at the next energy agreement period commencing 2020-21.

An outline of considerations for purchasing renewable energy is given in Appendix E.

5.2.5.1 Peer to peer energy trading

"Peer-to-peer" energy trading promises to enable direct trading of energy from one party (e.g. a business premises) to another, thereby cutting out the "middleman" and allowing transparent dealings between equals, as opposed to being treated as a "consumer" by a corporation.

The regulatory environment does not yet allow for peer-to-peer trading, but a number of trials using "blockchain technology" have been or are currently being conducted. These include:

- Power Ledger in Perth and Auckland[9];
- Transactive Grid in New York;
- Grid Singularity in Austria,
- AGL in Melbourne[10], and
- Local Volts in Sydney

This approach to renewable energy purchasing may provide Council with a future additional strategy that can help it achieve its goals in a cost effective manner. At this time it is recommended that Council maintain a watch on developments in trials and in the regulatory arena, and connect with trial participants (e.g. P2P equipment and project developers) to stay abreast of the progress of P2P trials.

[9] http://reneweconomy.com.au/power-ledger-expands-trials-blockchain-electricity-trading-38771/

[10] http://www.afr.com/business/energy/electricity/agl-energy-to-trial-peertopeer-household-energy-trading-20170525-gwd3zn

6 Systems and processes underpinning REAP

The success of the REAP will be dependent on how it is governed, funded and resourced over the next several years. The development of as involved discussions with numerous stakeholders, and the recommended approaches here reflect these discussions.

6.1 Funding and financing options

The cost to implement the energy efficiency, street lighting and solar / storage initiatives identified in the REAP is approximately $10.64 million to 2024-25. The procurement of renewable energy as part of the plan is premised on there being no added costs to energy purchased from the grid.

The main funding of REAP projects will consider the following:

6.1.1 Self-funded through normal budgeting process

The energy efficiency or renewables projects can be financed with Council's own funds – general fund, water & sewer fund or reserves as applicable. There are no ongoing contractual obligations and Council owns and depreciate the equipment. Projects may compete for funds with other activities.

Council carries all finance and performance risks. Council is also responsible for the maintenance, although many providers offer maintenance contracts to ensure that the equipment continues to operate efficiently and reliably.

6.1.2 Self-funded through Council's revolving energy fund (REF)

The energy efficiency or renewables projects can also be financed with Council's own funds from the REF. The fund is a financial mechanism, whereby the savings made as a result of sustainability initiatives are diverted back into the fund to repay the capital and also provide financial support for future initiatives. Key benefits of a REF include:

- It facilitates emission reductions, cost savings and resilience in the face of rising energy costs.
- Effectively allows a monetary investment to be spent a number of times (through reinvesting energy cost savings) without reducing its value.

Key to the success of a REF is that the project owners, after paying the capital with savings (and perhaps interest) get access to the ongoing savings. An appropriate balance should be struck between having funds for further investment and returning savings to project owners.

At present the REF has approximately $300,000. Council should also consider whether this should be topped up with an annual budget allocation to ensure its ability to fund initiatives in to the future.

6.1.3 Pre-existing and future incentives and grants

Pre-existing incentives for eligible renewable energy and energy efficiency initiatives include:

- Small-scale Technology Certificates (STCs) available as an upfront discount to renewable energy installations of <100 kW under the Renewable Energy Target (RET) scheme,
- Large-scale Generation Certificates (LGCs) available as an annual income stream based on energy generation, applicable to renewable energy installations of >100 kW under the RET,
- Energy Saving Certificates (ESCs) under the NSW Energy Savings Scheme (ESS) for eligible activities. LED lighting upgrades in buildings and street lights will be eligible to receive ESCs. This is usually applied as an upfront discount to the capital cost for 'deemed-savings' initiatives, though project-based approaches with periodic claim for ESCs is also possible

For renewable energy and energy efficiency initiatives implemented by the REAP Council should ensure that incentives are claimed, and this is assumed in all financial analysis where applicable.

Future grants or incentives are also likely to be available, such as the NSW Climate Change Fund, and potentially other State or Commonwealth initiatives, whether aimed at 'clean energy' initiatives or regional development. Council has been successful in the past at applying for and receiving grants – e.g. both the Art Gallery and Murwillumbah depot solar PV projects are grant-funded, and processes to identify and respond to new opportunities should be maintained.

6.1.4 Power Purchase Agreement (PPA)

PPA arrangements avoid many of the traditional barriers to adoption for solar systems such as high up-front capital costs; system performance risk; and complex design and permitting processes. In addition, PPA arrangements can be cash flow positive from the day the system is commissioned. They also allow for predictable energy pricing.

A PPA provider designs, constructs, owns, operates and finances the renewable energy generation equipment. The PPA provider is effectively leasing Council's space for a set contractual period of time. Alternatively, renewable energy could be purchased from a plant that is not located on Council-owned or leased land.

The PPA provider retains ownership of the system and the responsibility for any maintenance costs. Council agrees to buy a certain amount of electricity generated by the solar system at a price that is usually cheaper than the retail price of electricity from the grid. The cost per kWh can be fixed or escalate at an agreed rate.

Solar PPAs have a typical duration of around 10 years and will require a minimum duration of around five years. It depends on the PPA contract as to whether the ownership of the equipment will be transferred to Council during or after the contract period.

In 2017 the NSW State Government tendered for a panel of preferred solar technology suppliers, with a PPA model forming part of the services sought. This panel of providers and solar energy services will be available for local governments to use. Council should ensure it is informed about the panel process and gains access to details on the services that will be offered. This will help ensure it is in a position to decide whether this approach is useful in helping meet its goals.

6.1.5 Community Energy Projects

Another way that Council could develop solar projects is to be host to one or more Community Energy Projects. Many communities are benefitting from both the environmental benefits and the financial returns of locally-developed and financed renewable energy projects.

In essence, as a host Council could enter into a PPA with a community energy project, agreeing to host and buy the power from a system installed on its premises. Since the funders / shareholders of the system are local, the financial returns for the project are returned to local community members. In many projects some of the benefits are retained for the purpose of being re-invested in other community projects. Numerous examples now exist, such as Farming the Sun (Lismore) and Repower Shoalhaven.

6.2 Sustainable energy policy and leadership

A Sustainable Energy Policy is a way of capturing Council's targets and renewable energy aspirations and clearly communicating this to all of its stakeholders. It can clearly set out what its vision is for

Council as a leader in promoting a transition to a clean energy future and provide staff with a direction and mandate to act in alignment with this.

After Council has considered and taken decisions on its intent to be 'self-sufficient' in renewable energy, when that should occur, and on interim targets and focus areas along that journey, it should consider articulating this in such a policy that is visible to staff and the community.

6.3 Resourcing requirements

The proposed program of work in the REAP will require resources to be allocated to a range of tasks, which may include:

- Contract development and administration
- Project management of solar PV installations and energy efficiency upgrades
- Overall REAP program management, potentially including a management committee for the program as well as the REF
- Maintenance management process for solar PV projects, which will be new assets on many Council facilities
- Training of Council staff in the operation and maintenance of PV systems

The resourcing requirements should be taken into account when planning each year's program of work.

6.4 Project post-implementation monitoring

Council already has robust energy billing and large-site interval data records. As such macro-level changes in Council's energy consumption will be apparent over time as the overall program of work is implemented.

At the level of individual solar energy systems access to monitoring is strongly recommended. Without monitoring Council has no idea if a system is performing as expected and has no insight to problems that may have occurred (e.g. failed inverter, system isolated, physical damage).

Monitoring can be specified with individual projects and this can help to monitor performance in the post-implementation phase. A key criterion here may be the ability for the selected inverter technology to communicate with a supervisory monitoring system, on the assumption that Council will ultimately have a few different types of inverter.

Council should begin to investigate the availability and capabilities of supervisory monitoring systems, or whether it is practical to monitor performance via proprietary systems.

6.5 REAP review processes

There should be a process to review Council's REAP so that new technologies, innovative ideas, changed market conditions and other factors can be considered and the plan changed based on the best available solutions in future. A 2 to 3 year period is suggested.

Many of the new technology ideas and innovations come to Council in an ad hoc fashion, such as directly from suppliers, from community groups, advice from consultants, attendance at conferences or via social media. New ideas or solutions will come to numerous people across many functions.

Council should review what an appropriate process looks like for receiving, storing, evaluating and deciding on the merits of new clean energy ideas, and consider the resourcing requirements of this as part of the overall resourcing of the REAP.

7 Appendix A: Energy Efficiency in Council Operations

7.1 Lighting

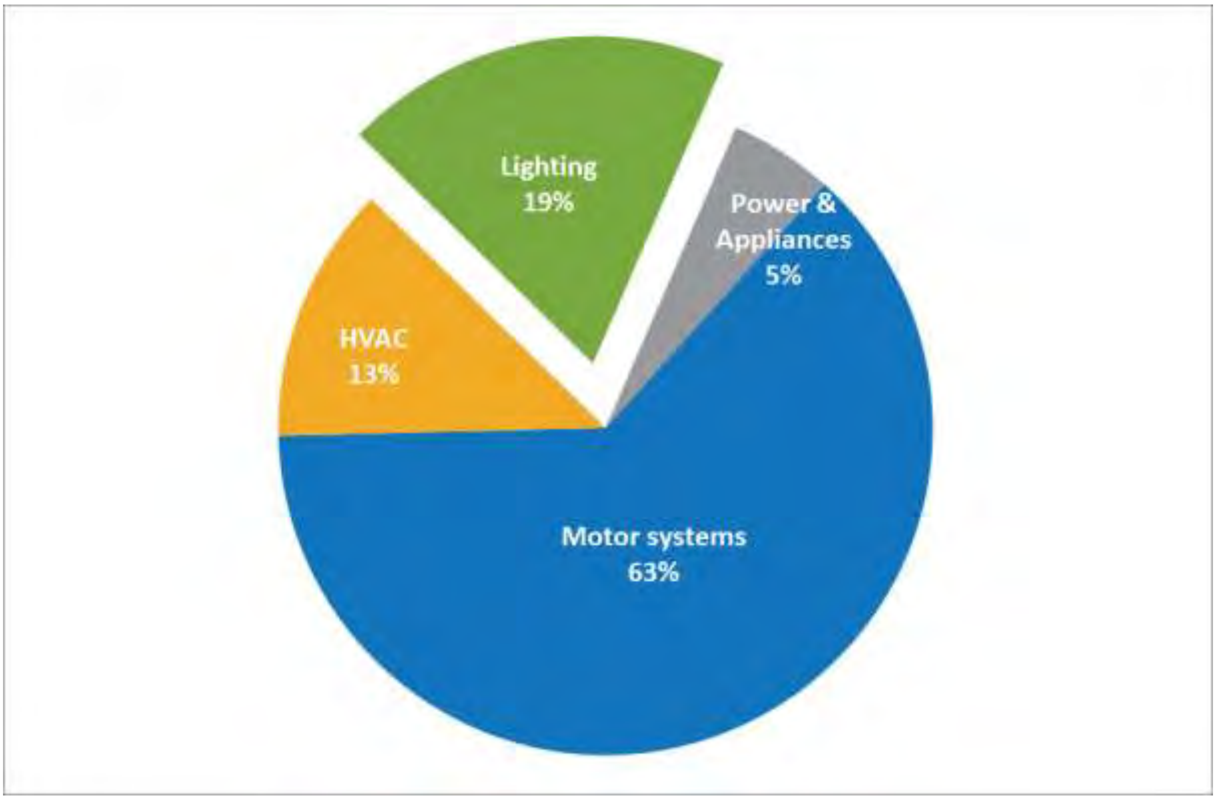


Figure 19: Lighting contribution to TSC electricity consumption

Category	Energy Efficiency
Technology / initiative	Energy efficient LED lighting technology and controls across TSC
Description of current situation and proposed modifications	Lighting is estimated to account for 19% of TSC's electricity demand, equal to 4,333,737 kWh per year. Of this 2,941,441 kWh is consumed by street lighting which is addressed separately. This leaves an estimated 1,392,296 kWh of electricity consumed by lighting systems in Council's buildings and public areas. Lighting is installed at nearly all of Council's sites, and upgrading to LED technology and in some cases controls is proposed. LED technology is proven across numerous applications to be an energy efficient and feasible solution. Council has implemented a number of LED upgrades, including: • LED trial areas within Council's administration building in Murwillumbah replacing single and twin linear fluorescent tubes, • Widespread use of LEDs at the Tweed Heads administration building, including LED panels in place of recessed fluorescent fittings and LED downlights, • Standard implementation of LED lighting in new builds or refurbishments, • Replacement of selected high bay lights with LED technology at the Buchanan Street depot Two basic approaches to LED upgrades are proposed:

	1. For intermittently / sporadically used sites and for sites with 'non-standard' light fittings a strategy of replace-on-fail or replace-on-upgrade is recommended. This applies to sites where lighting energy use is estimated to be 389,602 kWh per year. For example: a. Sewer pump stations or water pump stations or unattended WWTPs which may have just a few lights installed, but these may only be switched on a few times a year or intermittently. b. Sporting fields flood lighting where existing metal halide lighting is intermittently used, may have extended warranties (10+ years), and may be the responsibility of the end user or become their responsibility over time c. Public parks and other external lighting where high costs would be associated with engaging OEMs to advise on and design custom LED solutions, or where damage-resistant solutions may need to be identified and tested, d. Any other facilities where lighting energy demand is very low, say less than 1,000 kWh per year 2. For other sites, lighting systems are proposed to be upgraded to LED technology (except where LEDs have already been implemented and/or where intermittently used lights such as floodlighting or other high-bay lights are not suitable or cost-effective to retrofit), incorporating controls (occupancy, daylight, dimming) where applicable. This will replace lighting that currently consumes 1,002,694 kWh per year with LED technology. This will apply to 'standard' lighting technologies, which will predominantly be: a. Linear fluorescent lamps (T8 or T5) either surface-mounted or ceiling-recessed, and b. Downlights including halogens and compact fluorescent lamps The focus of lighting energy efficiency in the REAP is on this second category of opportunities, with costs and benefits to upgrade lighting over a 3-year period estimated. For all other lighting incremental improvement under a 'business-as-usual' approach is recommended.
Location(s)	The filters applied above leave 35 sites that may be suited to LED upgrade, either partial or wholly.

Electricity account	Lighting kWh pa
Water & Sewer facilities	
Banora WWTP (No1)	63,493 kWh
Banora WWTP (No2)	58,882 kWh
Mech & Elec Building	37,357 kWh
Kingscliff WWTP	32,660 kWh
Bray Park WTP (No2)	21,796 kWh
Bray Park WTP (no1)	6,665 kWh
Hastings WWTP	17,882 kWh
Murwillumbah WWTP	15,254 kWh
Sub-total	***253,990 kWh***

	<table><tr><th>Electricity account</th><th>Lighting kWh pa</th></tr><tr><td colspan="2">***Other facilities***</td></tr><tr><td>Art Gallery</td><td>255,613 kWh</td></tr><tr><td>Civic Centre Murwillumbah</td><td>197,876 kWh</td></tr><tr><td>Pool Murwillumbah</td><td>72,316 kWh</td></tr><tr><td>Work Depot Murwillumbah</td><td>63,307 kWh</td></tr><tr><td>Tweed Heads Civic Centre / Library</td><td>33,091 kWh</td></tr><tr><td>Works Depots at Tweed Heads & Bogangar</td><td>29,089 kWh</td></tr><tr><td>Stotts Creek Waste Facility - Main Account</td><td>24,662 kWh</td></tr><tr><td>Pool Tweed Heads South</td><td>10,149 kWh</td></tr><tr><td>Community Centre Murwillumbah</td><td>9,018 kWh</td></tr><tr><td>Kingscliff Library</td><td>8,968 kWh</td></tr><tr><td>Works Depot 'C' - Pizza Hut</td><td>8,387 kWh</td></tr><tr><td>Banora Point Community Centre</td><td>6,463 kWh</td></tr><tr><td>Stotts Creek Waste Facility - Pound</td><td>6,175 kWh</td></tr><tr><td>Pool Kingscliff</td><td>5,869 kWh</td></tr><tr><td>Cemetery</td><td>5,282 kWh</td></tr><tr><td>Health & Community Centre (HACC)</td><td>4,263 kWh</td></tr><tr><td>Museum Storage</td><td>3,608 kWh</td></tr><tr><td>South Tweed Community Hall</td><td>3,497 kWh</td></tr><tr><td>Records Storage</td><td>1,071 kWh</td></tr><tr><td>***Sub-total***</td><td>***748,704 kWh***</td></tr></table>
Capacity for grid energy reduction and/or carbon abatement	LED technology is typically 45-75% less energy intensive than conventional lighting for the same output, and greater savings can be achieved where controls are applicable. A 60% saving is assumed excepting selected sites: • Some of the sites noted above already use LED lighting in some areas, • Some sites use T5 fluorescent lighting which means that LED savings potential is lower – typically 45%, • Some sites – such as WWTPs – will have external night lighting that may not be simple or cost-effective to replace These factors are taken into account when estimating LED energy savings. This gives an estimated LED energy saving of 428,708 kWh per year, equal to 1.9% of Council's electricity consumption.
Potential incentives	Energy Saving Certificates can be created for eligible LED upgrades – that is, products that are registered with and approved by IPART under the NSW Energy Savings Scheme. Claiming ESCs can be done by Council, though it is often simpler to engage an Accredited Certificate Provider (ACP) to perform this task for a fee. In this case it is estimated that the value of ESCs could be $40-50,000 which would be realised around the time of implementation. The NSW Climate Change Fund is to be released and this may contain other opportunities for Council to seek incentives, particularly for marginally cost-effective sites.

Cost benefits	Fitting numbers can be estimated by assuming that lighting runs for 2,500 hours per year and is – on average – a twin 36W fluorescent fitting. There will be many different types of fitting and detailed assessments will determine this, however for high-level assessment purposes this is a reasonable approach. This gives an estimate of 3,247 fittings. Upgrade costs per fitting are taken to be $150 as this is close to the costs incurred for trial fittings in the Murwillumbah administration centre. This cost is on the high side as it includes in-built controls such as dimming or on-off in response to daylight and occupancy. This gives a total upgrade cost of $487,050. Cost benefits are from: • Reduced energy use at large sites with kVA tariffs account for 75% of potential savings • Reduced costs for peak demand at kVA sites, with a fairly high correlation between lighting operation and peak demand timing • Reduced energy use at small sites with General Supply ToU tariffs account for 25% of potential savings • Reduced maintenance costs (lamps and labour) with LEDs having life of 2.5 to 3.5 times that of conventional fluorescent lamps, and with first LED replacements not expected to occur for several years • Longer warranties on LED panels and drivers • Discount for Energy Saving Certificates (ESC) Cost savings are estimated to be: • $93,000 per year in energy cost savings, and • $13,000 per year in maintenance cost savings This gives a simple payback for LED lighting upgrades of 4.10 years when the ESC discount is taken into account.
Recommended implementation plan	It is recommended that lighting upgrades occur over a 3 year period, starting in 2017-18. The REAP assumes that one-third of costs are incurred in each of these years – in practice year-on-year budgets should be prepared for specific sites to be upgraded.
Approaches to implementation	Council’s existing budgeting processes and tendering systems can be used. Council’s revolving energy fund may also be a suitable funding mechanism.
Risks / barriers	Quality LED products and product support are key issues to be evaluated and managed by Council. For this reason local installers with direct access to product suppliers is often a preferred approach.

7.2 Heating, Ventilation and Air Conditioning (HVAC)

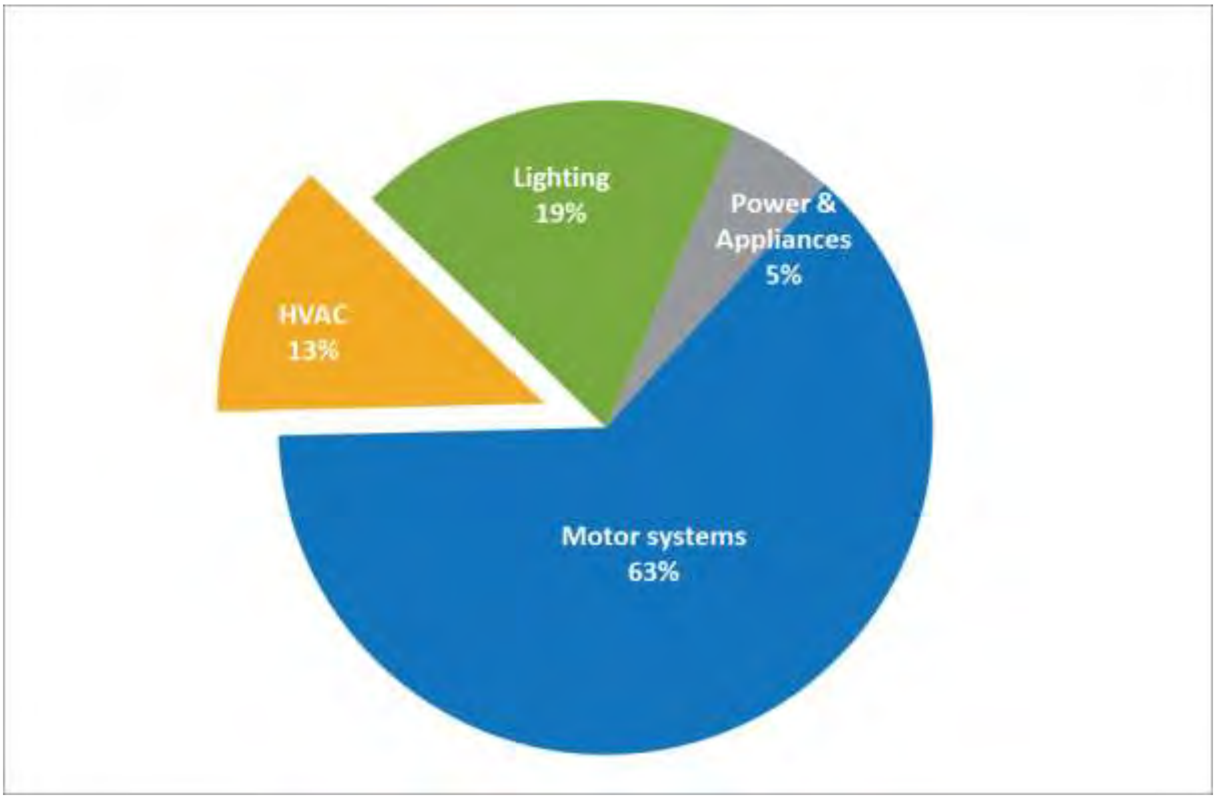


FIGURE 20: HVAC CONTRIBUTION TO TSC ELECTRICITY CONSUMPTION

Category	Energy Efficiency
Technology / initiative	Energy efficient HVAC systems across TSC
Description of current situation and proposed modifications	HVAC is estimated to account for 13% of TSC's electricity demand, equal to 2,867,888 kWh per year. Estimates of HVAC consumption are made with reference to 'typical' consumption for like facilities, or audits where available. The 15 largest HVAC users are estimated to use 87% of all HVAC across Council. These sites include:

Electricity account	HVAC kWh pa
Water & Sewer facilities	
Banora WWTP (No1)	63,493 kWh
Banora WWTP (No2)	58,882 kWh
Work Depot Murwillumbah	47,480 kWh
Kingscliff WWTP	32,660 kWh
Mech & Elec Building	28,018 kWh
Sub-total	***183,053 kWh***
All other facilities	
Art Gallery	613,472 kWh
Pool Murwillumbah	554,419 kWh
Civic Centre Murwillumbah	494,690 kWh
Pool Tweed Heads South	169,149 kWh

Tweed Regional Museum Murwillumbah	127,069 kWh
Pool Kingscliff	97,825 kWh
Tweed Heads Administrative Centre	97,063 kWh
Tweed Heads Civic Centre / Library	82,727 kWh
Community Centre Murwillumbah	22,545 kWh
Sub-total	***2,306,438 kWh***

HVAC consumption drops very sharply after just the first few sites. Where HVAC consumption is in the range of 20-80 MWh pa these systems are mainly characterised by small to medium sized split and packaged systems. Above this size a mix of air cooled chillers, air-cooled multi-unit split systems and water-cooled chillers, as well as heat pumps for pool heating are seen.

For the top 8 of these sites improvement in HVAC performance and energy demand has been a focus area for Council for a few years, and many fairly recent improvements have been made.

- Art Gallery: HVAC systems are fairly new and are required to run 24/7 to maintain humidity and temperature. As such the facility is energy-intensive and ongoing efforts aim to balance energy and conditions,
- Pool Murwillumbah: the air conditioning system and heat pump systems are not new but have a number of years' life left and are in good condition. Interlocking controls limit air conditioning use to times when the indoor centre's doors are shut. Pool heating energy demand is managed with separate water bodies for different pools and pool covers at night time,
- Civic Centre Murwillumbah: the main chiller was replaced and a substantial reduction in energy will be seen in future billing for the site. The new chiller is a best-in-class water-cooled system that has achieved a peak COP of 19. Solar film has been applied to several windows in the centre to reduce daytime heat gain,
- Tweed Heads South Pool: the heat pump systems for this facility were recently upgraded with new efficient technology, and solar hot water pre-heats water ahead of the use of the heat pumps,
- Tweed Regional Museum Murwillumbah: the multi-unit split systems at this site are new and energy efficient, are located in a cool place with good heat rejection / exhaust. The system is required to be available 24/4 as the facility houses many artefacts that require close temperature and humidity control,
- Pool Kingscliff: the pool heat pump system is supplemented with a solar hot water system that is currently bypassed. Re-instatement of the SHW system is contingent on other works occurring, but should occur in due course,
- Tweed Heads Administrative Centre: a new energy efficient air-cooled chiller services this building,
- Tweed Heads Civic Centre / Library: this facility is being refurbished

The significant work that has been implemented means that there are few 'quick wins' or large step changes in energy consumption that remain to be

	undertaken.
Location(s)	Sites with large HVAC systems have ongoing programs (business-as-usual) to improve operation and, where feasible deliver energy savings. The main focus of discrete efficiency efforts is likely to lie in control system optimisation and education, including for example: • Control systems at Civic Centre Murwillumbah which may include ventilation fan speed control, replacement of 3-way with 2-way valves, BMS optimisation, and optimisation of zoning, • Standardise time-of-use, temperature settings for split / packaged systems in use at Council sites – a range of practices were observed in terms of time-of-use and temperature settings. Council can consider adopting an awareness / education approach and/or consider implementing lock-out or fixed temperature range for small systems. For example the Banora Point WWTP implemented a range of modifications to air conditioners in 2015, contributing to an overall energy reduction at the site of 13%, • Procurement guidelines to ensure that all replacement systems are as energy efficient as possible, and that energy efficient controls are set up on commissioning, with consideration given to features including heat reclaim, pre-heat/cooling, occupancy sensing (on/off or setback). Best performance for small HVAC systems can be sourced from www.energyrating.gov.au.
Capacity for grid energy reduction and/or carbon abatement	Given past work on HVAC systems it is likely that a 10% savings target for HVAC would be ambitious, and half of this might be a more realistic objective for the larger sites. This equates to around 125 MWh savings per year, which is small in the context of Council's total electricity footprint.
Potential incentives	The NSW Climate Change Fund is to be released and this may contain opportunities for Council to seek incentives, particularly for marginally cost-effective sites.
Cost benefits	HVAC energy savings from control improvements will tend to have only a modest impact on demand, and 125 MWh of savings would save Council around $20,000 per year. If a 2-4 year payback on investment is considered 'typical' for control and behavioural improvements then an investment of $40-80,000 may be required.
Recommended implementation plan	A modest 5% target for large sites is included as a REAP measure, implemented over the 2-year period 2017-18 and 2018-19, with $80,000 capital spend over two years to achieve these saving in HVAC sites tabled above.
Approaches to implementation	Council's existing budgeting processes and tendering systems can be used. Council's revolving energy fund may also be a suitable funding mechanism.
Risks / barriers	Sustaining HVAC savings from operational and control changes is inherently difficult, and modest HVAC savings are difficult to measure. Good engagement and routine monitoring of HVAC settings are recommended to reduce risk of lost savings.

7.3 Power and Appliances

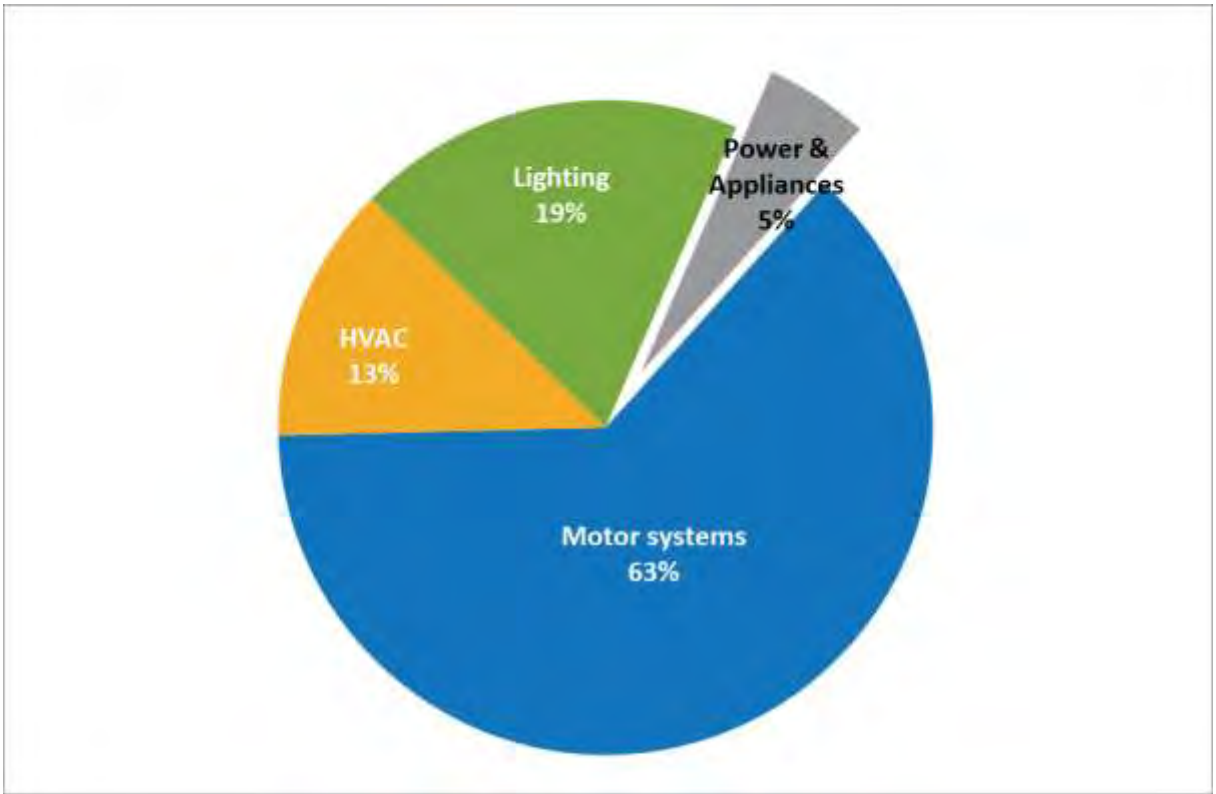


FIGURE 21: POWER & APPLIANCES CONTRIBUTION TO TSC ELECTRICITY CONSUMPTION

Category	Energy Efficiency
Technology / initiative	Energy efficient IT, office equipment and appliances across TSC
Description of current situation and proposed modifications	Power and appliances is estimated to account for 5% of TSC's electricity demand, equal to 1,159,290 kWh per year. There is a large diversity in the types of equipment that will make up this amount of energy including: • IT servers and related air conditioning systems, • UPS systems, • Communications infrastructure, • Computers and laptops for office staff, • Office equipment such as copiers, printers, including large devices used by planning, • Control systems for all water and wastewater systems and for building management systems, • Plug-in power for battery charging – e.g. tablets, phones, • Appliances such as refrigerators, freezers, dishwashers, microwaves, television screens and small plug-in devices Major IT servers and associated air conditioning systems will be the major energy consumer, and awareness of energy intensity and improvement opportunities (virtualisation, digital technology, remote shutdown of staff computers at night, air con technology and settings, etc) is good. As such the potential for material savings to Council is small, and savings are likely to come from: • Continued efforts to minimise IT energy footprint through

	operational improvements and upgrading to new technologies, • Purchasing policies that preference energy efficient devices
Location(s)	All sites. • IT department • Purchasing policies
Capacity for grid energy reduction and/or carbon abatement	Not estimated / small
Potential incentives	Nil identified
Cost benefits	Not estimated / small
Recommended implementation plan	Savings in power and appliances should be pursued through continued efforts to optimise IT system power (esp server systems), and procurement processes should be reviewed and efficiency requirements included and implemented for new purchases.
Approaches to implementation	Council's existing budgeting processes and tendering systems can be used.
Risks / barriers	

7.4 Motor Systems

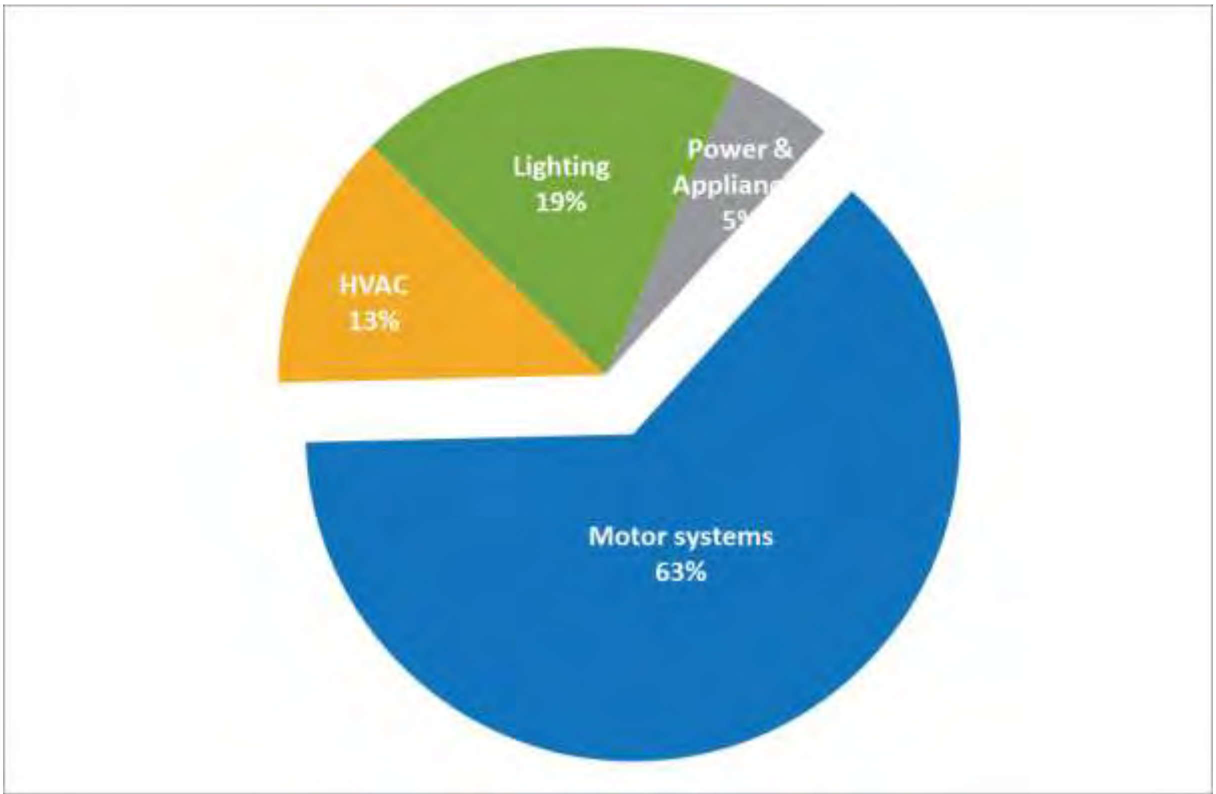


FIGURE 22: MOTOR SYSTEMS CONTRIBUTION TO TSC ELECTRICITY CONSUMPTION

7.4.1 Motor systems: water and wastewater treatment plants

Category	Energy Efficiency
Technology / initiative	Energy efficient motor systems across major treatment works
Description of current situation and proposed modifications	Motor systems dominate electricity consumption by Tweed Shire Council at 63% of total use. The top 40 sites consume 90% of this and are the main focus of an assessment of savings potential. Wastewater and water treatment plants motor systems account for an estimated 6,807 MWh of electricity consumption, with the majority of this consumed at a handful of treatment works. Each treatment plant is different and the initiatives that will lead to energy savings and the magnitude of potential savings will vary from site to site. The estimated potential for energy savings is drawn from an assessment of the Banora point WWTP and implementation of cost-effective measures to reduce consumption. A paper by TSC and GHD[11] indicates that the identified savings represent a potential decrease of around 20% in total plant energy use compared with FY 2015-16 (4079 MWh for the two main accounts). It is proposed that comparable whole-site assessments of energy savings through operating and minor capital improvements be carried out at other

[11] Banora Point WWTP Energy Efficiency Review – Finding the Savings and Dispelling Misconceptions, DW de Haas, and M Wraight, 2016/17

	major treatment plants in wastewater and water treatment.
Location(s)	A focus on the main treatment plants would examine motor system energy use of 2,859,118 kWh (from 3,141,888 kWh total) at Kingscliff, Murwillumbah and Hastings WWTPs and Bray Park WTP. A secondary focus beyond these sites could be at the smaller WWTPs and WTPs as listed below.

Electricity account	Motor System kWh pa
Banora WWTP (No1)	1,925,968 kWh
Banora WWTP (No2)	1,786,095 kWh
Kingscliff WWTP	990,677 kWh
Bray Park WTP (No2)	661,141 kWh
Hastings WWTP	542,430 kWh
Murwillumbah WWTP	462,703 kWh
Bray Park WTP (no1)	202,166 kWh
Uki WWTP	*69,690 kWh*
Mooball WWTP	*48,485 kWh*
Tumbulgum WWTP	*42,042 kWh*
Banora Pt WWTP Belt Press	*39,121 kWh*
Tyalgum WWTP	*36,483 kWh*
Sub-total	***6,807,001 kWh***

Capacity for grid energy reduction and/or carbon abatement	Savings of around 20% of whole-plant were identified at Banora point from motor system improvements, compared with FY2015-16. To date 10% savings have been achieved, due mostly to process changes that resulted in reduction in motor size or operating times. The capacity for energy reduction is taken to be 10% of energy used by motor systems at the large sites tabulated above. This gives an estimated potential saving of 285 MWh per year. Savings will decline over time as the ADWF into the plants increases. An annual reduction of 0.5% is assumed.
Potential incentives	Nil identified
Cost benefits	At current energy rates and assuming no peak demand savings this will result in annual cost savings of around $150,000. The capital costs identified at Banora Point were $91,000. This needs to be considered together with assessment costs and TSC staff time – say $150,000. The cost to replicate this process at the other four sites would likely be twice this, say $300,000 in total.
Recommended implementation plan	For the purpose of this plan it is assumed that benefits can be achieved over a 3–year period 2017-18 and 2019-20.
Approaches to implementation	• Specialist knowledge of WWTP & WTP operation is required to make an informed assessment of potential savings in conjunction with TSC. • Process changes / testing to be implemented by TSC. • Application for budget to implement capital improvements.

Risks / barriers	Sustainability of savings, process changes, meeting license requirements

7.4.2 Motor systems: water and sewer pumping stations

Water and sewer pump systems consume large amounts of energy. For those sites in the 'top 40' motor systems, pump motors are estimated to consume 5,139 MWh per year.

These sites are generally characterised by one or more pumps, typically large relative to the amount of electricity they actually consume.

Water pumping stations can be further characterised as:

- Subject to Council's *Large Sites Electricity Operating Rules* which govern the times and methods of operating large pumps. A key purpose of these rules is to avoid operation during Peak and Shoulder so as to avoid high charge periods, and to pump in Offpeak times,
- Hence demand tends to be high, in offpeak times and of short duration. For example, load profiles for the Bilambil Water Pump Station No.11 site are shown below (consumption 2016: 116,468 kWh), highlighting just 2.5 daily run hours, with up to 4 hours on weekends.

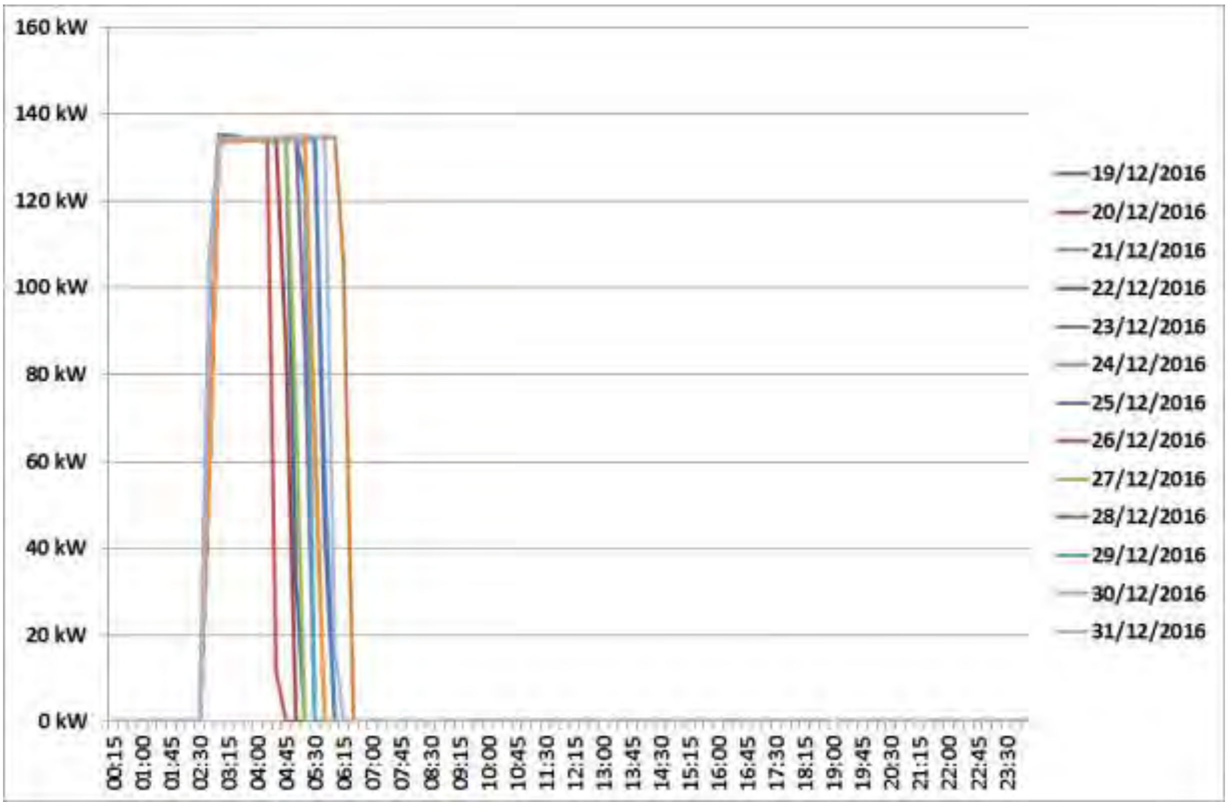


FIGURE 23: BILAMBIL WPS#11 LOAD PROFILES

Sewer pumping stations can be further characterised as:

- Operation is on-demand and highly intermittent, resulting in a very 'peaky' profile,
- Peak periods are shortly after morning and evening residential peak periods,
- Pumps are sized to meet the requirements of wet weather flows, when infiltration to sewer systems is high and pumps may be required to move large volumes of wastewater for extended durations

Selected Gollan Drive SPS 2018 load profiles are shown below to illustrate these characteristics.

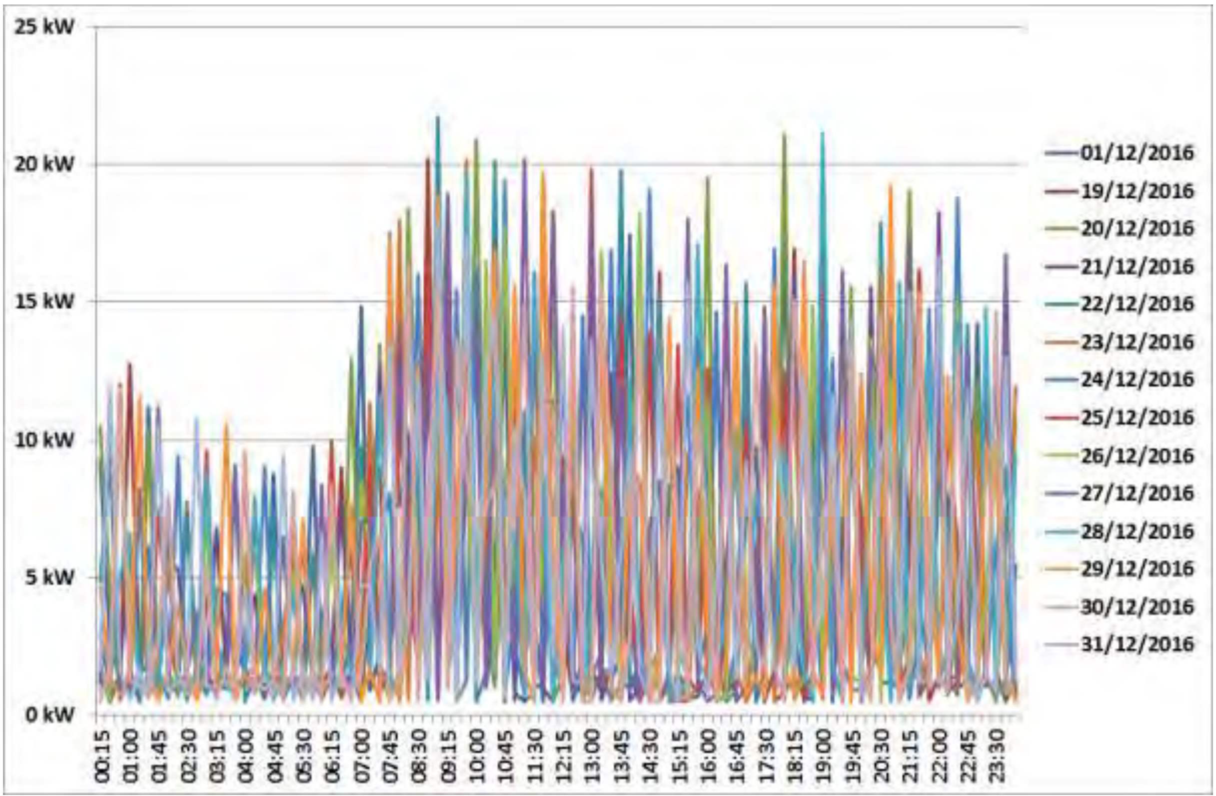


FIGURE 24: GOLLAN DRIVE SPS#2018 LOAD PROFILES

Energy saving opportunities for WPS and SPS pumping systems may include soft-start control, variable speed drives (VSD), high efficient motors and pumps (subject to duty requirements), optimised design for peak and average flows (SPS). Management of infiltration can also have benefits for SPS energy demand. VSDs will be most useful in systems with high dynamic head relative to static head.

GHG carried out a benchmarking study of WPS and SPS in 2013 and 2014, reporting results in terms of total energy use per megalitre of flow per metre of differential head across pumps in both sewer and water systems. Their results are summarised below[12]. It may be useful for Council to review the PEI (Pump Energy Indicators) for its major assets to determine if there are any systems that warrant further assessment.

	ALL	Water <4.5 kWh/ML/m	Water >4.5 kWh/ML/m	Sewer <5.5 kWh/ML/m	Sewer >5.5 kWh/ML/m
Total No. of PS	113	40	36	11	26
Mean Nominal Flow (L/s)	351	539	124	617	263
Median Nominal Flow (L/s)	116	229	54	52	78
Mean Nominal Head (m)	65	71	90	41	33
Mean kWh/ML/m	6.47	3.85	6.94	4.167	11.1

[12] http://www.awa.asn.au/documents/001%20CCharakos.pdf

TABLE 16: SUMMARY OF PUMP STATION DATA AND RESULTS (GHD BENCHMARKING)

The potential for large savings – such as from the implementation of VSD control, is likely to arise when pump systems are due to be upgraded. The high cost to retrofit VSDs to large pump systems (e.g. may require new cabinetry, security, MSB and potentially civil work), when compared with modest cost savings since many WPS / SPS pumps run intermittently and often offpeak, often shows this to be uneconomic. Two examples are given below for the sites noted above:

For the Belambil WPS:

- Belambil WPS consumes 112 MWh per year,
- Assume that this is a good candidate site for VSD control,
- VSD control would lower energy demand – say by 30% per year at the upper end, so savings are 34 MWh per year,
- This saving is at offpeak times only, at say 11¢/kWh including new energy charges and offpeak demand rates. This gives annual cost savings of $3,696,
- The WPS incorporates fairly large pumps and it would be reasonable to expect total costs to retrofit VSDs to be in excess of $50,000, so a payback of around 13 years could result,

For the Gollan Drive SPS:

- Gollan Drive SPS consumes 60 MWh per year,
- Assume that this is a good candidate site for VSD control,
- VSD control may would lower demand – say by 30% per year at the upper end, so savings are 18 MWh per year,
- This saving is at all times, at say 15¢/kWh including new energy charges. This gives annual cost savings of $2,700,
- The SPS incorporates pumps sized for wet weather flows so the average flow peak of 20 kW is well below the actual system capacity. It would be reasonable to expect total costs to retrofit VSDs to be in excess of $20,000, so a payback of around 7.5 years could result

When the WPS or SPS are due to be upgraded, the marginal cost of incorporating VSD control may be significantly less, and an opportunity arises to look at the design of the overall WPS/SPS and optimise to meet system needs. The payback on the marginal investment at this time is likely to be superior to the retrofit option.

These examples are simplistic but highlight the impact of low utilisation / load factor on the benefits of retrofitting significant items like VSDs to large pumps. TSC does have an approach that examines VSD options when upgrading large water and sewer assets, and a number of systems have been upgraded in this manner. A continuation of this business-as-usual approach is preferred to a program to retrofit existing systems.

Electricity account	Motor System kWh pa
WPS 02	1,766,906 kWh
WPS 01	970,775 kWh
WPS 03	350,487 kWh
WPS 09	324,165 kWh
WPS 10	268,883 kWh

WPS 18	114,313 kWh
SPS 3028	112,831 kWh
WPS 11	108,431 kWh
SPS 3015	98,631 kWh
WPS 13A	98,356 kWh
SPS 5005	93,718 kWh
WPS 12	83,820 kWh
SPS 5001	77,871 kWh
Banora Pt WWTP Sunshine Ave Effluent Pump^	77,730 kWh
SPS 2033	76,438 kWh
SPS 3006	71,592 kWh
SPS 2000	63,999 kWh
SPS 6001	60,249 kWh
SPS 2018	59,733 kWh
Uki WTP & WPS 16a	55,463 kWh
SPS 3019	56,744 kWh
SPS 4025	53,661 kWh
SPS 4005	48,922 kWh
CHD 1A & 1B	44,975 kWh
Sub-total	***5,138,693 kWh***

TABLE 17: LIST OF MAJOR WPS AND SPS SITES AND ENERGY USE

7.4.3 Motor systems: aquatic centres & other facilities

The assessment of motor systems also includes non-water & sewer sites,the main ones being tabulated below (motor system energy use shown).

Electricity account	**Motor System kWh pa**
Pool Murwillumbah	530,314 kWh
Pool Tweed Heads South	152,234 kWh
Pool Kingscliff	88,042 kWh
Stott's Creek Waste Facility - Main Account	41,104 kWh
Sub-total	***811,694 kWh***

TABLE 18: ENERGY USE BY MOTOR SYSTEMS AT AQUATIC AND OTHER FACILITIES

Current understanding of progress with energy efficiency:

- VSDs were installed on the pool pumps at Murwillumbah,
- VSD of pool pumps was implemented as part of the upgrade works for South Tweed pool,
- The pumps at Kingscliff pool are very old and may be undersized to meet pool turnover requirements. A future pool upgrade would likely remedy this with the installation of larger pumps,
- The leachate pumps at the waste facility run all the time, and this is required to manage a range of issues, including dissolved oxygen and odour among others. The location of the pond may change with planned changes to the site (organic waste management)

Based on the current status of these motor systems no further actions are recommended for inclusion in the REAP.

8 Appendix B: Solar PV and BESS in Council Operations

A total of 28 solar energy generation opportunities were identified at Council sites. These opportunities were identified following site inspections and interval data analysis. Of these five were selected and further more detailed modelling was conducted using PVSyst and tariff & interval data analysis where hourly solar output was mapped against site interval data to confirm self-consumption levels and cost benefits.

The timing, estimated capital cost, annual (year 1) savings (including an estimated depreciation expense) and simple payback calculations are summarised below.

Following this selected images of proposed solar energy installations are highlighted to illustrate locations where solar can be installed. The detailed modelling outputs for the five selected sites is then provided. The products used in this modelling are tabulated below.

Component	Product
Modules	LG 300W Mono X
Inverter	Fronious ECO 27kWp + Symo 20kWp
Warranty	25 year module output to 83% 12 year module structural warranty 10 year inverter warranty

TABLE 19: SUMMARY OF SOLAR PV PRODUCTS USED FOR MODELLING

8.1 Summary of solar energy projects

Site & Project	Timing	Capital cost	Year 1 cost savings (incl depreciation)	Payback (incl depn)
Murwillumbah Art Gallery 99.18 kW solar PV	2016-17	$111,221	$24,464	4.55 Years
Murwillumbah Works Depot and Building C 91.26 kW solar PV	2016-17	$67,264	$17,969	3.74 Years
Kingscliff WWTP Sustainability Centre 99 kW solar PV	2017-18	$126,361	$20,572	6.14 Years
Bray Park WTP 215 kW solar PV	2017-18	$415,360	$61,923	6.71 Years
Bray Park #2 pump 25 kW solar PV	2017-18	$28,575	$4,413	6.48 Years
Mooball WWTP 5 kW solar PV	2017-18	$5,715	$1,213	4.71 Years
Tweed Regional Aquatic Centre Murwillumbah 165 kW solar PV	2017-18	$313,500	$52,024	6.03 Years
Tweed Heads Civic Centre and Library 20 kW solar PV	2017-18	$22,860	$3,739	6.11 Years
Tweed Regional Museum 38.40 kW solar PV	2018-19	$49,727	$7,672	6.48 Years
Kingscliff Library 16.8 kW solar PV	2018-19	$19,568	$4,499	4.35 Years
Administration Centre Tweed Heads 95 kW solar PV	2018-19	$108,082	$16,138	6.70 Years
Civic Centre Murwillumbah 98 kW solar PV	2018-19	$113,996	$16,647	6.85 Years
Mechanical & Electrical depot Kingscliff - augment current system with 30 kW solar PV	2018-19	$34,131	$6,969	4.90 Years
Tweed Heads depot 15 kW solar PV	2018-19	$17,066	$3,484	4.90 Years
Banora Point WWTP 700 kW solar PV	2019-20	$1,597,178	$171,842	9.29 Years
Tweed Heads South Pool 55 kW solar PV	2019-20	$62,374	$10,772	5.79 Years
HACC Tweed Heads 6 kW solar PV	2018-19	$6,826	$1,394	4.90 Years
Crematorium facility - roof of main office, 8 kW solar PV	2017-18	$9,144	$1,803	5.07 Years
Stotts Creek facility 50 kW solar PV on new FOGO shed	2018-19	$56,886	$13,390	4.25 Years

Banora Point community centre - 23 kW solar PV + Battery Energy Storage	2020-21	$64,594	$6,890	9.37 Years
South Tweed Community Hall - 12 kW solar PV + Battery Energy Storage	2020-21	$33,701	$3,595	9.37 Years
Museum storage and Records storage Honeyeater Circuit - 17 kW solar PV + Battery Energy Storage	2020-21	$47,744	$5,093	9.37 Years
Expansion of Murwillumbah Art Gallery with 100 kW solar PV + BESS	2021-22	$253,271	$25,343	9.99 Years
Expansion of TRAC Murwillumbah / Civic Centre Murwillumbah with 150 kW solar PV + BESS on carpark awning	2021-22	$379,907	$38,015	9.99 Years
Expansion of Kingscliff WWTP on west side with 500 kW solar PV + BESS	2022-23	$1,151,771	$121,938	9.45 Years
Expansion of Banora Pt WWTP with 700 kW solar PV + BESS	2023-24	$1,503,550	$136,371	11.03 Years
Hastings Point WWTP floating array on southern overflow, 60 kW	2024-25	$152,830	$11,498	13.29 Years
Expansion of Bray Park solar with 50 kW + BESS on #2 pump reservoir roof	2023-24	$107,396	$8,048	13.34 Years

TABLE 20: SUMMARY OF TIMING, ESTIMATED COSTS AND SAVINGS FOR SOLAR ENERGY PROJECTS

8.2 Selected images of proposed solar energy projects

FIGURE 25: 700 KW SOLAR PV ON 14,370 M^2 LAND AREA AT BANORA POINT WWTP[13]

[13] Imagery from ©2017 Google Map data or Nearmap

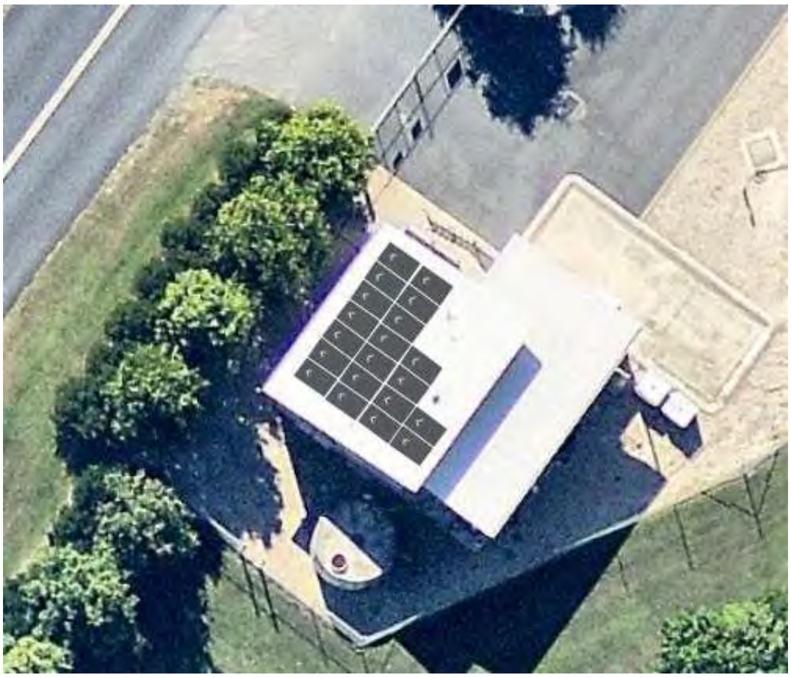


FIGURE 26: SOLAR PV ON MOOBALL WWTP[14]

FIGURE 27: SOLAR PV ON BRAY PARK #2 WPS[15]

[14] ibid
[15] ibid

FIGURE 28: SOLAR PV ON CIVIC CENTRE BUILDING, MURWILLUMBAH[16]

FIGURE 29: SOLAR PV ON TWEED HEADS DEPOT[17]

[16] ibid
[17] ibid

FIGURE 30: SOLAR PV ON SOUTH TWEED COMMUNITY HALL[18]

FIGURE 31: SOLAR PV ON TWEED HEADS ADMINISTRATION OFFICES[19]

[18] ibid
[19] ibid

FIGURE 32: SOLAR PV ON TWEED HEADS SOUTH POOL[20]

[20] ibid

8.3 Bray Park Water Treatment Plant

8.3.1 Recommended PV system size

The Bray Park WTP is a more complex site than others, with two NMIs on the one structure and various solutions for each NMI. For example:

the roofs of the main plant could potentially host a 290 kWp system using 300W panels, though this would not maximise self-consumption of generated electricity.

lower efficiency panels (e.g. 260W) could be used however this would utilise more of the less desirable south-facing roof.

load at the plant is generally morning-based, however modelling has not sought to tilt panels on the western-facing roof to the east, as this would have resulted in more panels being shifted to the less-desirable south-facing roof.

Two systems have been sized, one for each NMI, with a suitable balance struck between self-consumption and offset (i.e. grid electricity reduction).

It is noted that while the system for the smaller NMI will be <100 kW it will not be eligible for Small-scale Technology Certificates (STCs) if the combined systems on the same physical site exceeds 100 kWp, as per the Clean Energy Regulator's (CER) ruling[21].

The recommended size of each system is as tabulated below (highlighted rows), with the results from other options also shown. An overall target self-consumption level of 90% was sought.

Site	NMI	System size	Energy offset	Self-consumption
Durroon Ave Water Treatment Plant No.01	**4001215129**	43.2kWp (south)	24.97%	94.61%
		52.8kWp (south)	28.97%	90.65%
		60kWp (south)	31.54%	86.83%
		43.2kWp (tilted north)	**30.56%**	**91.50%**
		52.8kWp (tilted north)	34.96%	85.63%
Durroon Ave Bray Park	**4001215132**	140kWp	27.05%	95.54%
		160kWp	30.25%	92.81%
		172kWp	**32.63%**	**89.24%**
		200kWp	34.46%	86.99%
Total Bray Park WTP	**Both**	**215.2 kWp**		**~90%**

TABLE 21: SUMMARY OF SOLAR PV SYSTEM OPTIONS FOR BRAY PARK WTP

The selected systems provide the best balance between offset, self-consumption (target ~90%) and a return on investment. Other options could also provide viable returns – for example more recent load profiles for the larger NMI suggest that demand at the site is both larger and less 'peaky' in 2017 than was the case in 2016, so self-consumption of a larger 200 kWp system may have improved in

[21] A formal enquiry could be made to the Clean Energy Regulator to confirm, however in general if the intent is to install >100kWp on the site then it is likely that LGCs would be applicable for the whole PV installation and it would not be feasible to claim STCs for a small installation first and then LGCs for the balance. A case-by-case approach would be taken and an enquiry can be made to the Deemed Units section of the CER at deemedunits@cleanenergyregulator.gov.au.

this case. Council can refine the analysis and specified system ahead of the release of a tender, or refine the solution in conjunction with the preferred tenderer.

In the selected system the 172kWp system will occupy the Western, North and East roofs, while the smaller 43.2kWp system would be installed on the south facing roof tilted to 10degree north. A premium of 15¢/W was added to the estimated system cost to reflect added cost to tilt panels on this roof.

8.3.2 Solar PV system layout and locations

The recommended layout for the two systems is shown below.

FIGURE 33: RECOMMENDED SOLAR PV LAYOUT ON BRAY PARK WTP[22]

The pictures below show main switch / inverter location, metering for the 2 x NMIs and roof pictures.

[22] Imagery from ©2017 Google Map data or Nearmap

Main switch room with potential inverter location

2 x utility meters at the site

Western facing roof identifying setback for potential shading

Flat roof to north

FIGURE 34: ROOF, MSB AND METERING IMAGES AT BRAY PARK WTP

8.3.3 Solar PV energy output v grid electricity demand and return

8.3.3.1 Durroon Ave Bray Park 4001215132– 172kWp[23]

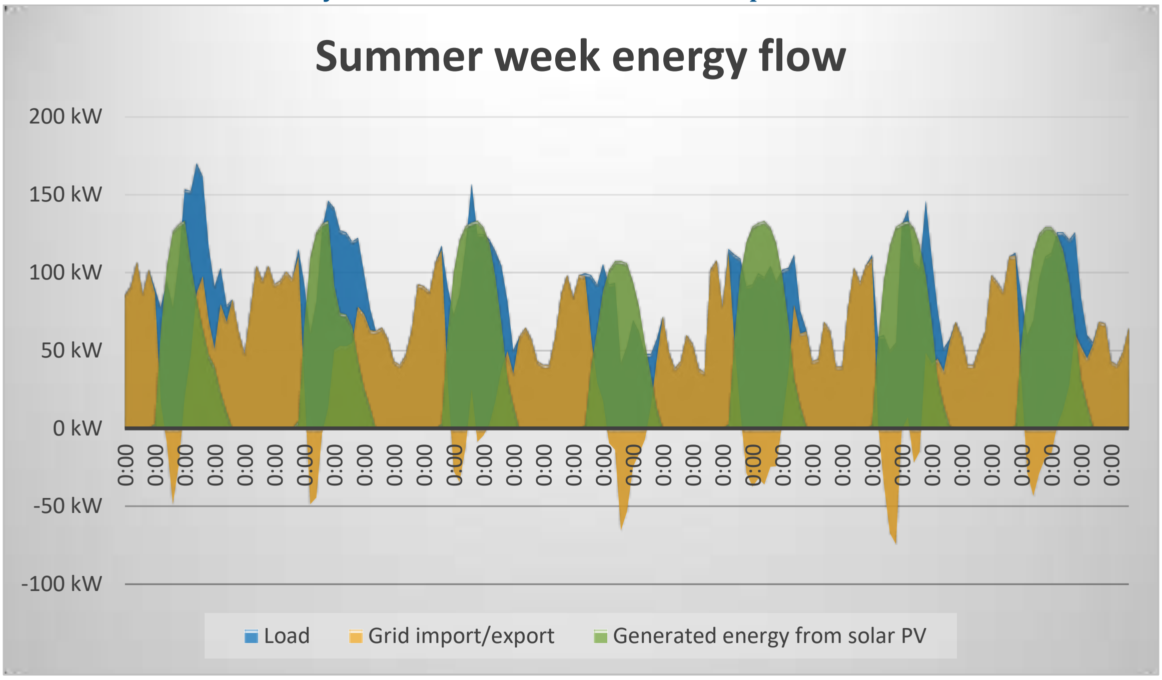


FIGURE 35: GRID AND SOLAR TO MEET SITE DEMAND – SUMMER WEEK BRAY PARK WTP 4001215132

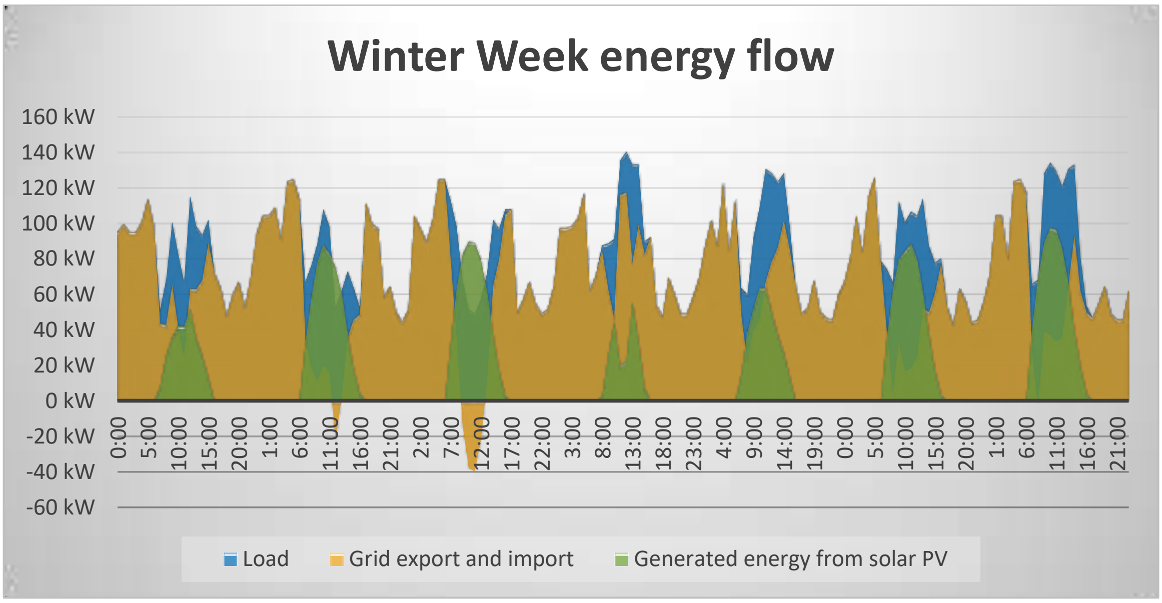


FIGURE 36: GRID AND SOLAR TO MEET SITE DEMAND – WINTER WEEK BRAY PARK WTP 4001215132

[23] It is noted that the average kVA demand for NMI 4001215132 for calendar year 2016 was just over 91 kVA, with a peak demand of just over 200 kVA; this corresponds to energy use recorded in Council's zEUS database. For April 2017 interval data show average demand of more than 200 kVA. This would lead to a greater level of self-consumption of solar if this represents a sustained change in energy demand at the Bray Park WTP. This would improve the return on investment for the solar PV system recommended, and could enable Council to select a larger system within the physical constraints of the roof of the facility. Hence the case presented here is likely to present a conservative view of the cost-effectiveness of solar PV.

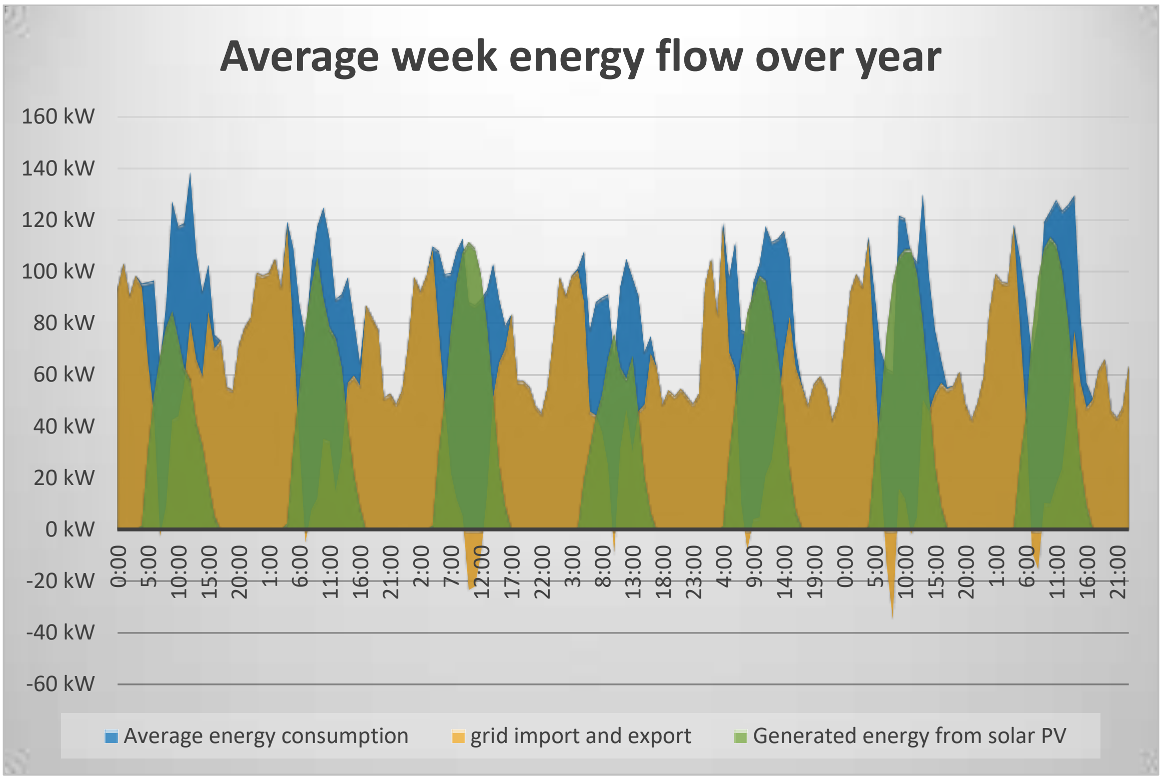


FIGURE 37: GRID AND SOLAR TO MEET SITE DEMAND – AVERAGE WEEK BRAY PARK WTP 4001215132

Key inputs to detailed financial model	
Gross system cost fully installed (ex GST)	$326,800
% of solar energy consumed	89.24%

TABLE 22: SUMMARY OF SOLAR PV SYSTEM COST AND SELF-CONSUMPTION FOR BRAY PARK WTP 4001215132

8.3.3.2 Durroon Ave Water Treatment Plant No.01 4001215129

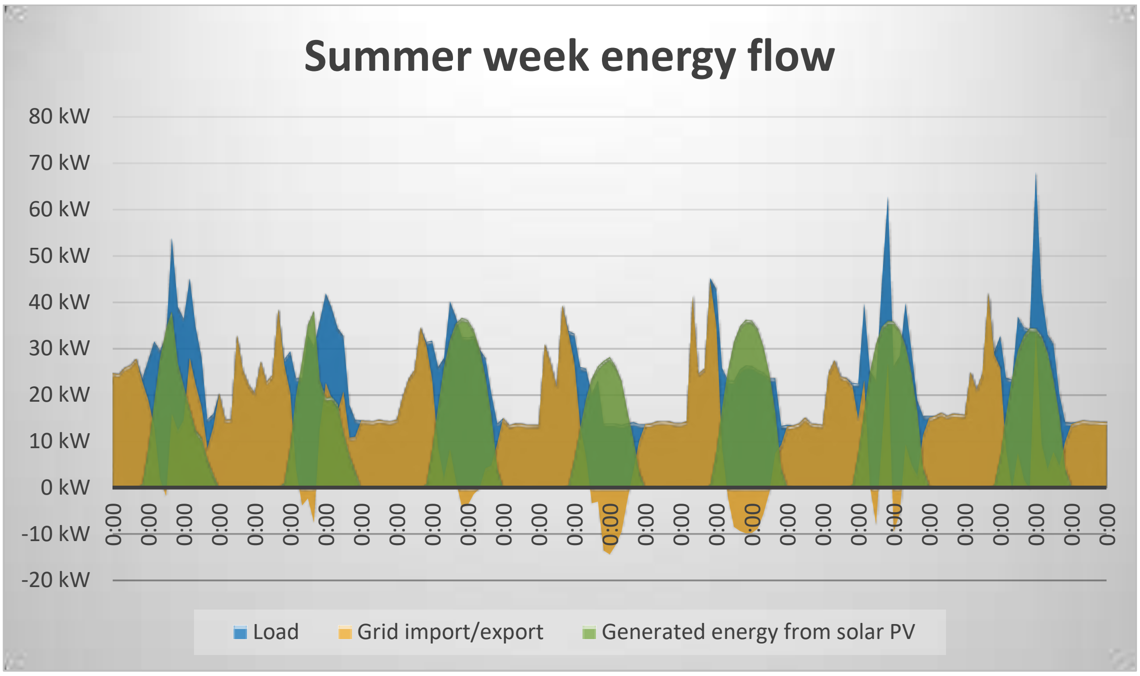


FIGURE 38: GRID AND SOLAR TO MEET SITE DEMAND – SUMMER WEEK BRAY PARK WTP 4001215129

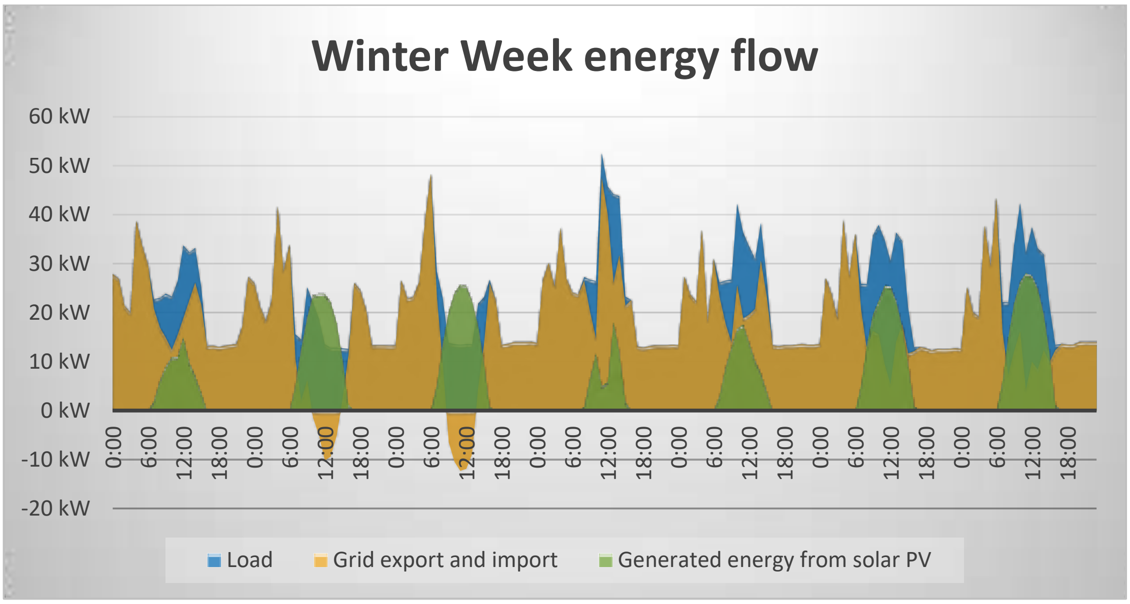


FIGURE 39: GRID AND SOLAR TO MEET SITE DEMAND – WINTER WEEK BRAY PARK WTP 4001215129

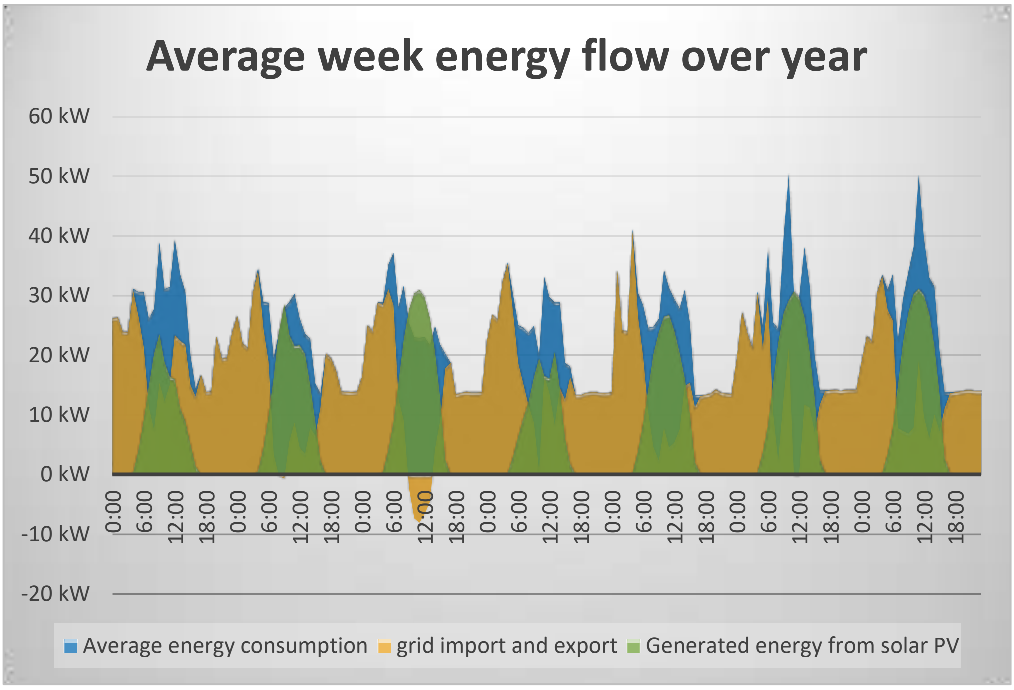


FIGURE 40: GRID AND SOLAR TO MEET SITE DEMAND – AVERAGE WEEK BRAY PARK WTP 4001215129

Key inputs to detailed financial model	
Gross system cost fully installed (ex GST)	$88,560
% of solar energy consumed	91.50%

TABLE 23: SUMMARY OF SOLAR PV SYSTEM COST AND SELF-CONSUMPTION FOR BRAY PARK WTP 4001215129

8.4 Tweed Regional Aquatic Centre (TRAC) Murwillumbah

8.4.1 Recommended PV system size

The TRAC Murwillumbah site was modelled using 300W panels. A system with nominal capacity of 165 kWp was determined to be suitable, offering a suitable balance between self-consumption and offset (i.e. grid electricity reduction).

The 165kWp system will occupy the two main roofs of the facility. There will be a level of shading in winter from the hill to the north, with an estimated impact of approximately 6% yield reduction.

8.4.2 Solar PV system layout and locations

The recommended layout for the system is shown below.

FIGURE 41: RECOMMENDED SOLAR PV LAYOUT ON TRAC MURWILLUMBAH[24]

The pictures below show main switch / inverter location, and metering arrangement.

[24] Imagery from ©2017 Google Map data or Nearmap

	
Main switch room at TRAC – suitable supply for solar system	Metering for adjacent carpark

Figure 42: MSB and metering images at TRAC Murwillumbah

8.4.3 Solar PV energy output v grid electricity demand and return

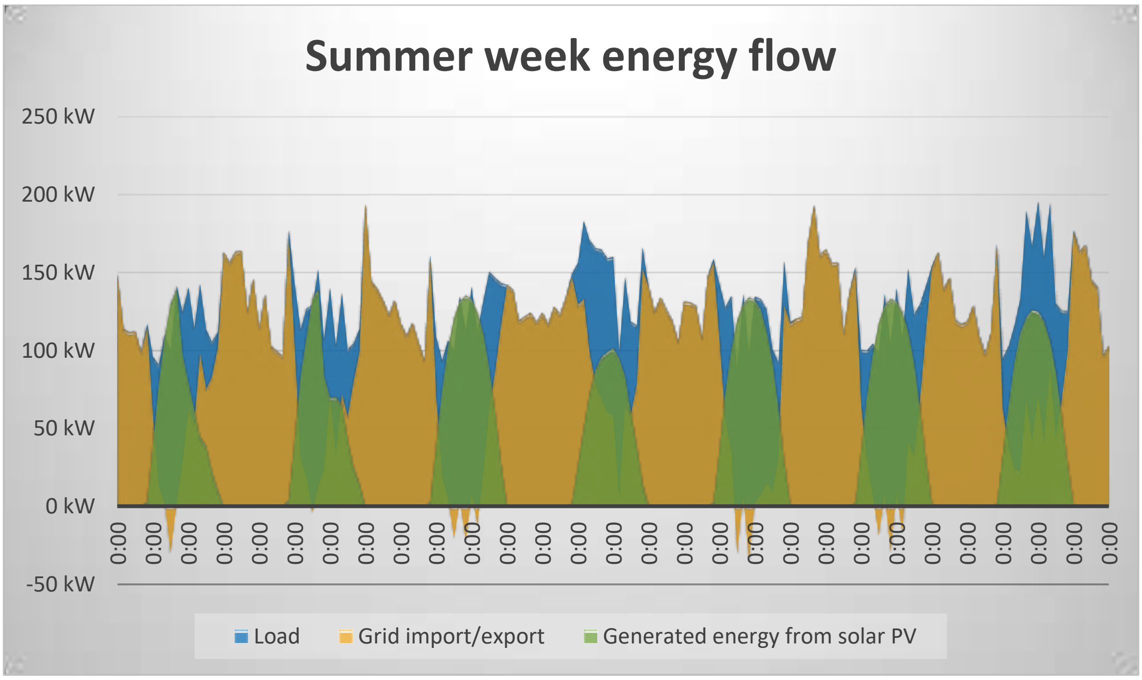


Figure 43: Grid and solar to meet site demand – summer week TRAC Murwillumbah

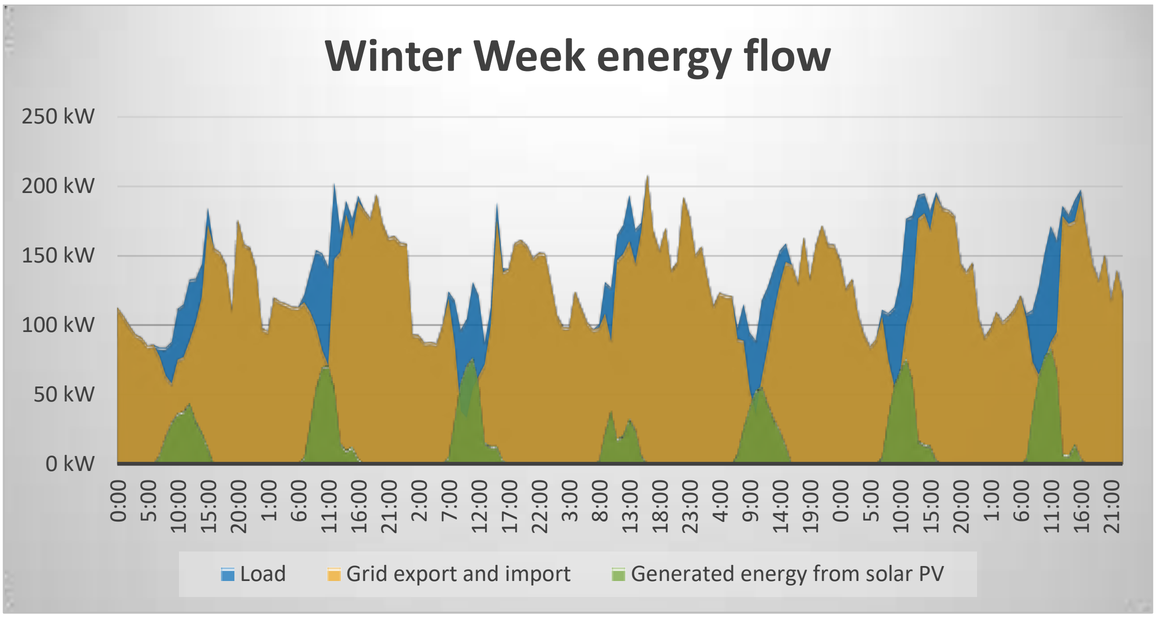


FIGURE 44: GRID AND SOLAR TO MEET SITE DEMAND – WINTER WEEK TRAC MURWILLUMBAH

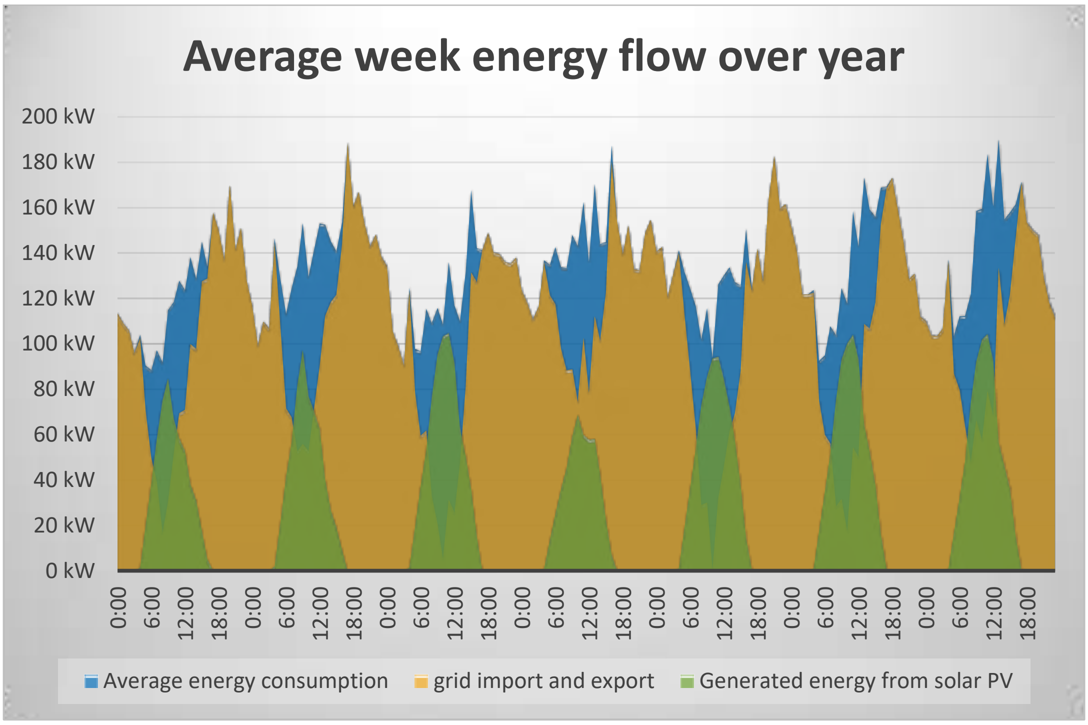


FIGURE 45: GRID AND SOLAR TO MEET SITE DEMAND – AVERAGE WEEK TRAC MURWILLUMBAH

Key inputs to detailed financial model	
Gross system cost fully installed (ex GST)	$313,500
% of solar energy consumed	98.59%

TABLE 24: SUMMARY OF SOLAR PV SYSTEM COST AND SELF-CONSUMPTION FOR TRAC MURWILLUMBAH

8.5 Kingscliff Library

8.5.1 Recommended PV system size

The Kingscliff Library site was modelled using 300W panels. A system with nominal capacity of 16.8 kWp was determined to be suitable, offerring a suitable balance between self-consumption and offset (i.e. grid electricity reduction).

There is no interval data for the site, so a nominal load profile was constructed based on the annual energy use for the facility and taking into account weekday and wekend opening times.

Given the surrounding shading provided by trees on three sides, as well as the modest load at the site, the PV system is centre-mounted on the southern end of the roof.

8.5.2 Solar PV system layout and locations

The recommended layout for the system is shown below.

FIGURE 46: RECOMMENDED SOLAR PV LAYOUT ON KINGSCLIFF LIBRARY[25]

[25] Imagery from ©2017 Google Map data or Nearmap

The pictures below show main switch and metering arrangement as well as a ground picture of the roof structure. The plant room on the mezzanine level on the south side of the building may be the best location to host inverter(s).

Roof structure looks suitable for install

Main switched board shared with neighbour

FIGURE 47: ROOF, MSB AND METERING IMAGES AT KINGSCLIFF LIBRARY

8.5.3 Solar PV energy output v grid electricity demand and return

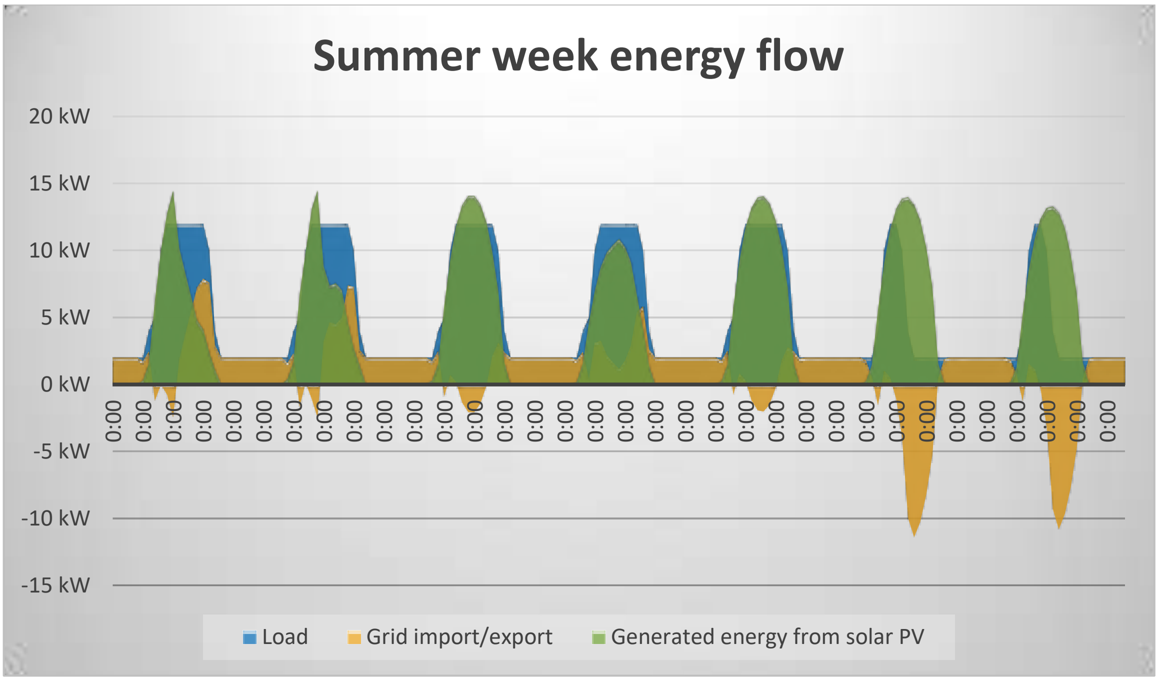


FIGURE 48: GRID AND SOLAR TO MEET SITE DEMAND – SUMMER WEEK KINGSCLIFF LIBRARY

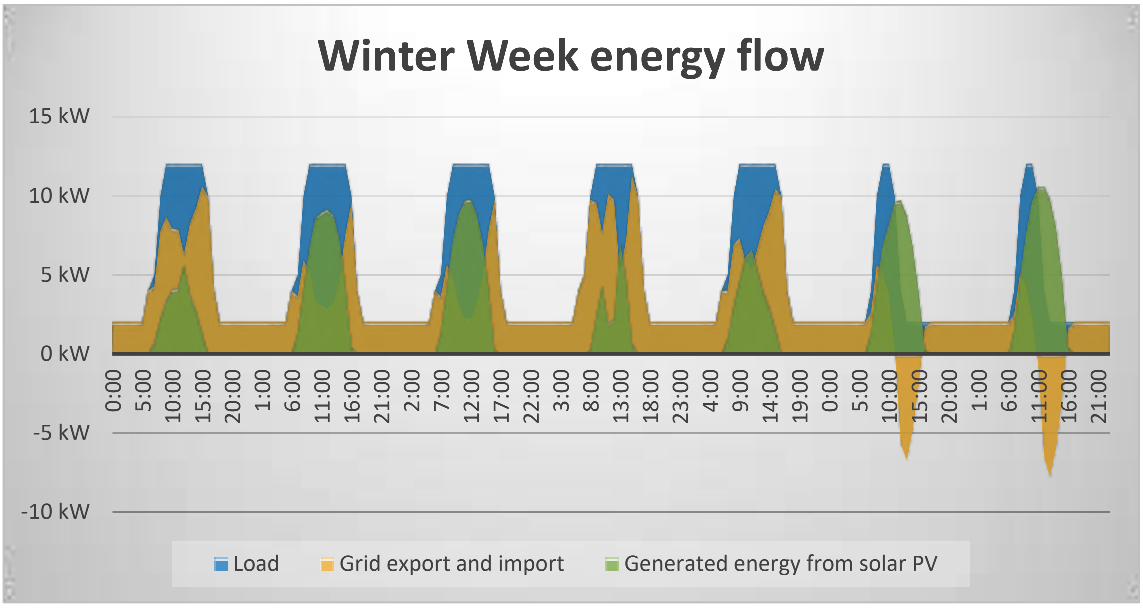


FIGURE 49: GRID AND SOLAR TO MEET SITE DEMAND – WINTER WEEK KINGSCLIFF LIBRARY

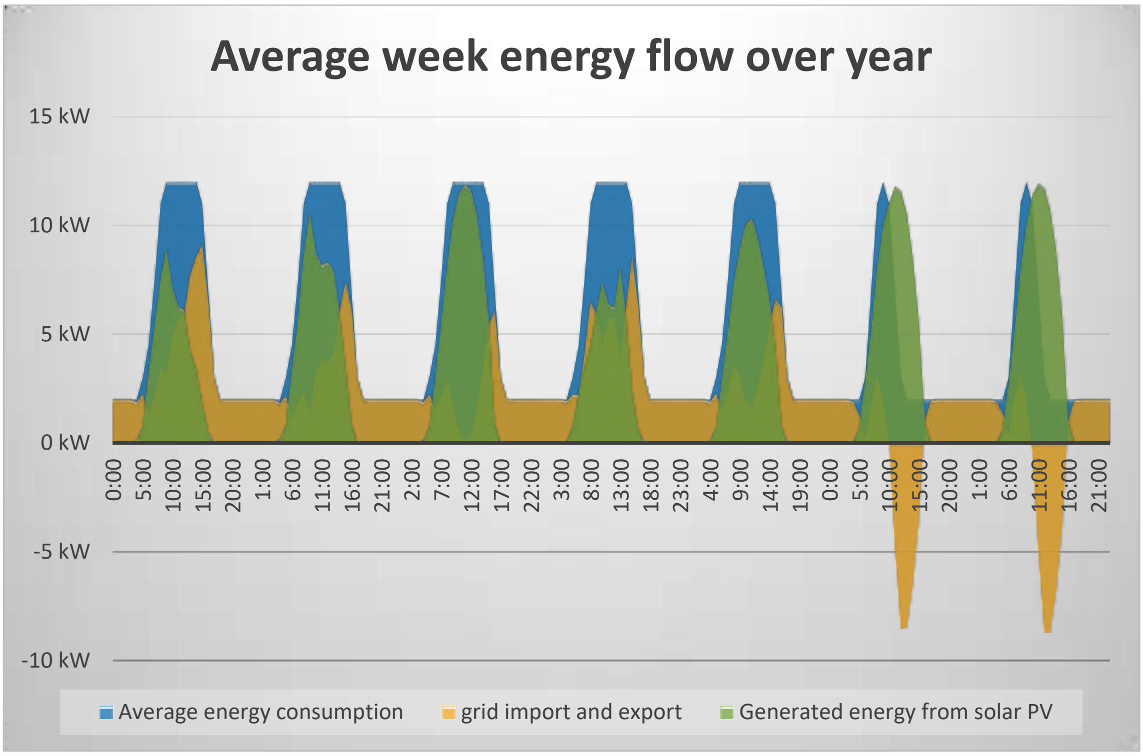


FIGURE 50: GRID AND SOLAR TO MEET SITE DEMAND – AVERAGE WEEK KINGSCLIFF LIBRARY

Key inputs to detailed financial model	
Net cost after STC discount exc GST	$19,568
% of solar energy consumed	88.42%

TABLE 25: SUMMARY OF SOLAR PV SYSTEM COST AND SELF-CONSUMPTION FOR KINGSCLIFF LIBRARY

8.6 Kingscliff Wastewater Treatment Plant

8.6.1 Recommended PV system size

The Kingscliff WWTP site was modelled using 300W panels. A system with nominal capacity of 99 kWp was determined to be suitable, offering a suitable balance between self-consumption and offset (i.e. grid electricity reduction). This system covers the main roof on the WWTP and of the adjacent Sustainability Centre (separate NMI).

8.6.2 Solar PV system layout and locations

The recommended layout for the system is shown below.

FIGURE 51: RECOMMENDED SOLAR PV LAYOUT ON KINGSCLIFF WWTP[26]

[26] Imagery from ©2017 Google Map data or Nearmap

It is noted that the layout covers two NMIs, with the Sustainability Centre building on the south side having a separate NMI to the wastewater treatment plant. As such it will be necessary to run a cable from the rooftop system on the Sustainability Centre to the MSB located as shown in the map above. There will be additional costs for this and an estimate is included in the costings for the project.

There may be alternative locations that the WWTP can consider if this option proves unsuitable (e.g. for laying an underground cable). The Water Section shed can accommodate up to 50 kWp and is within the WWTP boundary. In addition, the low shed within the Mech & Elec depot grounds can also host up to 50 kWp, and power could be cabled from there to the distribution board in the Water Section shed, subject to further site analysis.

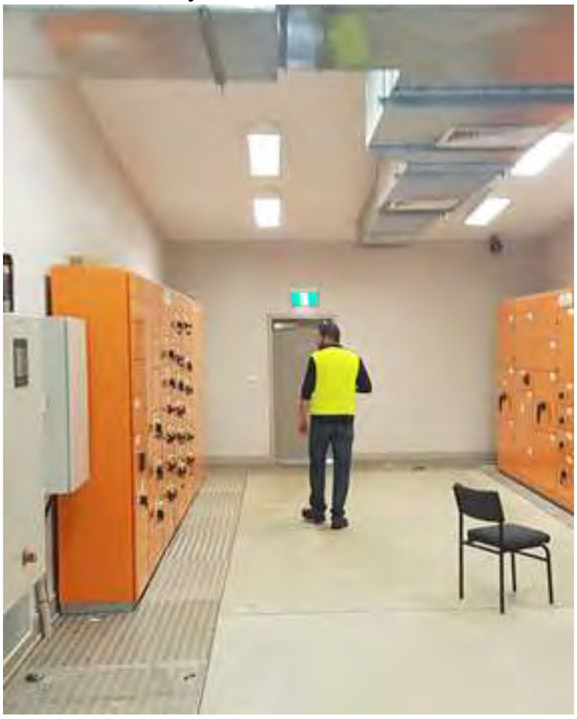
FIGURE 52: POTENTIAL ALTERNATE SOLAR PV LOCATIONS ON KINGSCLIFF WWTP[27]

Main switch, Sustainability Centre DB and locations for inverters are shown below.

[27] Imagery from ©2017 Google Map data or Nearmap

Distribution board in main building – space adjacent for inverters

Main switch at DB board in main building



Main switch room with space for inverters as required

FIGURE 53: MSB AND METERING IMAGES AT KINGSCLIFF WWTP

8.6.3 Solar PV energy output v grid electricity demand and return

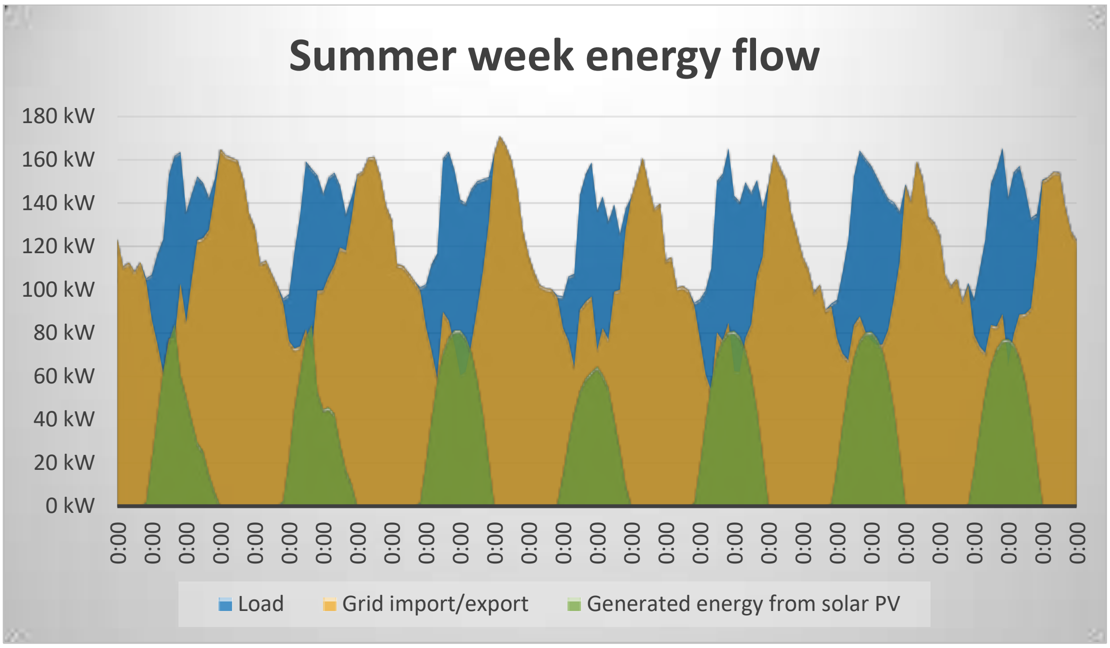


Figure 54: Grid and solar to meet site demand – summer week Kingscliff WWTP

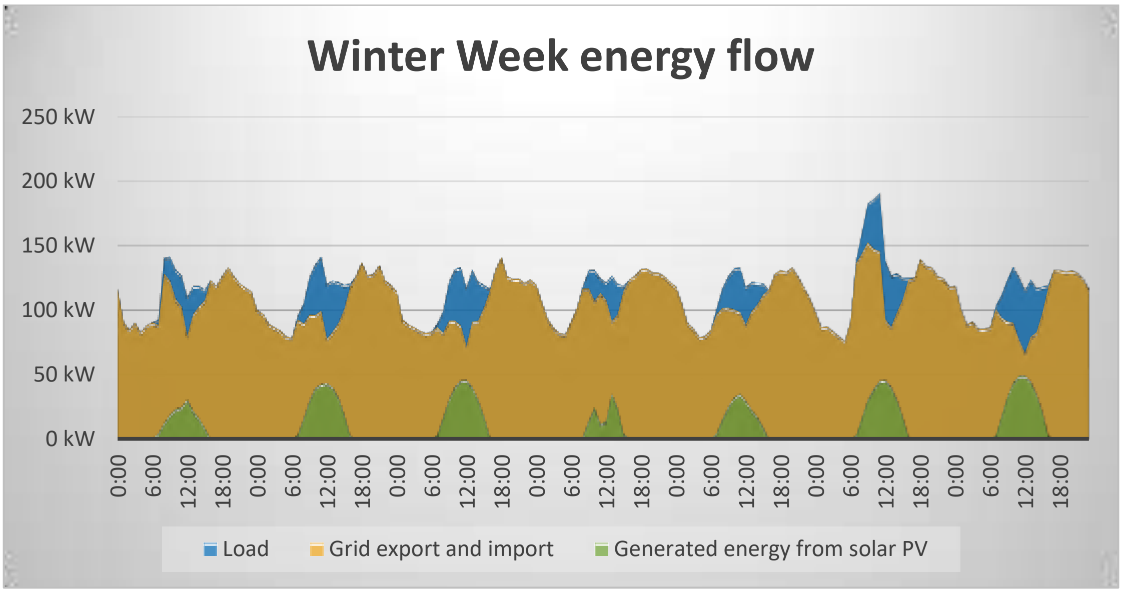


Figure 55: Grid and solar to meet site demand – winter week Kingscliff WWTP

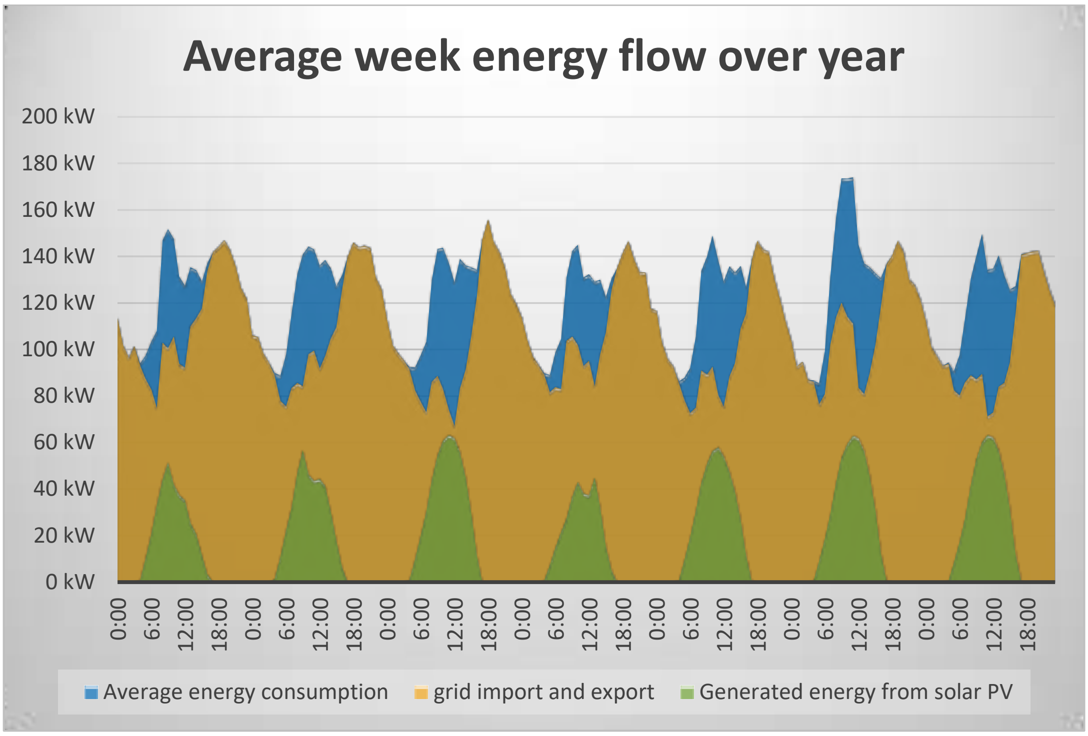


FIGURE 56: GRID AND SOLAR TO MEET SITE DEMAND – AVERAGE WEEK KINGSCLIFF WWTP

Key inputs to detailed financial model	
Net solar PV cost after STC discount exc GST	$116,361
Allowance for cabling and undergrounding works	$10,000
% of solar energy consumed	99.99%

TABLE 26: SUMMARY OF SOLAR PV SYSTEM COST AND SELF-CONSUMPTION FOR KINGSCLIFF WWTP

8.6.4 Potential phase 2

The Kingscliff WWTP site has much higher load and could accommodate a larger system. This would either be a ground-mount system within the WWTP, or could potentially be roof-mounted on the Mechanical & Electrical facility roofs and Water section shed roof with private-wire connection to the WWTP. The potential to expand would require assessment of the use of land for the WWTP and engagement with Essential Energy regarding the use of the adjacent site.

An additional 150 kWp would deliver the following results:

Key inputs to detailed financial model	
% of energy supplied by solar	32.78%
% of solar energy consumed	94.43%

TABLE 27: SUMMARY OF EXPANDED SOLAR PV SYSTEM COST AND SELF-CONSUMPTION FOR KINGSCLIFF WWTP

The average weekly energy balance between grid and solar is shown below.

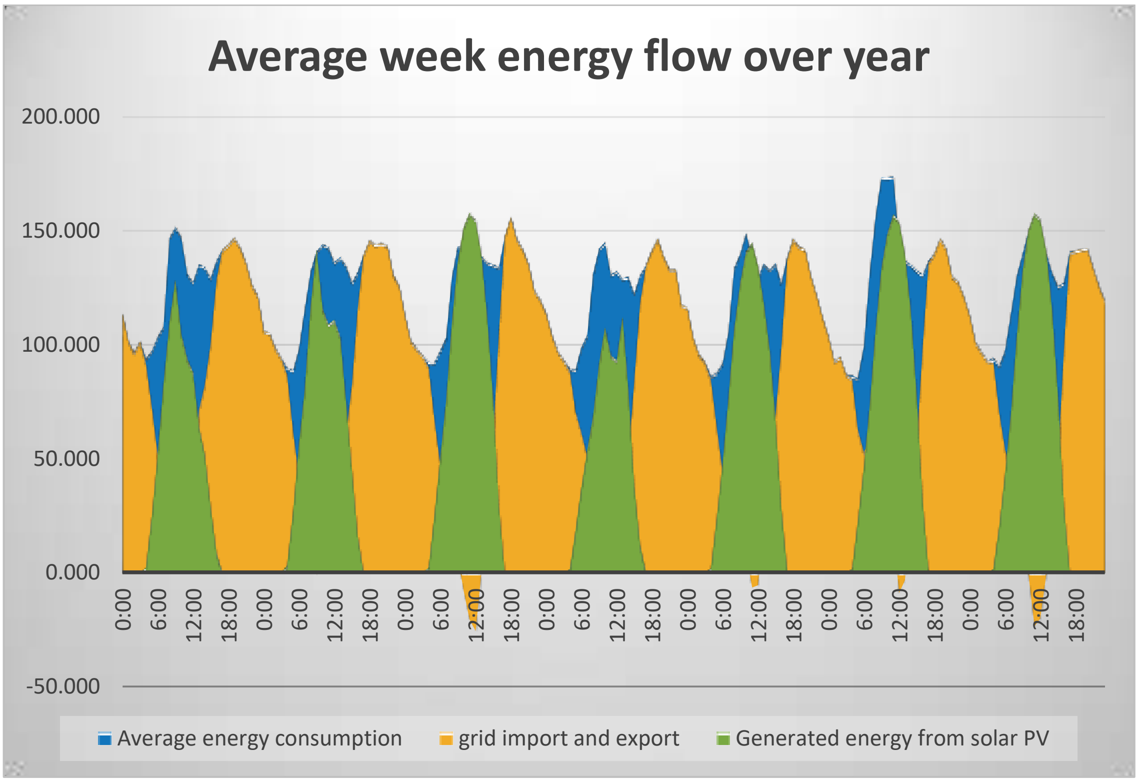


FIGURE 57: GRID AND EXPANDED SOLAR TO MEET SITE DEMAND – AVERAGE WEEK KINGSCLIFF WWTP

Possible locations for additional 150 kWp is shown below.

FIGURE 58: POTENTIAL EXPANDED SOLAR PV LAYOUT ON KINGSCLIFF WWTP [28]

[28] Imagery from ©2017 Google Map data or Nearmap

FIGURE 59: POTENTIAL EXPANDED SOLAR PV LAYOUT ON KINGSCLIFF WWTP [29]

[29] Imagery from ©2017 Google Map data or Nearmap

8.7 Tweed Regional Museum Murwillumbah

8.7.1 Recommended PV system size

The Tweed Regional Museum site was modelled using 300W panels. A system with nominal capacity of 38.4 kWp was determined to be suitable, offerring a suitable balance between self-consumption and offset (i.e. grid electricity reduction). There is no interval data for the site, so a nominal load profile was constructed based on the annual energy use for the facility and taking into account weekday and wekend opening times.

8.7.2 Solar PV system layout and locations

The recommended layout for the system is shown below.

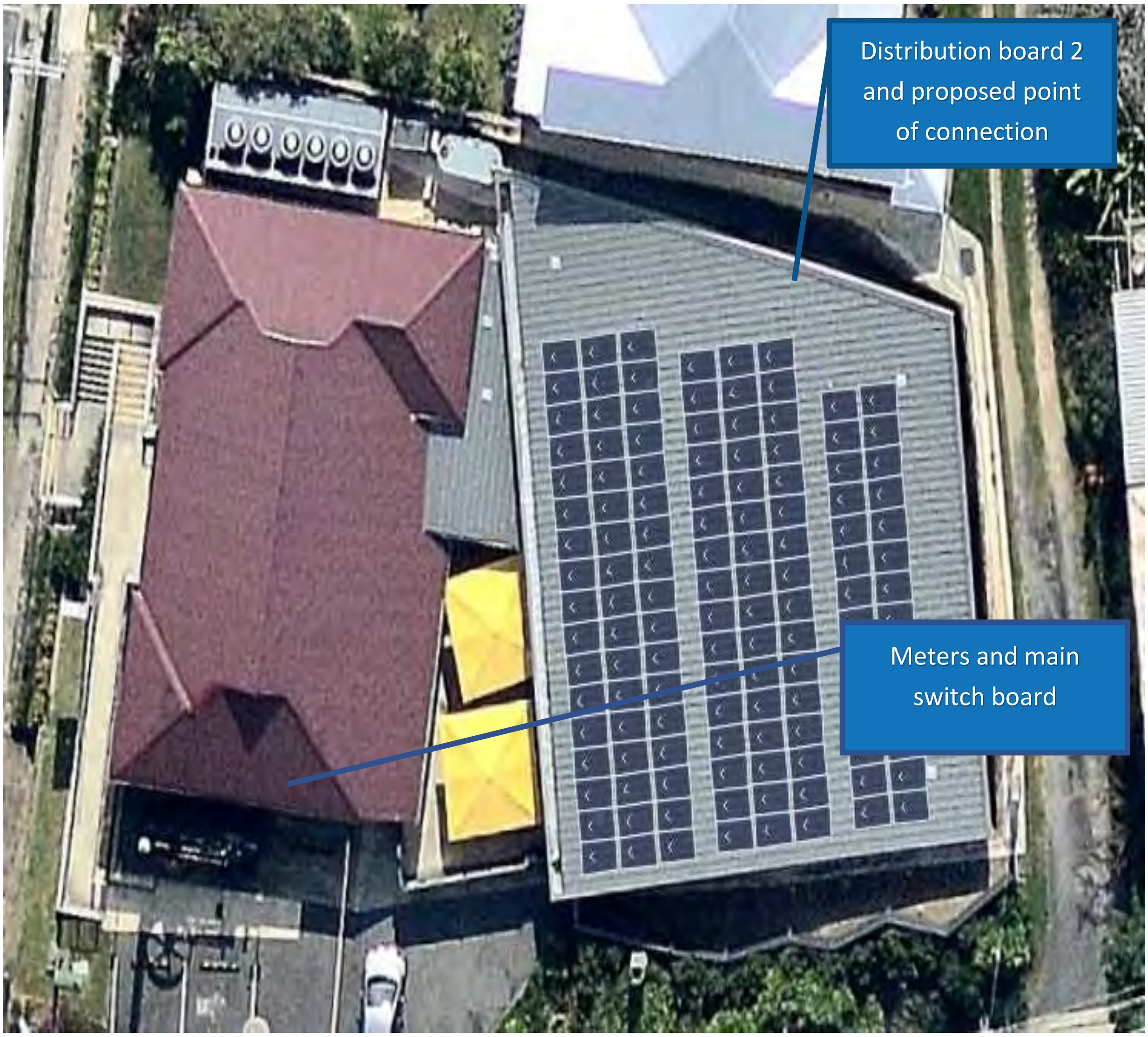


FIGURE 60: RECOMMENDED SOLAR PV LAYOUT ON TWEED REGIONAL MUSEUM MURWILLUMBAH[30]

[30] Imagery from ©2017 Google Map data or Nearmap

Feed to distribution board at eastern end top floor


Space in DB - 2


Proposed west facing roof for installation of modules

FIGURE 61: ROOF, MSB AND METERING IMAGES AT TWEED REGIONAL MUSEUM MURWILLUMBAH

8.7.3 Solar PV energy output v grid electricity demand and return

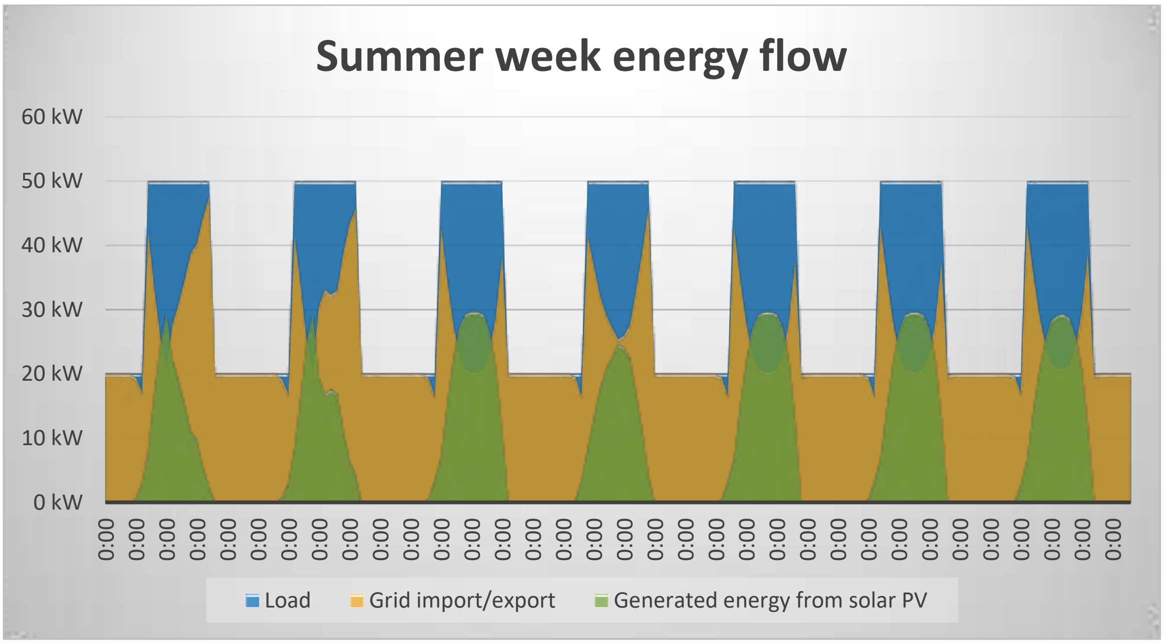


FIGURE 62: GRID AND SOLAR TO MEET SITE DEMAND – SUMMER WEEK TWEED REGIONAL MUSEUM MURWILLUMBAH

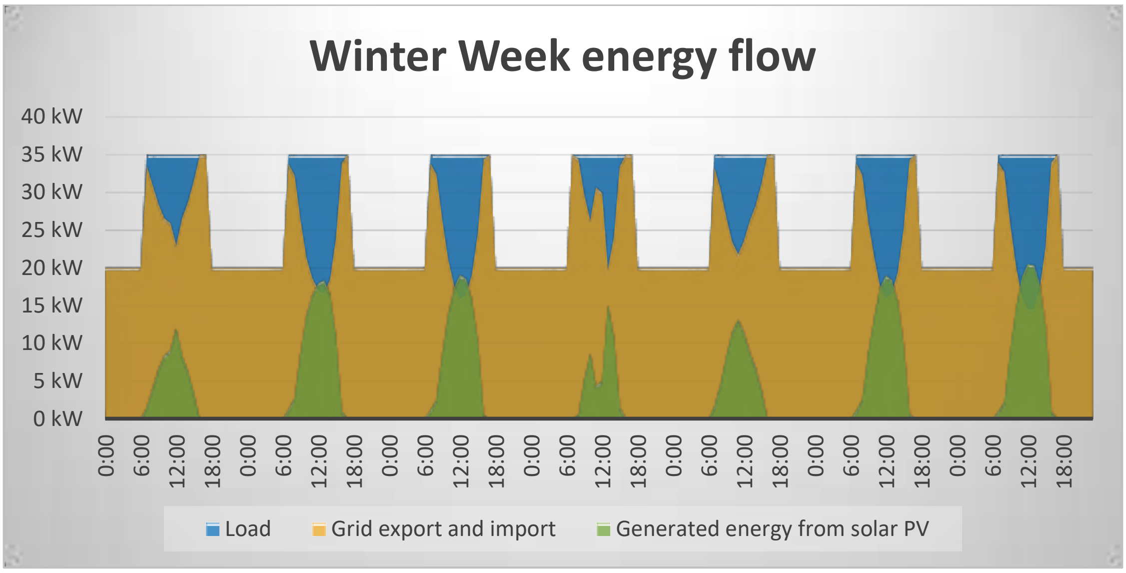


FIGURE 63: GRID AND SOLAR TO MEET SITE DEMAND – WINTER WEEK TWEED REGIONAL MUSEUM MURWILLUMBAH

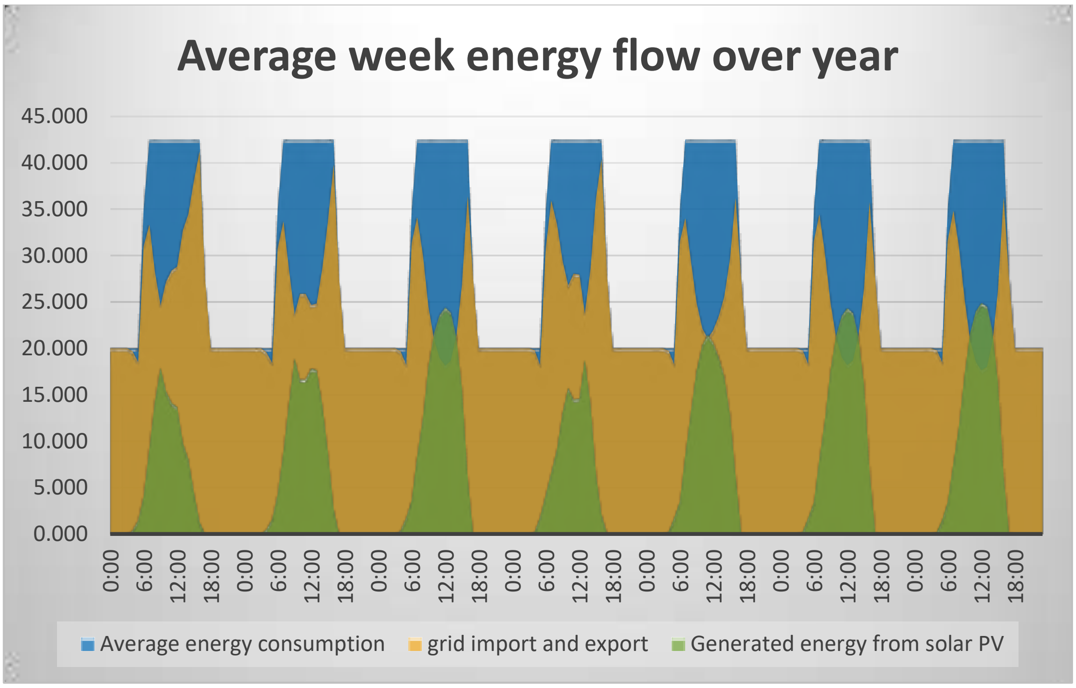


FIGURE 64: GRID AND SOLAR TO MEET SITE DEMAND – AVERAGE WEEK TWEED REGIONAL MUSEUM MURWILLUMBAH

Expected return on investment for this system is tabulated below. It is noted that this assumes implementation today, with first-year savings at the rates (energy + network + market) that will apply from 1 July 2017. Depreciation is not included as an expense. The REAP will reflect Council's preferred implementation timing and will include depreciation expense if/as required.

Key inputs to detailed financial model	
Net cost after STC discount exc GST	$44,727
% of solar energy consumed	100.00%

TABLE 28: SUMMARY OF SOLAR PV SYSTEM COST AND SELF-CONSUMPTION FOR TWEED REGIONAL MUSEUM MURWILLUMBAH

9 Appendix C: Street Lighting LED Upgrade

Tweed Shire Council (THC) received a proposal from Essential Energy to upgrade eligible Category P (local) street lighting to approved LED luminaires in early 2017. This offer was received pursuant to the completion of negotiations between Essential Energy and local governments in their network area to agree on Street Lighting Use of System (SLUOS) charges for LED lighting. The offer was comparable in nature to that received by numerous councils and is shown below.

Tweed Bulk LED Upgrade Summary

Date of Report 5/01/2017
Month of Stock Report Dec-16

	Number of Upgraded Luminaires	Cost of Upgrade	Discount for Tariff 2 Luminaires	Discount for Bulk Lamp	Residual Value	Total Cost for Council	Essential Energy's Contribution
Option 1	3404	$ 1,262,513.05	$ (16,729.13)	$ (188,916.20)	$ 142,775.70	$ 1,199,643.42	$ 205,645.11
Option 2	3404	$ 1,065,682.30	$ (16,729.16)	$ (188,916.20)	$ 142,775.70	$ 1,002,812.64	$ 205,645.16
Option 3	3404	$ 1,090,364.94	$ (16,729.17)	$ (188,916.20)	$ 142,775.70	$ 1,027,495.27	$ 205,645.17
Option 4	3404	$ 1,287,195.69	$ (16,729.14)	$ (188,916.20)	$ 142,775.70	$ 1,224,326.05	$ 205,645.14

	P4/P5 Luminaire Power Consumption (Watts)	P3 Luminaire Power Consumption (Watts)	LED Annual SLUOS (Current Proposed Negotiated)
Option 1	17	42	$ 160,993.43
Option 2	25	42	$ 182,704.19
Option 3	25	35	$ 189,367.23
Option 4	17	35	$ 167,656.46

FIGURE 65: SUMMARY OF ESSENTIAL ENERGY OFFER FOR LED LIGHTING FOR TSC

The offer was accompanied by supporting analysis and information, communicating the basis for the fee proposal as well as the analysis via which council can see the basis for the various components of the costing.

This assessment examines the case for the LED offer. Specifically;

- Review of information received from Essential plus initial calculations, as well as Council's future energy agreement for street lighting
- Liaise with other councils who have received similar offers to upgrade to LED to be informed regarding evaluation and decisions being taken by others
- Evaluate the value of Energy Saving Certificates (ESCs) that will be associated with the proposed upgrade and parties who can assist council in this regard
- Source information relating to other potential incentives that council could seek to access to support the case for implementation of the LED upgrade
- Assessment of the business case for LED upgrade, primarily focused on the offer presented. This involves estimation of the energy use / cost, SLUOS and ESC savings against the capital cost and liaison with Essential Energy to understand what, if any, capital costs may be incurred in future bulk upgrades for these lamps. A secondary assessment looks at residual values as part of the business case and considers the impact if high residual value assets were omitted from the LED program of work

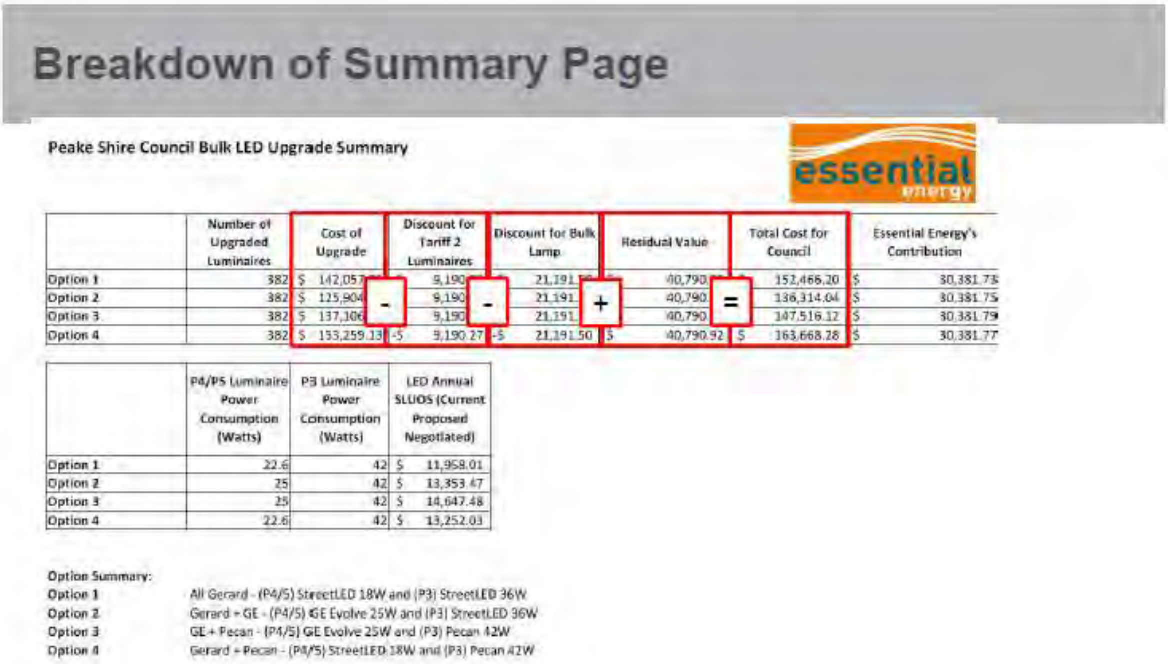
9.1 Inputs to the business case

9.1.1 Background inputs

The main input to the assessment of the street lighting LED upgrade case is Essential Energy's excel workbook, supplied by TSC. This sets out a range of inputs to the proposal, including:

- Summary of cost components making up the proposed net cost to TSC for each of 4 LED options,
- Summary of SLUOS charges that will apply to the 4 options, based on negotiated agreed rates between Essential Energy and representatives of local governments,
- Details underpinning the calculation of each cost component and supporting new SLUOS charges

A secondary input is a document prepared by Essential Energy that includes explanatory notes accompanying the excel workbook. Central to this is the outline of how the net costs to TSC are worked out, as shown below.



Breakdown of Summary Page

Peake Shire Council Bulk LED Upgrade Summary

	Number of Upgraded Luminaires	Cost of Upgrade	Discount for Tariff 2 Luminaires	Discount for Bulk Lamp	Residual Value	Total Cost for Council	Essential Energy's Contribution
Option 1	382	$ 142,057	9,190	21,191	40,790	152,466.20	$ 30,381.73
Option 2	382	$ 125,904	9,190	21,191	40,790	136,314.04	$ 30,381.75
Option 3	382	$ 137,106	9,190	21,191	40,790	147,516.12	$ 30,381.79
Option 4	382	$ 153,259.13	-$ 9,190.27	-$ 21,191.50	$ 40,790.92	$ 163,668.28	$ 30,381.77

	P4/P5 Luminaire Power Consumption (Watts)	P3 Luminaire Power Consumption (Watts)	LED Annual SLUOS (Current Proposed Negotiated)
Option 1	22.6	42	$ 11,958.01
Option 2	25	42	$ 13,353.47
Option 3	25	42	$ 14,647.48
Option 4	22.6	42	$ 13,252.03

Option Summary:

Option 1	All Gerard - (P4/5) StreetLED 18W and (P3) StreetLED 36W
Option 2	Gerard + GE - (P4/5) GE Evolve 25W and (P3) StreetLED 36W
Option 3	GE + Pecan - (P4/5) GE Evolve 25W and (P3) Pecan 42W
Option 4	Gerard + Pecan - (P4/5) StreetLED 18W and (P3) Pecan 42W

FIGURE 66: EXPLANATION OF CAPITAL COST COMPONENTS AND DISCOUNTS FOR CATEGORY P LED LIGHTING

Of primary importance in this document in terms of TSC's net costs is the Residual Value of assets that are to be upgraded, and how this cost can be mitigated through bulk upgrade timing and/or omission of certain assets from the upgrade.

Two other inputs are relevant in terms of assessing the business case for LEDs – i.e. benefits to offset the capital cost for the new luminaires. These include;

- Lighting load table[31]: all eligible unmetered devices in the NEM have an agreed power consumption and agreed operating hours to support billing by networks and retailers. For

[31] https://www.aemo.com.au/-/media/Files/Electricity/NEM/Retail_and_Metering/NEM-Load-Tables-For-Unmetered-Connection-Points.pdf

unmetered public lighting in the TSC there are two types of lamps that are proposed to be upgraded. These are summarised below, showing the prefix that identifies these lamps, their nominal wattage and their agreed actual system wattage inclusive of ballast losses. The actual wattage is used to determine energy consumption. Street lighting run hours are taken to be 4300 hours per year.

Lamp type	Prefix	Nominal watt	Actual system watts
Compact fluorescent	FLU0350	42 W	46.4 W
High pressure sodium	HPS0020	70 W	86 W

TABLE 29: NOMINAL AND ACTUAL WATTAGE OF LAMPS PROPOSED TO BE UPGRADED TO LED

- Energy contract: TSC is about to commence a three year agreement for supply of electricity for street lighting. This agreement sees steep rises in energy rates. For the purposes of this analysis, the following assumptions are applied:
    - Recently negotiated energy rates are used until end 2019/20
    - Rates then escalate at 2.5% per year
    - Network rates for street lighting are taken from Essential Energy's published rates for 2017-18, and then assumed to escalate at 2.5% per year

9.1.2 Scope of upgrade

The proposed LED bulk upgrade is limited to eligible Category P luminaires, essentially non-decorative local road lighting. While TSC has 6,191 street lights in total (unmetered), the proposal will see 3,404 new LED luminaires installed, while main road lights (Category V) are excluded.

Current Tariff	Option 1	Option 2	Option 3	Option 4	Number of Luminaires Upgraded
FLU0350-ST-0001-006-B	LED0003-ST-3540-004	LED0006-ST-3900-004	LED0006-ST-3900-004	LED0003-ST-3540-004	3
FLU0350-ST-1620-003-B	LED0003-ST-3540-004	LED0006-ST-3900-004	LED0006-ST-3900-004	LED0003-ST-3540-004	164
FLU0350-ST-1620-004-B	LED0003-ST-3540-004	LED0006-ST-3900-004	LED0006-ST-3900-004	LED0003-ST-3540-004	1381
FLU0350-ST-1620-005-B	LED0003-ST-3540-004	LED0006-ST-3900-004	LED0006-ST-3900-004	LED0003-ST-3540-004	14
FLU0350-ST-1660-003-B	LED0003-ST-3580-004	LED0006-ST-3940-004	LED0006-ST-3940-004	LED0003-ST-3580-004	5
FLU0350-ST-1660-004-B	LED0003-ST-3580-004	LED0006-ST-3940-004	LED0006-ST-3940-004	LED0003-ST-3580-004	49
FLU0350-ST-1660-005-B	LED0003-ST-3580-004	LED0006-ST-3940-004	LED0006-ST-3940-004	LED0003-ST-3580-004	3
FLU0350-ST-1700-003-B	LED0003-ST-3620-004	LED0006-ST-3980-004	LED0006-ST-3980-004	LED0003-ST-3620-004	55
FLU0350-ST-1700-004-B	LED0003-ST-3620-004	LED0006-ST-3980-004	LED0006-ST-3980-004	LED0003-ST-3620-004	1441
FLU0350-ST-1700-005-B	LED0003-ST-3620-004	LED0006-ST-3980-004	LED0006-ST-3980-004	LED0003-ST-3620-004	17
FLU0350-ST-1720-004-B	LED0003-ST-3640-004	LED0006-ST-4000-004	LED0006-ST-4000-004	LED0003-ST-3640-004	12
HPS0020-ST-0040-001-B	LED0001-ST-3300-004	LED0001-ST-3300-004	LED0009-ST-4260-004	LED0009-ST-4260-004	5
HPS0020-ST-0040-002-B	LED0001-ST-3300-004	LED0001-ST-3300-004	LED0009-ST-4260-004	LED0009-ST-4260-004	2
HPS0020-ST-0040-003-B	LED0001-ST-3300-004	LED0001-ST-3300-004	LED0009-ST-4260-004	LED0009-ST-4260-004	2
HPS0020-ST-0040-004-B	LED0001-ST-3300-004	LED0001-ST-3300-004	LED0009-ST-4260-004	LED0009-ST-4260-004	32
HPS0020-ST-0040-005-B	LED0001-ST-3300-004	LED0001-ST-3300-004	LED0009-ST-4260-004	LED0009-ST-4260-004	2
HPS0020-ST-0350-003-B	LED0001-ST-3340-004	LED0001-ST-3340-004	LED0009-ST-4300-004	LED0009-ST-4300-004	2
HPS0020-ST-0350-004-B	LED0001-ST-3340-004	LED0001-ST-3340-004	LED0009-ST-4300-004	LED0009-ST-4300-004	10
HPS0020-ST-0360-001-B	LED0001-ST-3380-004	LED0001-ST-3380-004	LED0009-ST-4340-004	LED0009-ST-4340-004	22
HPS0020-ST-0360-002-B	LED0001-ST-3380-004	LED0001-ST-3380-004	LED0009-ST-4340-004	LED0009-ST-4340-004	90
HPS0020-ST-0360-003-B	LED0001-ST-3380-004	LED0001-ST-3380-004	LED0009-ST-4340-004	LED0009-ST-4340-004	14
HPS0020-ST-0360-004-B	LED0001-ST-3380-004	LED0001-ST-3380-004	LED0009-ST-4340-004	LED0009-ST-4340-004	76
HPS0020-ST-0360-005-B	LED0001-ST-3380-004	LED0001-ST-3380-004	LED0009-ST-4340-004	LED0009-ST-4340-004	3

TABLE 30: SCOPE OF LAMPS PROPOSED TO BE UPGRADED TO LED

The proposed upgrade can be summarised as including 3,144 compact fluorescent lamps and 260 high pressure sodium lamps.

9.1.3 Options for LED

The proposal sets out four options available to TSC, based on suppliers of eligible lamps. The four options are advised to be:

- Option 1: All Gerard luminaires, 17W and 36W LEDs replacing those currently in use
- Option 2: GE and Gerard luminaires, 25W and 36W LEDs replacing those currently in use
- Option 3: GE and Pecan luminaires, 25W and a 42W LEDs replacing those currently in use
- Option 4: Gerard and Pecan luminaires, 17W and 42W LEDs replacing those currently in use

Luminaire Type	Current Lamp Size	Tariff Code	Luminaire Option 1 - All Gerard		Luminaire Option 2 - GE/Gerard		Luminaire Option 3- GE/Pecan		Luminaire Option 4- Gerard/Pecan	
			Tariff Code	Luminaire	Tariff Code	Luminaire	Tariff Code	Luminaire	Tariff Code	Luminaire
Compact Fluorescent	32w	FLU0355	LED0003	StreetLed 17W	LED0006	GE Evolve 25W	LED0006	GE Evolve 25W	LED0003	StreetLed 17W
	42w	FLU0350	LED0003	StreetLed 17W	LED0006	GE Evolve 25W	LED0006	GE Evolve 25W	LED0003	StreetLed 17W
High Pressure Sodium	70w	HPS0020	LED0001	Streetled 36W	LED0001	Streetled 36W	LED0009	Pecan 35W	LED0009	Pecan 35W
	150w	HPS0090	No Replacement		No Replacement		No Replacement		No Replacement	
	250w	HPS110	No Replacement		No Replacement		No Replacement		No Replacement	
	400w	HPS0170	No Replacement		No Replacement		No Replacement		No Replacement	
Mercury Vapour	50w	MVA0010	LED0003	StreetLed 17W	LED0006	GE Evolve 25W	LED0006	GE Evolve 25W	LED0003	StreetLed 17W
	80w	MVA0020	LED0003	StreetLed 17W	LED0006	GE Evolve 25W	LED0006	GE Evolve 25W	LED0003	StreetLed 17W
	125w	MVA0080	LED0001	StreetLed 36W	LED0001	StreetLed 36W	LED0009	Pecan 35W	LED0009	Pecan 35W
	250w	MVA0190	No Replacement		No Replacement		No Replacement		No Replacement	
	400w	MVA0220	No Replacement		No Replacement		No Replacement		No Replacement	
Metal Halide (Reactor Ctrl)	150w	MHR0030	No Replacement		No Replacement		No Replacement		No Replacement	
	250w	MHR0060	No Replacement		No Replacement		No Replacement		No Replacement	

TABLE 31: APPROVED LEDS FOR CATEGORY P ROADS

9.1.4 Energy use in base and LED cases

Energy use for all cases was estimated by applying the wattages indicated above to all lamp / LED luminaires for 4300 hours per year. This results in the following estimate of energy use:

Existing kWh pa	kWh pa Option 1	kWh pa Option 2	kWh pa Option 3	kWh pa Option 4
721,843 kWh	270,074 kWh	378,228 kWh	384,936 kWh	276,782 kWh

Table 32: Current and estimated energy consumption for Category P lighting

It can be seen that the expected electricity savings in all cases are substantial, with savings of up to 66% for Option 1 (all Gerard LEDs).

9.1.5 SLUOS in base and LED cases

SLUOS costs are determined by referencing the existing and proposed luminaire codes in the Essential Energy Public Lighting Pricelist, located on the SLUOS Tariffs tab in the workbook supplied with the LED proposal.

The existing and proposed SLUOS costs are shown below. It is noted that these differ from the values in the ‘Summary’ tab, and this requires checking with Essential Energy (noting that the approach to lookup the SLUOS Tariffs table is correct per discussions with Essential Energy). It is also noted that the pricelist is valid from1 July 2016 and so will cease to be valid after 30 June 2017. As part of discussions with Essential Energy it was indicated that rises are likely to be in line with CPI or similar and would not have a material impact on the business case for LEDs. As such the 1 July 2016 pricelist is suitable for this analysis.

Existing SLUOS pa	SLUOS pa Option 1	SLUOS pa Option 2	SLUOS pa Option 3	SLUOS pa Option 4
$265,059	$111,678	$122,552	$125,543	$114,669

Table 33: Current and estimated SLUOS charges for Category P lighting

9.1.6 ESCs in each LED case

As the ‘first energy saver’ TSC is the eligible applicant for Energy Saving Certificates under the NSW Energy Savings Scheme. Discussions with Accredited Certificate Providers (aggregators who help end users access ESC benefits) indicate that for LED street lights the available ESCs will be based on:

- All MWh saved via reference to the unmetered public lighting load tables,
- 12 years claim of ESCs,
- 1.06 tCO2-e per MWh of electricity saved

Application of this to the expected savings gives the following estimate of ESCs for all four options.

ESCs Option 1	ESCs Option 2	ESCs Option 3	ESCs Option 4
5,746 ESCs	4,371 ESCs	4,285 ESCs	5,661 ESCs

Table 34: ESCs created for each of the 4 Category P options

9.1.7 Other incentives

At this stage the NSW Climate Change Fund process is still ongoing, and programs and grant / incentive funding priorities and processes are not finalised. It is understood that providing support to the accelerated uptake of LED in public lighting is a specific measure that may be supported.

One potential aspect that may have an impact is whether councils will be eligible to access both grants / incentives from the CCF as well as ESCs for LED street lighting upgrades.

9.1.8 Future capital cost input requirements

It is understood that the proposed capital cost for the four options presented is the only capital cost TSC would incur for the foreseeable future. Any future request for capital input from council would relate to new LED technology – e.g. higher efficiency LEDs driving further step change in energy demand and requiring the installation of new luminaires.

While bulk upgrades are normally scheduled for 4-year intervals the proposed LEDs would have an 8-year cycle. The rated life of the three technologies ranges from 10 years (GE) to 15 years (Gerard) and out to 20 years (Pecan).

9.1.9 Residual value

Of the capital cost to council ($1m to $1.2m), a sizeable portion is made up of the residual value in some of the existing street lighting assets. The total residual value across all 3,404 lamps to be upgraded is $142,776 (out of $881,945 total residual value across all street lighting). However of this figure:

- The value of $142,776 is for residual value in just 297 assets,
- $57,708 of this residual value is for just 18 assets

The residual value in these assets may have fallen as the original offer was prepared in January 2017.

Council may omit some or all luminaires from an LED upgrade, meaning that costs to pay off the residual value of assets can be avoided if this is desired.

9.2 Business case analysis

The case for upgrading to one of the four LED options now was evaluated using the information outlined above and taking the net cost to TSC (including residual value) as correct.

A present value analysis approach is taken to compare the cost of the existing and LED options over time. A discount rate of 7% is used.

For initial analysis purposes and to assess cost-effectiveness it is assumed that the project is implemented now – i.e. in 2016-17 with benefits realised from 2017-18 onwards (note that Council could implement the LED upgrade 'out-of-cycle' but any discount for bulk upgrade would be added to the price).

Energy consumption, energy rates, SLUOS costs and ESC quantities are input to the model as described above, including noted escalation rates. ESCs are assumed to have a net value to TSC of $11 each (i.e. assumed spot price of $15/ESC less a $4/ESC ACP fee).

The resultant analysis yields the following outcomes.

Scenario	NPV (2030) ($)	Capital cost ($)	Net cost to TSC after ESCs	Simple payback	Annual cost saving (year 1)
Existing	-$3,685,744	$0	$0	NA	NA
Option 1	-$2,634,383	$1,199,643	$1,136,432	4.67 Years	$244,585
Option 2	-$2,730,649	$1,002,813	$954,734	4.50 Years	$211,876
Option 3	-$2,795,542	$1,027,495	$980,355	4.71 Years	$207,531
Option 4	-$2,699,276	$1,224,326	$1,162,053	4.85 Years	$240,239

TABLE 35: ESTIMATED FINANCIAL PERFORMANCE OF CATEGORY P LEDS V EXISTING LAMPS

- The Option 1 solution (all Gerard LEDs) has the best financial outcome on a NPV basis as well as having the greatest annual cost and energy savings, with all four options being financially superior to the existing situation.
- TSC is $1 million better off by 2030 under Option 1, and is at least $0.89 million better off even with the poorest-performing LED option (on a financial basis).
- The value of ESCs ranges from $47,000 to $63,000 net benefit to TSC, which equates to up to 5% of the project cost.
- A simple payback is achieved within 5 years for all options, well within the replacement cycle. The payback for Option 2 is slightly better than Option 1.

The financial analysis shows that council is materially better off under an LED network for its local roads based on the assessment parameters used here.

The NPV analysis for each of the five scenarios is shown below.

9.3 No upgrade

Scenario			2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30
Existing system	Capital Cost	$				$				$				$	
	Energy Consumption		721,843 kWh	721,843 kWh	721,843 kWh	721,843 kWh	721,843 kWh	721,843 kWh	721,843 kWh	721,843 kWh	721,843 kWh	721,843 kWh	721,843 kWh	721,843 kWh	721,843 kWh
	ESCs	$ -													
	Energy Cost		$ 145,726	$ 131,562	$ 125,004	$ 128,129	$ 131,332	$ 134,615	$ 137,981	$ 141,430	$ 144,966	$ 148,590	$ 152,305	$ 156,113	$ 160,013
	SLUOS		$ 265,059	$ 271,685	$ 278,477	$ 285,439	$ 292,575	$ 299,890	$ 307,387	$ 315,072	$ 322,948	$ 331,022	$ 339,298	$ 347,780	$ 356,475
	ESC Value	$ -													
	Net Cashflow	$ -	-$ 410,785	-$ 403,247	-$ 403,481	-$ 413,568	-$ 423,907	-$ 434,505	-$ 445,368	-$ 456,502	-$ 467,914	-$ 479,612	-$ 491,603	-$ 503,893	-$ 516,490
	NPV	-$ 5,665,744													

9.4 Option 1 – Gerard

Scenario			2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30
Option 1 - All Gerard	Capital Cost	$ [illegible]								[illegible]					
	Energy Consumption		270,074 kWh	270,074 kWh	270,074 kWh	270,074 kWh	270,074 kWh	270,074 kWh	270,074 kWh	270,074 kWh	270,074 kWh	270,074 kWh	270,074 kWh	270,074 kWh	270,074 kWh
	ESCs	5,746													
	Energy Cost		$ 54,323	$ 49,223	$ 46,770	$ 47,939	$ 49,137	$ 50,368	$ 51,625	$ 52,916	$ 54,238	$ 55,594	$ 56,984	$ 58,409	$ 59,869
	SLUOS		$ 111,678	$ 114,469	$ 117,331	$ 120,264	$ 123,271	$ 126,353	$ 129,512	$ 132,749	$ 136,068	$ 139,470	$ 142,957	$ 146,531	$ 150,194
	ESC Value	$ 63,211													
	Net Cashflow	-$ 1,136,432	-$ 166,200	-$ 163,693	-$ 164,101	-$ 168,203	-$ 172,408	-$ 176,719	-$ 181,137	-$ 185,665	-$ 190,307	-$ 195,064	-$ 199,941	-$ 204,939	-$ 210,063
	NPV	-$ 2,434,383													

9.5 Option 2 – GE / Gerard

Scenario			2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30
Option 2 - GE / Gerard	Capital Cost	$ [illegible]								[illegible]					
	Energy Consumption		378,228 kWh	378,228 kWh	378,228 kWh	378,228 kWh	378,228 kWh	378,228 kWh	378,228 kWh	378,228 kWh	378,228 kWh	378,228 kWh	378,228 kWh	378,228 kWh	378,228 kWh
	ESCs	4,371													
	Energy Cost		$ 76,357	$ 68,935	$ 65,499	$ 67,136	$ 68,815	$ 70,535	$ 72,299	$ 74,106	$ 75,959	$ 77,858	$ 79,804	$ 81,799	$ 83,844
	SLUOS		$ 122,552	$ 125,616	$ 128,756	$ 131,975	$ 135,275	$ 138,656	$ 142,123	$ 145,676	$ 149,318	$ 153,051	$ 156,877	$ 160,799	$ 164,819
	ESC Value	$ 48,079													
	Net Cashflow	-$ 954,734	-$ 198,909	-$ 194,551	-$ 194,255	-$ 199,112	-$ 204,089	-$ 209,192	-$ 214,421	-$ 219,782	-$ 225,277	-$ 230,908	-$ 236,681	-$ 242,598	-$ 248,663
	NPV	$ 2,710,649													

9.6 Option 3 – GE / Pecan

Scenario			2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30
Option 3 - GE / Pecan	Capital Cost	$ [illegible]								$					
	Energy Consumption		384,936 kWh	384,936 kWh	384,936 kWh	384,936 kWh	384,936 kWh	384,936 kWh	384,936 kWh	384,936 kWh	384,936 kWh	384,936 kWh	384,936 kWh	384,936 kWh	384,936 kWh
	ESCs	4,285													
	Energy Cost		$ 77,711	$ 70,158	$ 66,661	$ 68,327	$ 70,035	$ 71,786	$ 73,581	$ 75,420	$ 77,306	$ 79,238	$ 81,219	$ 83,250	$ 85,331
	SLUOS		$ 125,543	$ 128,682	$ 131,899	$ 135,196	$ 138,576	$ 142,041	$ 145,592	$ 149,231	$ 152,962	$ 156,786	$ 160,706	$ 164,724	$ 168,842
	ESC Value	$ 47,140													
	Net Cashflow	-$ 980,355	-$ 203,254	-$ 198,840	-$ 198,559	-$ 203,523	-$ 208,611	-$ 213,827	-$ 219,172	-$ 224,652	-$ 230,268	-$ 236,025	-$ 241,925	-$ 247,973	-$ 254,173
	NPV	-$ 2,795,942													

9.7 Option 4 – Gerard / Pecan

Scenario			2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30
Option 4 - Gerard / Pecan	Capital Cost	$ [illegible]								$					
	Energy Consumption		276,782 kWh	276,782 kWh	276,782 kWh	276,782 kWh	276,782 kWh	276,782 kWh	276,782 kWh	276,782 kWh	276,782 kWh	276,782 kWh	276,782 kWh	276,782 kWh	276,782 kWh
	ESCs	5,661													
	Energy Cost		$ 55,677	$ 50,446	$ 47,931	$ 49,130	$ 50,358	$ 51,617	$ 52,907	$ 54,230	$ 55,586	$ 56,975	$ 58,400	$ 59,860	$ 61,356
	SLUOS		$ 114,669	$ 117,535	$ 120,474	$ 123,486	$ 126,573	$ 129,737	$ 132,980	$ 136,305	$ 139,713	$ 143,205	$ 146,785	$ 150,455	$ 154,217
	ESC Value	$ 62,273													
	Net Cashflow	-$ 1,162,053	-$ 170,546	-$ 167,981	-$ 168,405	-$ 172,615	-$ 176,930	-$ 181,354	-$ 185,888	-$ 190,535	-$ 195,298	-$ 200,181	-$ 205,185	-$ 210,315	-$ 215,573
	NPV	-$ [illegible]													

9.8 Re-assessment with significant residual value assets omitted

As noted above there is a significant amount of the total residual value tied up in just a small number of assets. The financial return for the LED upgrade would be improved if these were omitted from the upgrade, which is permitted.

A re-assessment of Option 1 is carried out with 18 assets omitted and their associated residual value of $57,708. In this case energy savings and ESCs are dropped by 0.5% to reflect the fraction of lamps taken out.

Scenario	NPV (2030) ($)	Capital cost ($)	Net cost to TSC after ESCs
Existing	-$3,685,744	$0	$0
Option 1	-$2,634,383	$1,199,643	$1,136,432
Option 1 modified	-$2,569,501	$1,141,935	$1,079,040

TABLE 36: CHANGE IN FINANCIAL OUTCOMES FOR CATEGORY P LEDS WITH LARGE RESIDUAL VALUE ITEMS OMITTED

This shows the overall outcome being an improved NPV and lower capital cost.

9.9 Future Category V LED upgrade

A preliminary estimate of the likely business case for upgrading Category V (main road) lighting to LED is also made. Drawing on TSC data and this LED assessment a number of parameters for this future upgrade are developed as shown below. It is noted that estimated energy and SLUOS savings (as a %) are discounted by 25% to the Category P proposal, reflecting a conservative view of the benefits.

Measure	Quantity	Source
TSC Street Lighting Electricity Consumption	2,941,441 kWh	zEUS
Existing Consumption by LED-eligible lamps (Category P)	721,843 kWh	Essential Energy
Existing Consumption by Category V lamps	2,219,598 kWh	Calculated
SLUOS for Category V lamps (2016-17)	$309,123	Essential
Number of Category V lamps (2016-17)	2,795	Essential
% Energy Saving Category V lamps	47%	% saving for Cat P discounted by 25%
% SLUOS Saving Category V lamps	43%	% saving for Cat P discounted by 25%
Price of Category P lamps per lamp (Option 1)	$352.42	Calculated
Expected added cost of LED lamps for Category V (net of discounts – e.g. for bulk lamp upgrade, tariff 2)	200%	Assumed – close to trial values, bulk quantities likely to be cheaper
Expected capital cost per Category V LED	$704.84	Calculated
Expected energy savings for Category V LEDs	1,041,859 kWh	Calculated

TABLE 37: ESTIMATED PARAMETERS FOR FUTURE CATEGORY V LEDS

With these parameters applied an initial estimate of the potential benefits of future Category V LED upgrade can be developed as tabulated below.

Scenario	NPV (2030) ($)	Capital cost ($)	Net cost to TSC after ESCs	Simple payback	Annual cost saving (year 1)
Existing Cat V	-$6,521,948	$0	$0	NA	NA
Cat V estimate	-$5,388,907	$1,970,037	$1,824,260	5.47 Years	$344,492

TABLE 38: COMPARISON OF ESTIMATED CATEGORY V LEDS V EXISTING LAMPS

TSC may be around $1.15 million better off with future Category V LED upgrades, on top of benefits from Category P LEDs.

9.10 Approach for Tweed Shire Council REAP

The analysis of the business case for LED street lighting shows that this is a cost effective option, and Council should implement this at the next available opportunity. A bulk upgrade was scheduled for 2016-17, so the next opportunity (in-cycle) will be in 2020-21. The REAP assumes that a full upgrade to LED lighting will occur at this time, and that the inputs to the business case are the same as used in this analysis, with Option 1 (all Gerard LEDs) being the preferred option. A thorough analysis of the business case will need to be conducted at the appropriate time to verify that this remains strong, and at this time Council should consider the impacts of a range of factors, including:

- Up-to-date SLUOS charges for different lamp types, and up-to-date energy rates,
- Changes in available LED technologies for Category P & V roads and the change in energy demand compared with the existing technologies in use,
- Omission of assets with high residual value,
- Incentives available as ESCs and/or through the NSW Climate Change Fund if applicable

The outputs for the business case assessed here are summarised below:

LED Upgrade (all Category P and V)	Amount
Timing	2020-21
Capital cost (payable to Essential Energy) – net of any discounts	$3,169,681
Energy Savings Certificate (ESC) discount	$208,988
Net cost to TSC	$2,960,692
Annual energy saving	1,493,627 kWh
Annual energy cost saving (in 2020-21)	$271,751
Annual SLUOS saving (in 2020-21)	$317,392
Simple payback	4.79 years
Net present value benefit compared with doing nothing, to 2030 at 7% discount rate	$1,237,946
Net present value benefit compared with doing nothing, to 2040 at 7% discount rate	$4,344,148

TABLE 39: SUMMARY OF EXPECTED LED BUSINESS CASE FOR LED STREET LIGHING IN TSC IN 2020-21

10 Appendix D: 'Offsite' renewable energy generation

Council may want to consider the option to self-generate some or all of its electricity needs on land (or water) that it owns. The assessment of the capacity for Council to reduce its grid electricity needs as well as growth scenarios, suggest that Council could require 15-26,000 MWh from renewable energy in 2030. This could require the following renewable generation capacity.

Type of generation	MWh requirement	Estimated RE generation capacity	Comment
Micro-hydro	15,000 MWh	4.28 MW	40% capacity factor assumed
	26,000 MWh	7.42 MW	
Wind	15,000 MWh	4.89 MW	35% capacity factor assumed
	26,000 MWh	8.48 MW	
Biomass	15,000 MWh	2.28 MW	75% capacity factor assumed
	26,000 MWh	3.96 MW	
Solar energy	15,000 MWh	18.57 MW	1,400 kWh/kWp assumed. Storage (CSP or battery/PV will see delivered kW flatten
	26,000 MWh	10.71 MW	

TABLE 40: ESTIMARED RENEWABLE ENERGY CAPACITY TO MEET TWEED SHIRE COUNCIL ENERGY DEMAND

10.1.1 Micro-hydro

Council has twice examined the feasibility of installing micro-hydro at the Clarrie Hall Dam, initially in 2004 and again in 2012. It is understood that the dam wall may be lifted in coming years, and this may affect the location and output from a micro-hydro plant.

Based on the 2012 study 2 x 100 kW micro-hydro turbines were proposed. Potential implementation costs were estimated to be around $1 million. Benefits of the project were estimated to be:

- 695 MWh of electricity generation
- Estimated value of this generation output of $36,000 at $51.80/MWh – Council could hold preliminary discussions with retailers to get an updated sense of the potential value of this output today; for example at $90/MWh this would be worth $62,550 per year,
- Large-scale Generation Certificates value of $25,000 at $36/LGC. If the market price was at $85/LGC say, this would raise the value to $59,075 per year

Taken together the income from the project could feasibly be more than $120,000 (noting LGCs expire in 2030, and may have a low value past 2020), which could potentially deliver a return in 8-10 years.

Planned works to the dam, the likely or known impact on the placement or feasibility of any micro-hydro project are required in the first instance. If this remains a project of interest then the prior feasibility assessment would require updating with a view to implementation if found to still be cost effective.

10.1.2 Wind energy

Council began to examine wind energy potential in 2003, focused on the top of the escarpment on Mt Nullum, on Council owned land. Environmental impact and poor access to the location were deemed to outweigh the site's high exposure to good wind patterns. For these reasons the potential project did not proceed past the preliminary stage.

10.1.3 Bioenergy

Council will develop a new facility to treat organic / green waste for future years. Council is expecting approximately 19,000 tonnes of Food Organic and Garden Organic (FOGO) material to be processed at the facility which will be a combination of domestic kerbside, self-haul garden organic material and bio-solids (from treatment plants).

The treatment of this FOGO material over the next several years will involve composting and return of material to land. Energy generation does not form part of the planned processing – i.e. through the production of bio-char with energy generation as a by-product.

10.1.4 Solar technologies (PV and/or CSP)

As an owner of both land and water bodies Council is in a position to consider the use of these assets to host renewable energy projects. There is a small but increasing number of councils in Australia implementing and developing such renewable energy projects. Prominent examples involving solar include:

- Sunshine Coast Council 15 MW solar PV farm at Valdora, in construction,
- Newcastle Council sought expressions of interest for a 5MW solar farm to be built on the Summerhill waste management centre, with the EOI released in October 2016

In order to evaluate the potential for solar energy generation at 'mid-scale' – i.e. a level that could meet most or all of Council's energy needs, a review of Council-owned land was carried out using TSC's Geographic Information System (GIS). Criteria that were used to identify potential areas included:

- Flat or near-flat land (e.g.<5% slope) or water body,
- Council-owned that currently has no other committed future use (could be WWTP land, old landfill, other owned land, dam, tertiary pond),
- Generally a north-facing aspect but N-E to N-W also to be included,
- Buffer to residents or highlighting nearby residential areas,
- Flood status (indicating flood level),
- Highlight if areas are subject to a vegetation management plan or similar constraint,
- Proximity to the electricity grid with LV/HV overlaid,
- Note of (total plus flat) land size in Ha, with a focus on land parcels or continuous land parcels with an area exceeding 10 Ha (10.71-18.57 MW of PV could occupy 25-50 Ha of land)

The results of this analysis indicate that this strategy may be challenging to develop locally. Most of the land identified that fits most of the criteria is subject to flooding, is preserved koala habitat or is in hilly areas. Just three sites were identified that could be considered further. Images for these three sites are shown below.

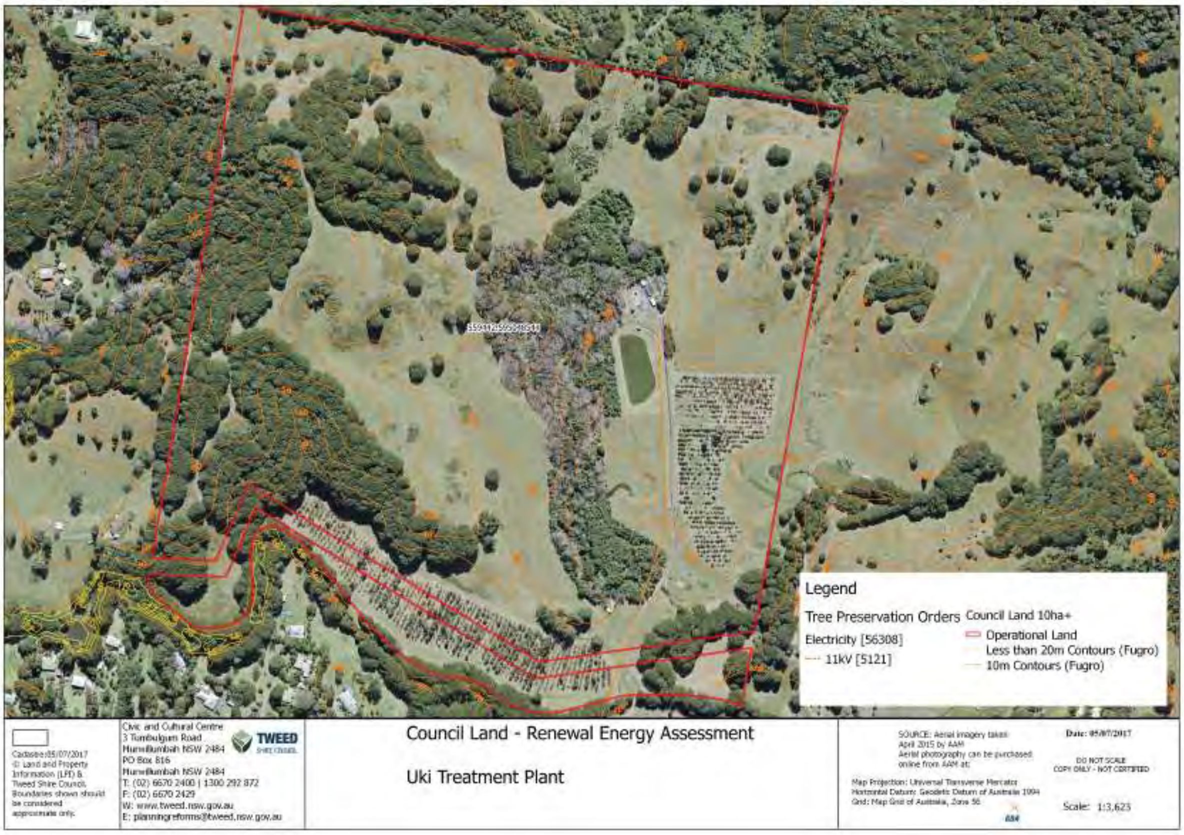


FIGURE 67: UKI WASTEWATER TREATMENT PLANT

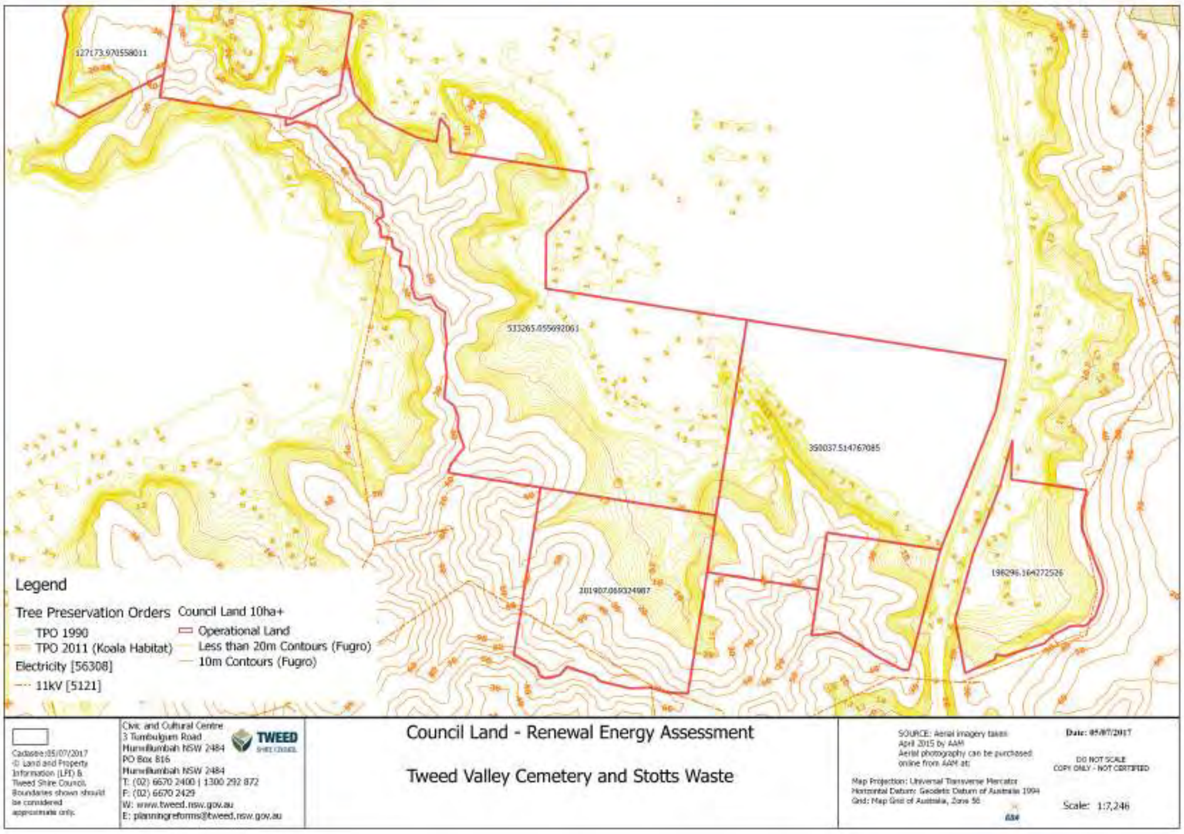


FIGURE 68: COUNCIL LAND FROM TWEED VALLEY CEMETERY AND STOTT'S CREEK WASTE FACILITY

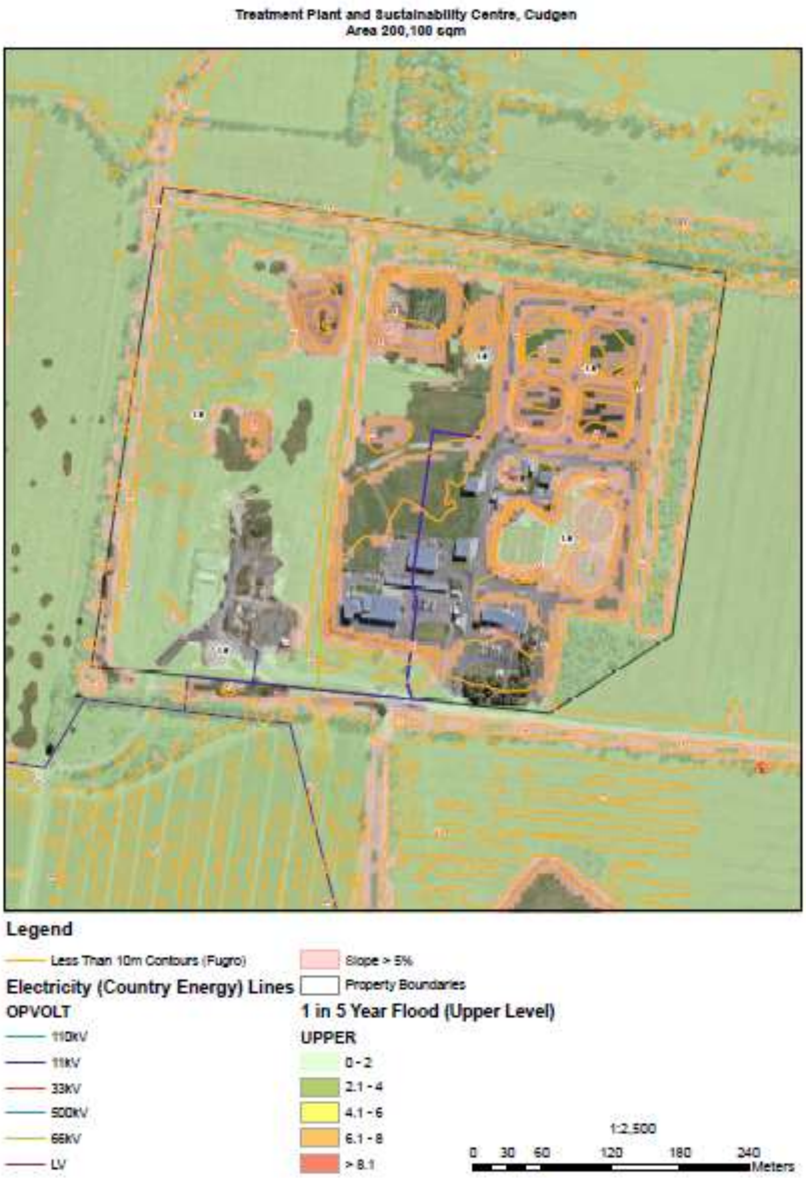


FIGURE 69: KINGSCLIFF WASTEWATER TREATMENT PLANT

Site	Area	PV capacity at 2 Ha/MWp	PV capacity at 3 Ha/MWp
Uki wastewater treatment plant	28 Ha (total is 56 Ha, say 50% is potentially useable)	14 MW	9.3 MW
Land near Tweed Valley Cemetery & Stotts Creek Waste Facility	30 Ha (est – parts of 2 contiguous parcels that make up >73 Ha)	15 MW	10 MW
Kingscliff wastewater treatment plan	4 Ha (est – part of WWTP land, some may be used for a behind-the-meter system)	2 MW	1.3 MW

TABLE 41: FIRST-PASS IDENTIFICATION OF TSC LAND THAT COULD POTENTIALLY HOST OFFSITE SOLAR GENERATION

One key issue that appears to apply to all three of these sites relates to electrical infrastructure, with just 11 kV lines appearing to be proximate to the three sites. The load on these systems will be an important factor in determining is it is feasible to connect solar generation to the grid, and these systems may be lightly and/or intermittently loaded.

On balance the investigations are inconclusive but do not appear to indicate clearly ‘good’ sites for solar energy generation. Further investigation to confirm the load on these lines and potentially to identify smaller parcels of land that could be suitable may be warranted, and any engagement with other local councils should include the possibility of working together to develop Council-owned generation. For the purpose of this plan no contribution to Council’s renewable energy goal is taken to be supplied via this approach.

11 Appendix E: The case for purchasing renewable energy

Recent trends in energy markets have seen prices rise steeply for many consumers. Both steep rises and uncertainty in the policy arena, allied to increasing action by business to address climate risks, is seeing the emergence of alternate purchasing strategies for energy, including renewables.

Tweed Shire Council has the capacity to significantly reduce its carbon footprint through solar PV and in future through additional solar with battery storage. However this, plus energy efficiency will only go part way to meeting Council's goal of self-sufficiency in renewable energy.

Council could seek to achieve some of its additional renewable energy needs through renewable energy purchasing. For this reason expert advice was sought that can assist Council to progress this opportunity[32].

In the first instance a suggested approach is that Council engage with others in the local government sector to get an understanding of the current status in terms of knowledge of energy market opportunities and potential interest in developing a sector or regional-level approach. Council should also investigate the potential to source renewable energy from pre-existing renewable energy projects as this could enable the purchase of renewables to be brought forward.

The next three years will see Council maintain its current procurement approach, given an agreement to supply electricity was recently signed. Given the complexities in both aligning contract dates for multiple parties and lead time to generation, it may be practical to assume that a preferred renewable energy purchasing approach and agreement is in place from 2023-24[33], with Council assumed to purchase 5,000 MWh pa of its electricity requirements from renewables at this time (this figure falls in the 20-30% range of Council's electricity needs, depending on its success in reducing energy demand through efficiency, solar and other approaches). This level is consistent with percentage of renewables being sought by many organisations who have joined buyers groups for the purpose of sourcing some of their energy from renewables. Ongoing evolution of the renewable energy purchasing market may see the potential for much higher percent of an organisation's energy to come from renewable sources, and these are developments that Council should maintain a close watch on going forward. For illustration purposes it is assumed that Council will be able to source say 15,000 MWh from renewables from 2026-27.

The business case for purchasing of renewables is that it is available at the same or lower cost to 'black' power, with trends in renewable energy power purchase agreements suggesting this may be feasible. Case examples cite solar PV costs at mid-scale for as low as $1/Watt[34], while in April 2017 Monash University issued a tender to supply 55 GWh per year to meet part of its energy demand (to come from a 40 MW wind farm). Similarly Telstra recently signed a contract to build a 70 MW solar farm in North Queensland to help cap / manage its energy costs; this system will supply up to 10% of Telstra's electricity demand.

The overview of market trends and PPAs in renewables below is intended to provide Council with more information at this time, so that it can engage with this opportunity in coming months.

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[32] Advice was provided to 100% Renewables by Sourced Energy. The content in this section is derived from this advice.

[33] Note that if Council were to try to source renewable energy from a pre-existing RE generator this lead time would not apply and council could act to source a % of their electricity from renewables earlier

[34] http://reneweconomy.com.au/solars-new-sweet-spot-low-cost-compact-pv-plants-1watt-65190/

11.1 Current Electricity Pricing

By way of context it is useful to look at current trends in electricity markets.

Historical and current wholesale ‘spot’ price trends are a useful way to see where electricity prices have come from, while the futures market provides insight into the current thinking around what pricing will be in future years or quarters. In 2017 spot market prices are at an all-time high, up from lows in just 2014. Futures market trends were at $120/MWh in April 2017 but have reduced since then. Out to 2020 pricing is still at around $75/MWh. The two graphs below illustrate these trends.

FIGURE 70: SPOT AND FUTURES ELECTRICITY MARKET TRENDS

In NSW, projections of demand v available generation over the next two years are showing limited spare capacity in the summer of 2018-19, and advice is that while there is no actual capacity shortfall it would be risky to approach the market for pricing during these periods. Potential capacity shortfalls could be seen in SA and/or Vic during this time, which could afftect prices NEM-wide.

FIGURE 71: NSW FORECAST MARKET DEMAND VS GENERATION

The main factors that are affecting electricity prices this year include:

- Decreased generator bidding and reliability
- High gas prices
- Intermittency of renewables
- Retirement of coal generation and specifically Hazelwood
- LGC pricing

11.2 Off-site Power Purchase Agreement (aka Corporate PPA) key issues

11.2.1 What is it and why do it?

1. A contract that facilitates the purchase of (renewable) energy between a generator or installer (seller) and an off-taker (buyer).
2. Typically a rate for purchase of electricity per kilowatt hour will be agreed covering the complete term of the agreement.
3. Can help off-takers hedge against volatile electricity prices, secure energy supply and can assist in achieving sustainability goals.

11.2.2 Concept

An organisation agrees to purchase power (typically over a long term) at a rate per kilowatt hour from a renewable energy generator but still pays network costs to deliver the electricity.

There is the potential for the buyer to invest in part in the renewable energy development, which may be a requirement to begin construction of the generation asset. In this situation, there may be a discounted rate for the subsequent PPA.

Contractual arrangements can either be direct between generator and the consumer, or a tri-partite agreement where the retailer acts as the intermediary, being the counterparty with developer for the PPA, and then the counterparty with the consumer for the PPA, bundled or unbundled with the retail electricity contract.

The current off-site renewable energy projects in Australia are significant, mainly in excess of 40MW, and Council would require only a fraction of this generation to satisfy its own needs. This has given rise to some speculative models of engagement, all recognising that a developer will likely engage with multiple buyers.

It is feasible that any of the combinations below may negotiate take up of a project’s renewable energy output, on differing terms for differing volumes:

- one or many consumers,
- with or without a negotiating agent or buyers group (on their behalf) or Aggregator (independent solution provider),
- working with one or many retailers

11.2.3 Financial implications and risks

Off-site PPAs are becoming cheaper relative to the current electricity and LGC markets. In the short term to 2020, many projects will likely be offering bundled electricity and LGC deals which are at a discount to retail electricity pricing. This results from increased competition for financing and banks requiring low credit risk counterparties in their approval process.

There are many permutations of counterparties’ involvement and contract constructs in an off-site PPA, and negotiations of preferable terms, price and timeframe will need to consider the bargaining positions of each of the stakeholders.

There needs to be equal focus on contract extension or retail transfer opportunities throughout the life of the PPA, with the expectation that a customer such as Tweed Shire Council will want the option to engage with different retailers over say a 10 year period, in line with the life of a PPA.

A risk may occur where a retailer grid power deal is struck for a short period. The retailer may impose an additional fee when next negotiating the grid power contract or potentially not want to work with an off-site project that was not their own. This could indeed be the case post 2020 if the supply of renewable projects exceeds demand.

Where a buying group (e.g. a group of local councils) enters into an off-site PPA there is a risk that the make-up of the group may change over time, impacting the energy load and profile that underpins the PPA agreement.

11.2.4 Issues in market delivery and timing

It is expected that there will be a reasonable supply of off-site renewable energy projects coming to market as a result of the shortfall in the RET and LGC pricing providing good investment incentive in the next few years at least. As noted above, many projects still need their generation secured with a reputable off-take party in order to secure project investment. On this basis some analysts suggest it is currently a 'buyers' market' for off-takers.

Off-site large scale renewable projects will often take around 2 years to begin generating. If say a group of local councils wish to incorporate new build renewable energy generation project into their next purchasing period then negotiations for this should begin well in advance of expiry of the current contract.

11.3 Off-site PPA Models

There are two main types of contract structure available with respect to renewable energy projects and aggregated groups of off-takers.

One is a 'buying group' where the off-takers all take up an intermediated deal through a retailer who has a single energy agreement with a project developer. In some cases, this becomes a tri-partite deal where the project developer, the retailer and the end user are all counterparties. As per the diagram below this is a "Buy side aggregation" model.

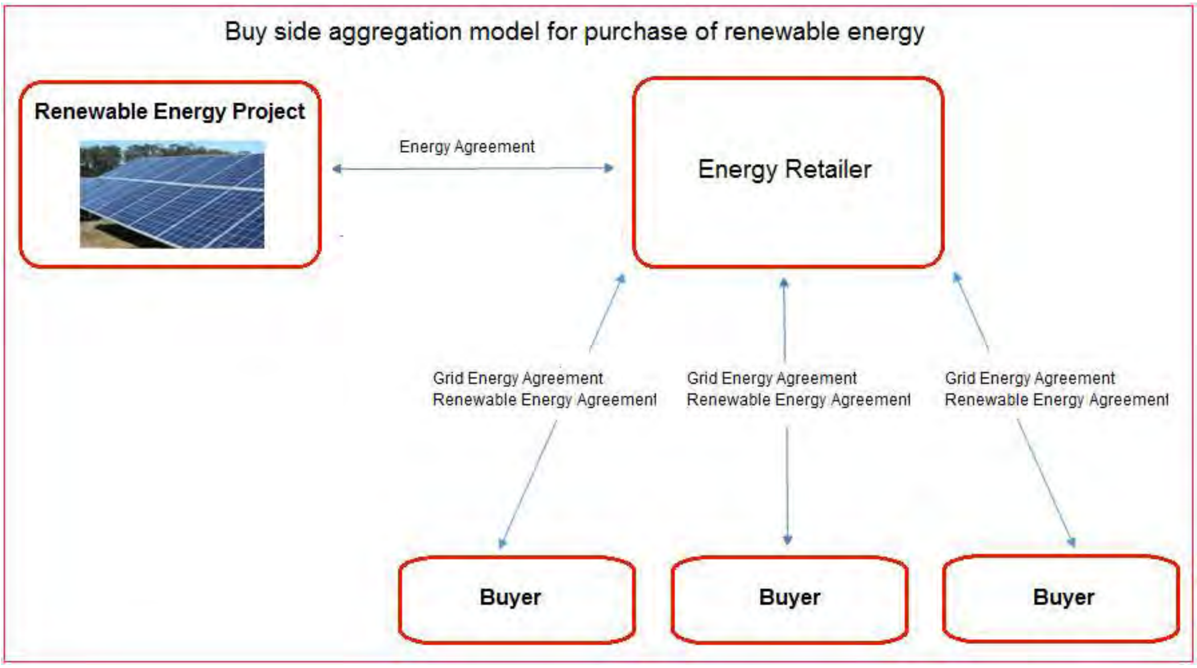

FIGURE 72: PPA 'BUY-SIDE' AGGREGATION MODEL

The other 'sell-side' aggregation model is an aggregation where each member of the aggregated group signs their own direct agreement with the project developer. This then requires a second separate energy agreement with a retailer of their choice where they agree to pass through the renewably generated quantity of power at an agreed price.

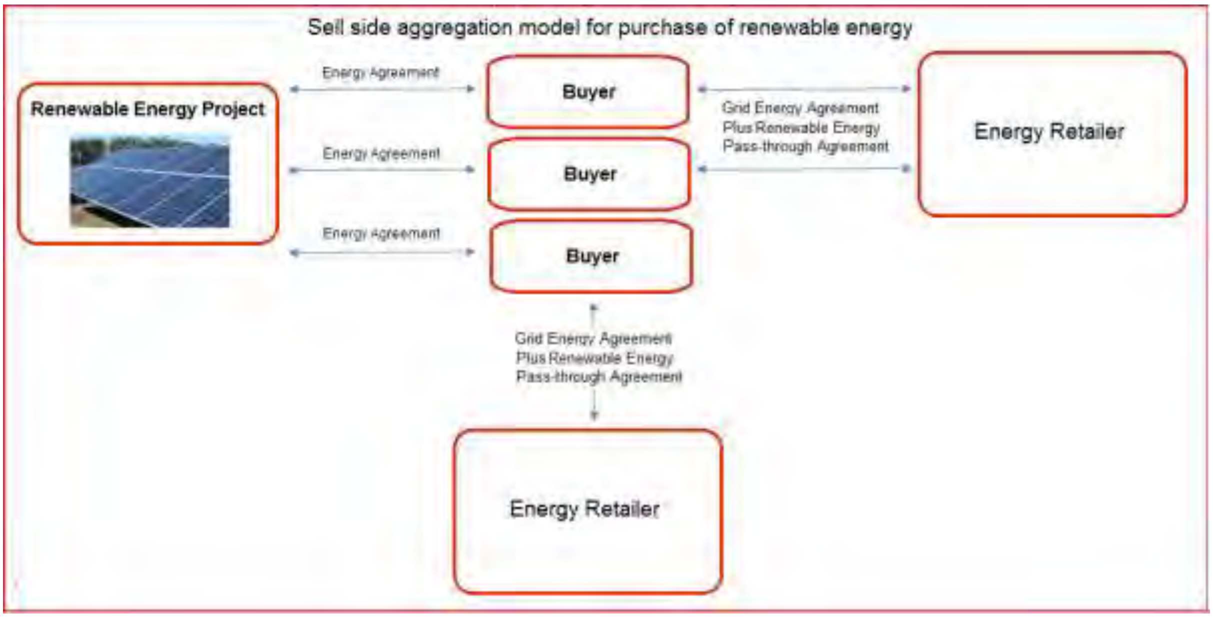

FIGURE 73: PPA 'SELL-SIDE' AGGREGATION MODEL

11.4 Will a PPA help? - Business Case for PPAs

It is possible to negotiate an on-site PPA or a bundled electricity plus LGC deal at rates that are lower than grid power rates today. This is a function of grid power rates being very high and the cost of renewables and financing decreasing.

	Current retail FY19	**Bundled Off-Site PPA Electricity +LGCs**
Electricity price*	11c/kWh- 15c/kWh	8c/kWh – 9c/kWh
Delivered cost	16c/kWh- 20c/kWh	13c/kWh- 14c/kWh
LGC Cost	1.2c/kWh	0c/kWh
Total	**17.2c/kWh-21.2c/kWh**	**13c/kWh- 14c/kWh**

TABLE 42: POTENTIAL BUSINESS CASE FOR CORPORATE PPA TODAY[35]

[35] The pricing presented in the table is subject to change over time but is correct at mid-2017. The prices are flat prices not peak and off-peak. FY 19 prices were used for comparison as it will take around 2 years before a new build PPA would be generating. Later year retail electricity prices are showing even further reductions in most recent market pricing.

11.5 What makes a good PPA?

A good PPA:

- Contemplates and mitigates risks -See risks and mitigants table below
- Doesn't impact your grid power contract: this may require only taking up to maximum of 20-30% of your load as a PPA. More than this could make the retailer less likely to take it on if it is through a project developer. If the PPA is with the retailer then it should be possible to go for a larger percentage (but it also may be at a greater cost per kWh).
- Allows flexibility in changing retailer: it should be designed to be easy to take over for a new retailer if the grid contract expires before the PPA. It should not add too much to the risk of a retailer if cost is fixed or uses the spot market and a contract for difference with the project developer (ie the cost is simply a pass through and no price risk is taken by the retailer). They would be taking on the risk of intermittency but for this they would be charging at their agreed grid power rate.
- Delivers the price you need over the term you need: As it is a buyers market you can negotiate for the pricing and term you need. The shorter the term the higher the price. A shorter term PPA in today's market would be 7 years and a longer term would be 15 years. Most are now being set at 10 years or less.
- Minimises management burden The PPA should in essence be a simple invoice payment each month with respect to energy times rate. Reconciliation of generation into the market should hopefully be handled by your retailer and confirmed by the generator.

Risk Type	Issue	Mitigant
Delivery /performance risks	Connection / Start date not achieved Output not achieved Excess Generation Break in generation	Performance minimums and contingencies Right-sizing of PPA generation Qty Spread risk over multiple PPA sites
Market risk	Electricity price moves against you LGC price moves against you	Derivative hedging component built in Fixed price contract vs other method CFDs, Caps and collars, discount to market
Duration risk	Material difference in consumption Break in generation effectively shortens contract	Right-size quantity, Take less than complete load Ensure PPA covers actual operation and extends if break occurs
Counterparty	Retailer or Project developer default	Thorough credit risk assessment and viability check
Grid Contract Risk	Lowering black load increases black prices Recontracting difficult if retailers have their own project PPAs	Ensure risk and burden for retailer is minimised Consider longer term contracting or reset pricing option

TABLE 43: SUMMARY OF PPA RISKS AND MITIGANTS

11.6 What are other businesses doing?

For a business such as Tweed Shire Council, the electricity load will be too small to contemplate an own PPA especially if the intent is to only cover a portion of the load – e.g. 5,000 MWh pa. This means that Council will likely have to become part of a buying group (eg City of Melbourne, WWF, other local governments) in order to achieve good pricing. Most projects are 15MW or above which equates to load of 25GWh or more, which exceeds Council's current energy consumption.

11.6.1 WWF Renewable Energy Buyers Forum

WWF Renewable Energy Buyers Forum aims to enable organisations to more easily purchase renewable energy as part of their regular electricity procurement and transition towards a zero-carbon future.

The Forum brings together large energy consuming organisations to aggregate electricity load for supply by renewable projects. Potential participants have indicated they would be open to committing between 10% and 40% of their electricity or 100% of nominated building loads to a PPA.

A single retailer or off-taker will be selected for each renewable energy project who will then agree terms with each of the participants. The price for wholesale electricity from the selected project(s) plus Large Generation Certificates (LGCs) will be the same for each participant.

WWF seeks to facilitate the development of a corporate PPA market in Australia in order to increase demand for renewable energy. WWF hopes that stimulating the corporate PPA market will also result in new product offerings to allow smaller businesses to purchase renewable energy at competitive prices.

This buyers' forum is an example of a buying group using 'Buy-side aggregation'. The retailer has one agreement with the project developer and then sells individual common contracts to each member of the group.

A model such as this could be used by Council or a group of local councils if electing to incorporate an off-site large scale renewable energy project into their next purchasing.

11.6.2 City of Melbourne

City of Melbourne, as part of their commitment to emissions targets, has formed a buying group of interested parties committed to the commissioning of an off-site renewable energy project. The buying group have a combined load of around 120,000 MWh.

The group have gone to market requesting that consortia of project developers and retailers arrange to supply renewable electricity and LGCs to cover their load under a long term agreement.

An initial Expression of Interest round in 2015 established that pricing for the output electricity would be similar to available grid power prices provided the renewable energy project received grant funding monies. With increases in grid power rates and decreases in project development costs, pricing achieved is likely to be cheaper than current grid power rates.

As part of the specification of the tender, the buying group is looking for significant co-benefits to the community in which the project is commissioned and the buying group have developed a number of requirements around environmental impact.

The likely contract construct will be a tri-partite agreement with buy side aggregation and may involve a retailer's own renewable energy project.

11.6.3 UTS / Solar Singleton

The UTS – Singleton agreement relates to a pre-existing solar PV plant (18 years old) and it covers just 2% of the UTS load, therefore not interfering with the broader retail contract. Under the PPA agreement Singleton Solar exports to the grid via an individual NMI for the UTS load. The retailer bills UTS for their grid power NMIs and nets off difference in kWh consumed against that was generated at Singleton. UTS still pay the applicable network charges for supply to their NMIs.

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