Cabonne Shire Council
Renewable Energy Action Plan

Completed by Ashley Bland and Tom Griffiths – Constructive Energy Pty Ltd

March 2019

Table of Contents

Executive Summary 4

1.0 Introduction..6

1.1 Cabonne Shire Council (CSC)..6

1.2 Purpose Statement 6

1.3 CSC Objectives 7

1.4 Decision Making Framework..7

1.5 Desktop Analysis 7

2.0 Contract Site Analysis..8

2.1 Contract site overview 8

2.2 Billing structure..9

2.3 Specific site analysis..11

2.3.1 Molong Council Chambers..11

2.3.2 Charles McCarron Baths 13

3.0 Tariff Site Analysis 15

Tariff site overview 15

Tariff site strategy..16

4.0 Renewable Energy Options 18

4.1 Medium scale solar arrays 18

4.2 Distributed Solar Installation (Virtual Net Metering)..24

4.3 Council as Energy Generator / Retailer..26

4.4 Energy Storage..30

4.5 Energy Efficiency Measures 32

4.6 Electrification of fleet and plant 32

4.7 Pumped Hydro 33

4.8 Bioenergy 33

4.9 Microgrids 34

4.10 Off-grid facilities and critical infrastructure..36

4.11 Retail arrangements..36

4.12 Contract site cost reduction strategies 37

4.13 Demand Side Participation (DSP)..37

5.0 Proposed Renewable Energy Projects..38

5.1 Project ranking template 42

6.0 Constructive Energy 44

Disclaimer

This report documents the results of preliminary observations and analysis of material provided to Constructive Energy Pty Ltd. In preparing the report, we have relied upon information provided by Cabonne Shire Council, E21 EnergyPlus, Origin Energy and Energy Australia through referral to form our conclusions. Whilst we have reviewed this information to assess its reasonableness and internal consistency, we are not able to consider specific and/or abnormal circumstances that may impact your energy use.

The findings, conclusions and recommendations and all written material contained in the report represents our best professional judgement based on estimated and generic data and visual inspection where appropriate. Recommendations have assumed average conditions and historical usage.

Executive Summary

Constructive Energy has conducted a detailed analysis of electricity consumption and generation opportunities for Cabonne Shire Council (CSC) sites, including a review of factors related to installation and management of renewable energy infrastructure.

This plan is written to provide a knowledge base for CSC and set out the options over the short to medium term for renewable energy projects that meet the unique objectives of Council. It should be noted that this plan is pitched at the 'pre-feasibility' level and while we are confident the recommendations make sense, detailed modelling and due diligence is required on individual projects, particularly if Council elects to engage in grid-scale generation and storage and/or energy 'retailing'.

It is apparent that the following approaches would be of significant benefit to Council;

- Install multiple solar arrays 'Behind the Meter' up to 100kW while the substantial government subsidies are in place. These sized systems make very good economic sense and create usable export.
- Develop, own and operate a mid-scale solar array (500kW – 5MW) matched to council consumption and potentially local commercial and industrial consumers. The Sewerage Treatment Plant (STP) in Molong is a promising potential site for this.
- Upgrade all sites (in preferential order) to smart meters preferably with distribution-board-level load monitoring and control. This is especially pertinent to the non-lighting contract sites but also includes some tariff sites and should result in adaptive management capacity to reduce costs.
- Establish a new retail arrangement to self-consume export from renewable assets, participate in the National Energy Market and virtually retail to selected customers.
- Investigate the appetite of local businesses and communities to engage with Council in microgrid and energy sharing or Virtual Net Metering projects.
- Prioritise renewable energy and storage projects with back-up and redundancy capabilities for critical infrastructure.
- Support villages with local generation and possible microgrid capacity over time.
- Integrate or strengthen energy efficiency/management into the performance criteria of key staff.

Depending on the mix chosen by Council, benefits of implementing projects identified in this plan include;

- Medium term reduction in annual energy consumption costs.
- Provision of low risk infrastructure with strong returns on investment. Council will own the infrastructure in a medium-term timeframe.
- Creation of a new and enduring revenue stream for CSC.
- Energy pricing certainty for CSC.
- Energy resilience/security to the CSC community.
- Capacity to provide subsidised energy consumption costs to low income or other priority people/homes within the Local Government Area.
- Supporting existing and attracting new SME / industry to the LGA and stimulating the local economy via providing access to affordable and reliable energy.
- Future proofing CSC in terms of carbon abatement and any potential government mechanisms for emission reduction.
- Commencing transition to electric vehicles, plant and machinery.
- Demonstrating leadership and positioning Cabonne Shire for economic growth in the renewable energy sector.
- Setting up the capacity for a renewable energy revolving fund.

We recommend that Council adopt this Renewable Energy Action Plan and use it to gain or leverage government and private investment. Constructive Energy can assist in grant submission, business case development, tendering and financing to whatever extent Council requires.

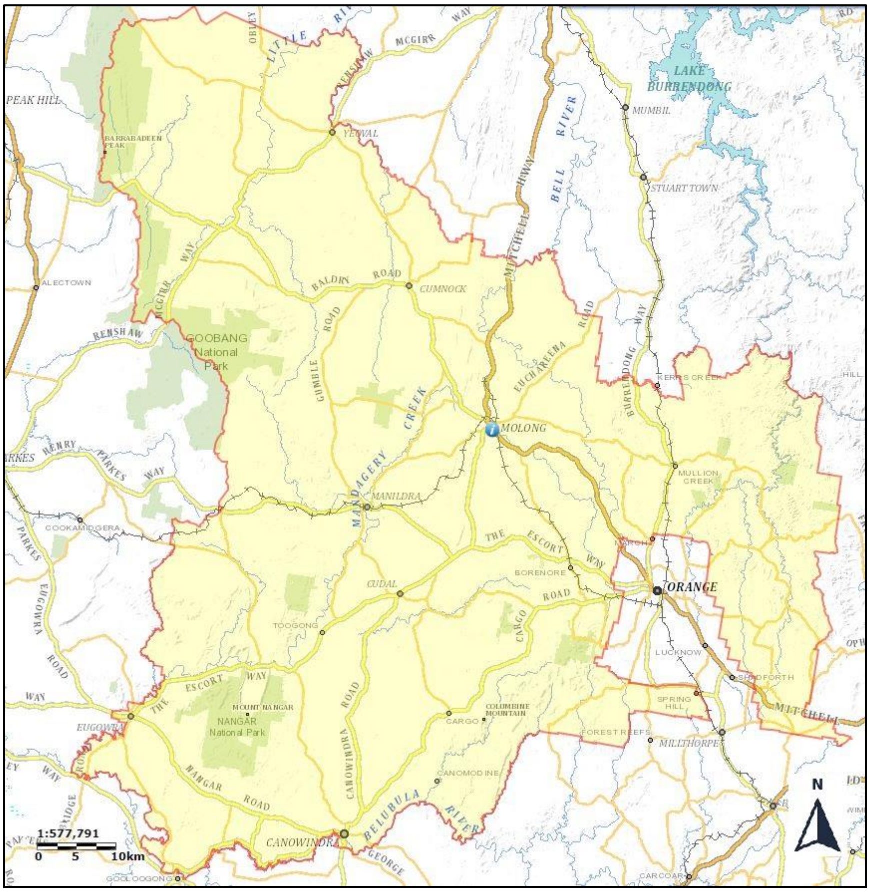
Constructive Energy is passionate and dedicated to the integration of renewable energy in Regional Australia for the advantage of local communities. As such, we are available as a ‘critical friend’ to Council on an ongoing basis at no charge. Recognising that energy is important but not necessarily core business for Councils, we also have the capacity to fully-fund, install and operate infrastructure to the benefit of Council and regional communities.

1.0 Introduction

1.1 Cabonne Shire Council (CSC)

CSC is a local government area located in the Central West region of New South Wales. Within the Shire are the villages of Canowindra, Cargo, Cudal, Cumnock, Eugowra, Manildra, Molong and Yeoval.

The Shire is covers approximately 6024 km2 and is located within the Essential Energy distribution network.



Map 1. CSC boundary – (source: https://maps.six.nsw.gov.au/ - Jan 2020)

1.2 Purpose Statement

The Renewable Energy Action Plan reflects CSC's desire to engage with renewable energy and identify options for projects that benefit Council and the Cabonne Shire community.

CSC supports innovation in energy use and delivery for the purpose of improved cost control, demonstrating leadership within the community and preparing for any future carbon price.

- CSC is passionate about country living and focussed on providing country people, with the care and support they require.
- CSC leads and supports the community through education, demonstration, partnership and projects.

1.3 CSC Objectives

CSC has developed this Renewable Energy Action Plan with the following objectives:

- To reduce the cost and uncertainty of future energy supply to Council infrastructure
- "To strengthen our towns and villages, retain our social and physical infrastructure, create new jobs and use technology to spread the word about the advantages of living and working in Cabonne Country" (Cabonne 2025 Community strategic plan)
- To attract and retain people and businesses to Cabonne country living.
- To support local businesses and residents suffering financial stress or discomfort due to energy affordability.

1.4 Decision Making Framework

The following framework was developed in consultation with CSC staff and Councillors to assist in evaluating the relative importance of projects identified through the Renewable Energy Action Plan:

- Benefit/Cost – does the project have positive financial impact?
- Community benefit – how does the wider community benefit from this project?
- Logic – is the project practical, defensible, sound, ethical, enduring?
- Leadership – will the project stimulate positive change in others?

1.5 Desktop Analysis

The first task in developing this action plan was to complete a desktop analysis of all metered sites to create a general profile of how CSC uses electricity. Then further, to understand how contracts and energy supply arrangements are structured with various energy retailers and the network provider.

CSC engages E21 to provide a bill validation service and this portal was used to collect and verify site data. Council engages with Origin Energy and Energy Australia as energy retailers and they were contacted to obtain interval data from any sites that had appropriate meters installed.

The analysis period for all sites was the 2019 financial year. Both negotiated 'Contract' sites and general 'Tariff' sites were analysed. In NSW consumers are entitled to negotiate or 'contest' a cheaper electricity retail charge if they consume more than 100,000 kWh per year.

Unfortunately, only limited interval data was available for Cabonne's contract and tariff sites. This is on account that most electricity meters being the old "spinning disk" type, however it was surprising that interval data was not available for some of the larger sites on Time of Use tariffs. Raw data tables and analysis are not included in this report.

	kWh	MWh	% usage	Cost $	% cost	c/kWh
Contract	677,878	678	37%	$ 251,744.45	43%	0.37
Tariff	1,137,131	1,137	63%	$ 340,559.45	57%	0.30
Total	1,815,009	1,815		$ 592,303.90		

Table 1. Contract site VS Tariff site summary

In 2019, the 6 Contract sites consumed 678 MWh of electricity compared to 1,137 MWh consumed by the 85 tariff sites as is shown in the Table 1.

While the major 'contract' sites represent 37% of energy usage, they represent 43% of the overall energy costs. This indicates that the energy pricing for these sites, particularly street lighting, should be renegotiated as CSC doesn't receive the most competitive the volume discounting available for the large guaranteed consumption.

2.0 Contract Site Analysis

2.1 Contract site overview

The following table lists all contract sites with their usage and annual cost. We have also included the resultant cents per kilowatt hour (c/kWh) to help identify which sites might be the most important to focus on. This figure reflects the ratio of fixed costs (i.e. metering and supply) to consumption and will change between bills and years, however it does help identify expensive sites and sub-optimal contract terms.

On the face of this information one might focus on sites with the highest c/kWh rate or those with the highest consumption however, more detailed analysis can often move the priority elsewhere.

Site Name	Retailer	Usage kWh	Cost $	c/kWh
CANOWINDRA STREET LIGHTS	Energy Australia	110,239	$53,131.09	**$0.48**
EUGOWRA STREET LIGHTING	Energy Australia	40,489	$18,211.81	**$0.45**
MANILDRA & OTHERS STREET LIGHTING	Energy Australia	113,911	$52,094.67	**$0.46**
MCCARRON BATHS GASKILL STREET CANOWINDRA	Energy Australia	167,611	$41,215.58	**$0.25**
MOLONG COUNCIL CHAMBERS	Energy Australia	129,259	$33,516.92	**$0.26**
MOLONG STREET LIGHTS	Energy Australia	116,369	$53,574.37	**$0.46**
		677,878	**$251,744.45**	**$0.37**

Table 2. CSC costs by contracted site

The following chart relates to the same data but provides a clear visual indication of which sites consume the most electricity.

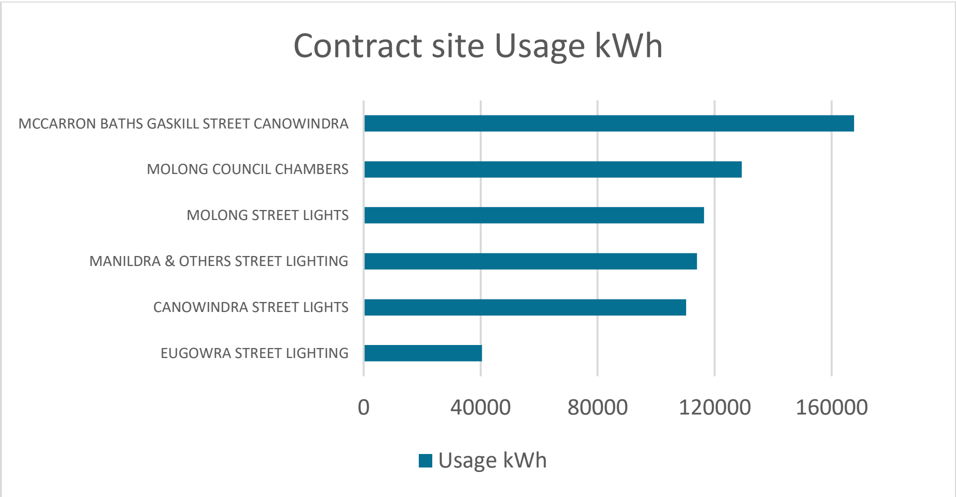


Chart 1. Contract site usage

The McCarron baths were the highest consumer amongst the portfolio of sites but, as demonstrated later, it has seasonal variable profile.

2.2 Billing structure

The billing structure becomes important when considering the potential of on-site renewable energy to reduce costs and drive operational changes. The following image is an excerpt of a bill for the McCarron baths and provides a detailed breakdown of the charges for energy supply to this site.

Site Name: 58087 - McCarron Baths - Gaskill Street, Canowindra
Period 01/12/2019 to 31/12/2019

Item	Quantity	Units	Rate	Total
Energy Charges				
Peak Energy	3,215.7	c/kWh	11.0845	356.44
Shoulder Energy	7,320.5	c/kWh	11.0845	811.44
Off Peak Energy	14,199.6	c/kWh	7.2835	1,034.23
Losses {DLF =6.910; TLF = 3.140; Rate = %}		%	10.2670	226.09
Sub-Total				2,428.20
Market Charges				
Ancillary Services Charge	26,444.0	c/kWh	0.0480	12.69
ESC	26,444.0	c/kWh	0.1657	43.82
LRET	26,444.0	c/kWh	1.5196	401.84
SRES	26,444.0	c/kWh	0.8692	229.85
NEM Fee	26,444.0	c/kWh	0.0368	9.73
Sub-Total				697.94
Network Charges				
Network Peak Energy	2,262.7	c/kWh	4.0186	90.93
Network Shoulder Energy	9,202.1	c/kWh	3.5620	327.78
Network Off Peak Energy	13,271.0	c/kWh	2.3030	305.63
Peak Demand	48.2	$/kVA	9.9185	478.07
Shoulder Demand	53.5	$/kVA	8.9739	480.10
Off Peak Demand	52.4	$/kVA	2.1699	113.70
Fixed Charges - Daily Rate	31.0	$/meter/d	14.8322	459.80
Sub-Total				2,256.02
Associated Charges / Adjustments				
Metering Provision	31.0	$/meter/d	2.1300	66.03
Supply Charge	31.0	$/day	1.7800	55.18
Sub-Total				121.21
			Total (inc GST of $550.34)	$6,053.70

Example Invoice for Contract Site (Charles McCarron Baths - Canowindra)

For ease of analysis the charges can be grouped and represented visually as per the chart below.

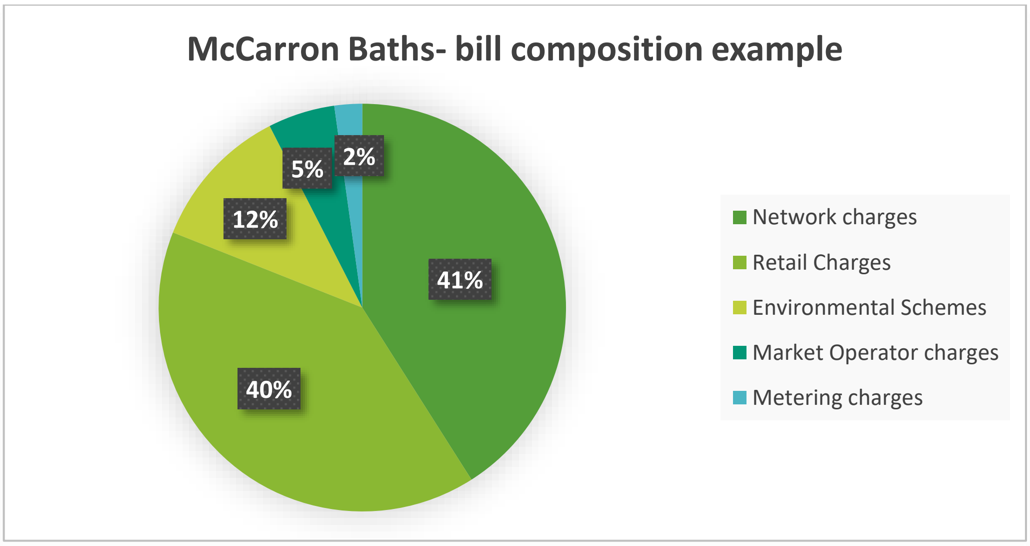


Chart 2. Contracted sites bill comparison (Charles McCarron Baths - Canowindra– Dec2019)

There are important insights to be made from this information.

- Consumers have no bargaining power over the Network, Market, Metering or Environmental charges. The only way to avoid these is to not buy electricity.
- 40% of the bill is open to negotiation (retail charges). If, for example, one could halve the retail charge rate, the overall bill saving would be 20%, or, in the above example $4,402 vs $5,503.
- The reason that 'behind the meter' (BTM) projects are attractive is because they reduce all elements of the bill though reducing the purchase of electricity
- Short of purchasing the network 'poles and wires' from Essential Energy, embedded networks and micro-grids can also avoid network charges.

Understanding the composition of electricity fees and charges can lead to the ideal of going "off grid", however, other than for new installations, this will generally push out the pay-back period due to the inability to sell excess energy.

Being aware of the charge structure can also lead to simple 'wins' through load shifting. The below chart shows the current retail charge structure for CSC's large usage sites.

The most cost-effective time of day to consume electricity is in the Off-peak period from 8pm to 7am. Shoulder times (9am-5pm) and Peak times (7-9am and 5-8pm) are charged at the same usage rate which is not usually the case. All other councils we have reviewed have a three-tier tariff structure that includes a 'Shoulder' period from 9am to 5pm charged between the peak and off-peak rate.

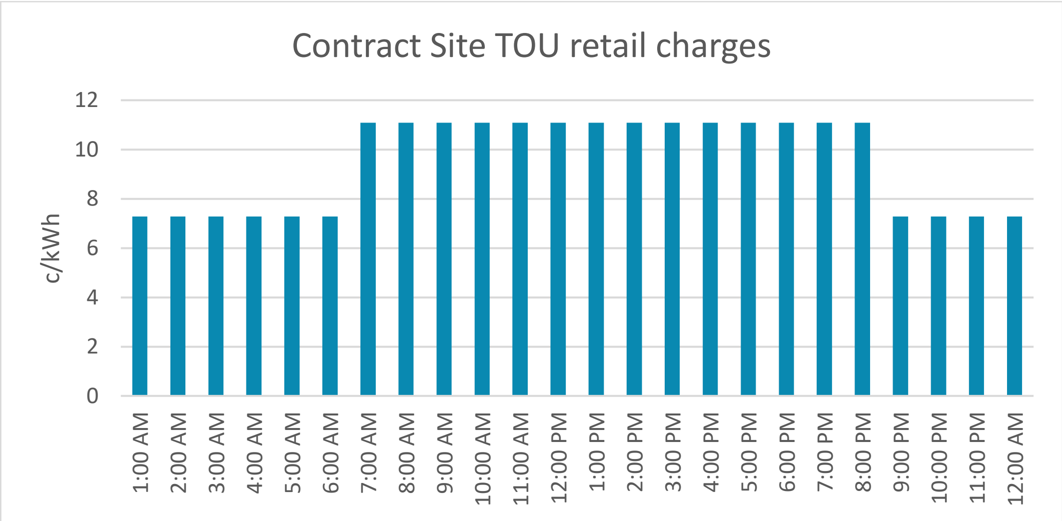


Chart 3. Contract Sites - Time of Use retail charges

Finally, the differential between peak and off-peak charges can also provide the economic rationale for battery storage.

Most obviously, can energy be purchased at the least expensive off-peak times, stored and then consumed Behind-the-meter in the most expensive periods?

2.3 Specific site analysis

We will now explore a series of charts related to each of the facilities listed. Understanding when energy is consumed across time creates an 'energy profile' for each site which becomes important in making decisions about the business case for renewable power, load shifting, energy storage and efficiency.

Streetlights are omitted from this detailed analysis due to the timing and consistency of the load however an offset option will be discussed later in the report.

2.3.1 Molong Council Chambers

Site details

Street Address	99-101 Bank Street, Molong
NMI	4001000601
Current Retailer	Energy Australia
Roof space	Yes
Map URL	https://nationalmap.gov.au/renewables/#share=s-37NOqPuRNkwhScoE
Description	Located in the main street of the township Molong. The Council chambers have an existing solar installation.

Assessment

The Council Chambers located in the main street of Molong has an interval meter, which allows for electricity consumption to be recorded in 30-minute intervals.

Analysis of the energy usage at this site by hour, matched the typical profile of an administration centre, showing a relatively small 'resting' load overnight, ramping into higher use during the morning peak when HVAC systems (heating, ventilation and air conditioning) are scheduled to turn on. The consumption is then consistent through till the end of the business day when consumption drops back to the overnight levels.

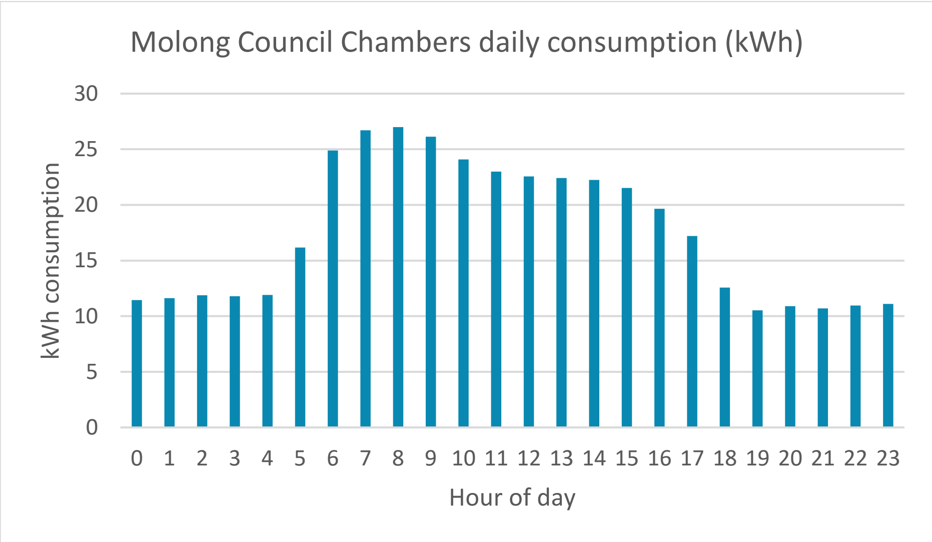


Chart 4. Molong Offices daily consumption profile

Clearly there is a strong overlap between the office consumption profile and the generation profile of photo-voltaic (PV) solar panels. This overlap, combined with the ability to generate 'behind the meter' and thus to avoid purchasing energy, is what makes the business case for commercial solar so strong.

The other factor to consider, which we can obtain from the monthly billing data, is the annual energy profile. For example, does the centre use more energy for cooling in summer or heating in winter? The figure below (Chart 5) shows that energy use is higher across both winter and summer months, likely due to electrical HVAC systems at the site.

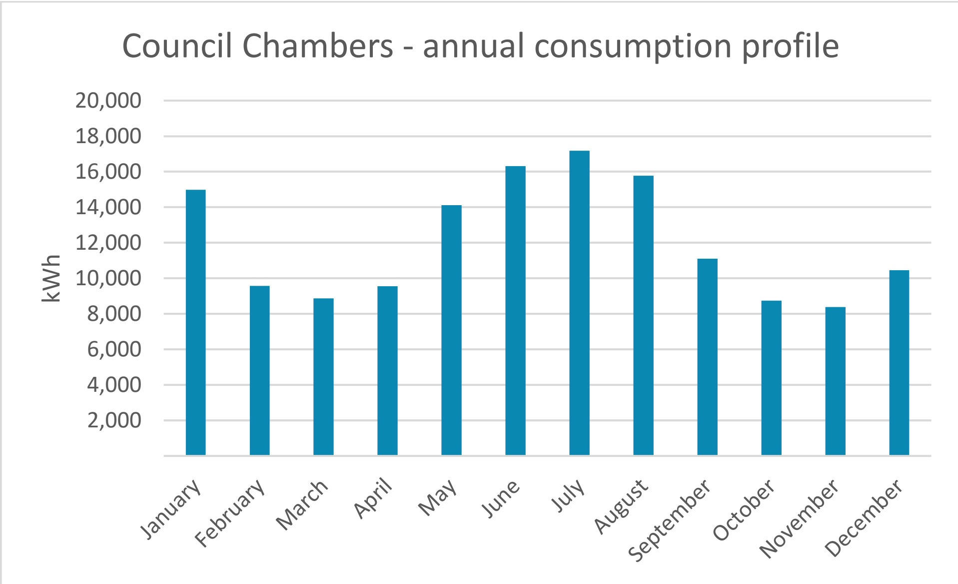


Chart 5. Council Chambers annual usage profile

Site recommendation

There is a great opportunity for Council to install rooftop solar PV panels and become energy "self-sufficient" at this site. This site has the potential to be a major energy production site, either supplying and selling back to other Council sites or selling on the open energy market.

The Council Chamber's energy usage profile closely matches the solar production hours and aerial photography reveals that there's adequate roof space, with no shading. The average daily consumption for this site is approximately 400kWh per day. A rough rule of thumb says that 1kW installed solar produces about 4kwh daily production, indicating that a rooftop solar installation in the vicinity 100kW would be suitable at the Chambers to fully offset usage.

An additional consideration in sizing a solar PV installation is deciding to cover the seasonal peak in consumption or the minimum (winter) generation period, raising the following question;

- If sizing the system for winter, what would be done with excess summer export?

Answers to this question are covered in more detail later in the REAP, in the sections 'Medium scale solar arrays – 4.1' and 'Council as a Retailer - 4.4'. Options exist for Council to consume excess energy at other council sites and/or generate revenue from the excess solar energy production.

Given the site usage profile, there is no obvious case for a battery installation alongside the rooftop solar however, as battery installation costs fall this option should be kept on-the-horizon. Battery installations provide the ability for a site to 'time-shift' solar production hours to night-time hours when other Council sites and plant are operating e.g. STP, town water pumps and\or street lighting.

We also recommend implementing energy efficiency measures at the Council Chambers as an easy and cost-effective opportunity to reduce energy consumption at this site. These measures include, lighting upgrades, increased insulation and window/wall shading that would reduce energy demand – particularly in summer.

The final recommendation for this site, and this applies across all the contestable sites, is to review existing contractual arrangements. The Shoulder times (9am-5pm) and Peak times (7-9am and 5-8pm) are charged at the same usage rate. This is an unusual pricing arrangement and strengthens the case for a BtM solar installation, including accommodating for contract exit fees.

2.3.2 Charles McCarron Baths

Site details

Street Address	Gaskill Street, Canowindra
NMI	4001048683
Current Retailer	Energy Australia
Roof space	Yes
Map URL	https://nationalmap.gov.au/renewables/#share=s-gQ46eaWNucxVfloK
Description	Located on the intersection between Gaskill Street and the Canowindra road (towards Cowra). This facility is located on the edge of the Canowindra township. The land parcel is approximately 4ha in size and slopes down towards the Belubula river flat.

Assessment

During our desktop investigation we were able to gain some valuable insights about this site by investigating the monthly usage, see Chart 6.

The baths are closed from April through to November, however some substantial usage occurred for May19 and June19 (38,000 kWh). This poses the question;

- Was this a once-off event or an annual occurrence?

During the Baths opening months, they consume approximately 720 kWh a day, however this drops dramatically during the off season to 70kwh a day (excluding May19 and June19).

Such variation over seasons diminishes the business case for on-site solar because of the inevitable large export which is of lower value than avoided consumption. In addition, although the land is large enough, it is sloping to a floodplain and doesn't have a large, well oriented roof structure for an easy BtM rooftop renewable installation.

There are more likely other suitable sites within the Council's portfolio for these types of installations (including the Council Chambers) and, due to its large summer-autumn seasonal consumption, this site would be a suitable candidate to be a 'consumer' of Cabonne Council's excess summer export from another site.

Other suitable Council sites could have 'oversized' installations to accommodate their own winter consumption and the excess solar production could be sold back to the McCarron baths during the summer months at a Council-set, reasonable price.

There would be some financial benefit in installing a small solar array at this site, however this would partially diminish the business case for a larger oversized solar array built elsewhere within the Council's energy portfolio.

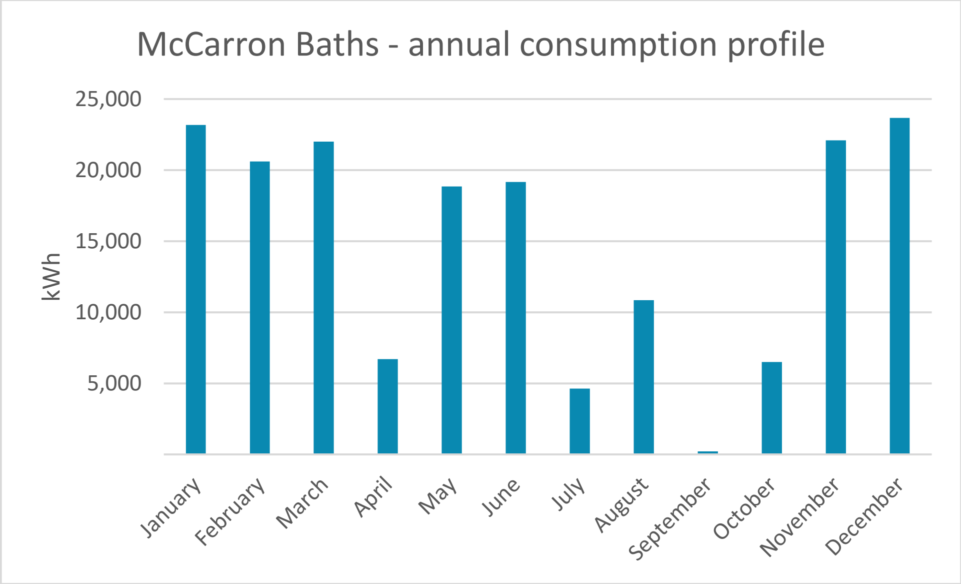


Chart 6. McCarron Baths - annual usage profile

Site recommendation

Our recommendation for the McCarron baths is to offset the large summer\autumn consumption by selling Council's excess summer export from a renewable energy installation at another Council operated site. The mechanism to facilitate this is outlined below in the Renewable Energy Options section (refer to section 4.1 – 4.4 below).

Also recommended for this site is to clarify the reason for, and likely continuation of, relatively high usage in winter. If a base level of usage is going to occur year-round then this improves the case for a small on-site installation.

Finally, this site will also benefit from the installation of a load controlling device. This will allow for simple operational changes that ensure the plant is operated most effectively during the cheapest tariff windows. This change would lead to significant energy consumption savings.

3.0 Tariff Site Analysis

Tariff site overview

CSC manages 85 facilities which relate to a unique National Meter Identifier (NMI). For the purpose of this analysis we have grouped these sites into areas of common function as per the Table 3 below. As per contract sites, the simple derivative of annual cost and consumption, c/kWh, provides a potential indication of priority sites to benefit from renewable energy.

Site group	Annual kWh	Annual cost	c/kWh
AMENITIES	305,551	$ 89,876.87	29.41
COUNCIL FACILITY	145,064	$ 43,446.52	29.95
HALL OR COMMUNITY CENTRE	96,466	$ 28,543.81	29.59
HEALTH	163,181	$ 35,479.30	21.74
OTHER	96,976	$ 37,866.34	39.05
PARK OR SPORTS FIELD	39,741	$ 14,290.18	35.96
WATER TREATMENT OR PUMPING	290,153	$ 91,056.43	31.38
	1,137,131	$ 340,559.45	29.95

Table 3. Tariff sites cost and usage breakdown

The categorisation used for table 3.

Site group	Description
Amenities	Caravan parks, kiosks, toilet blocks, baths and swimming pools.
Council facility	Council chambers and depots.
Hall or community centre	Halls, community centres and libraries.
Health	Council operated health facility.
Parks or sports fields	Sports facilities, parks and sports fields.
Water treatment or pumping	Sewerage treatment plant, bores, sewer and water pumps.
Other	Any other site that did not fit into the above categories.

Chart 7 below represents the same information in a manner that allows us to see the groupings that draw the most energy, the major ones being Council Amenities and Water treatment and pumping.

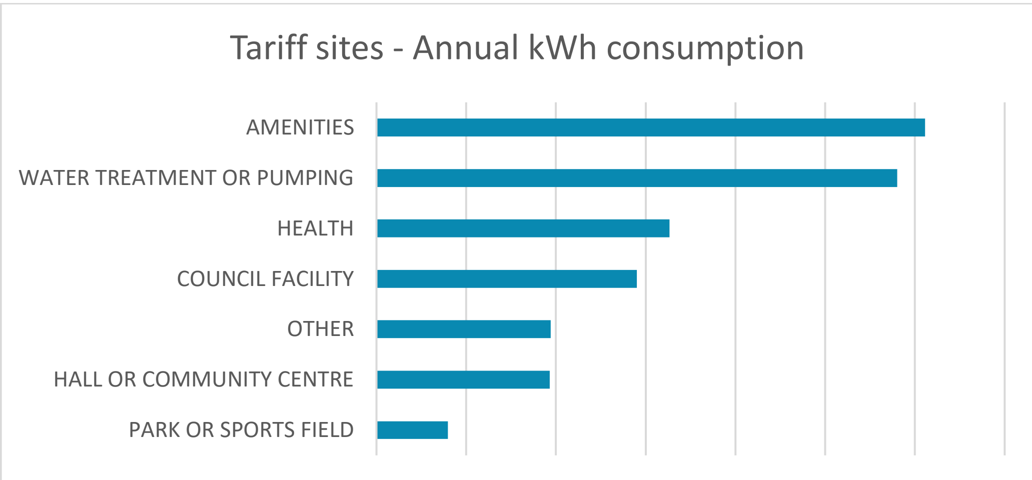


Chart 7. Grouped Tariff sites annual kWh usage chart

Further insight is gathered by looking into the individual sites that consume the most energy. Table 4, below, displays any sites that consume over 50,000 kWh pear year.

Site Name	kWh	$ cost	c/kWh
Health One Molong	163,181	$ 35,479	$ 21.74
Molong Caravan Park	83,758	$ 22,605	$ 26.99
Molong Sewerage Treatment Plant	74,738	$ 20,194	$ 27.02
Cudal Office	72,235	$ 19,586	$ 27.11
Googodery Road Water pump	59,733	$ 16,274	$ 27.24
Molong Depot	53,599	$ 14,705	$ 27.44
	507,242	**$ 128,844**	**$ 25.40**

Table 4. Tariff sites cost and usage breakdown

At first glance it appears that Health One, should be on a contestable tariff however interestingly enough, at 21.74 c/kWh the rate is equivalent or below the cost of the other sites on the contracted rates. The presence of rooftop solar on this site will also be impacting on this figure. Unfortunately, these sites do not have smart interval meters, so the data doesn't exist to accurately model and interpret the usage profile.

Continual tariff review is also likely to remain of value for this group of facilities, and all others on contestable tariffs.

Key questions

- Which of these sites are best suited to BtM solar?
- Which sites can change their energy use through either behaviour change or technology?
- How can we get interval/operational data for these sites?

Tariff site strategy

The c/kWh column in the Table 4 above is a relatively blunt but useful metric. Sites with high rates (greater than 30c/kWh) usually occur when the proportion of energy consumed is small compared to the daily supply charges. The highest of these figures point to potential disconnection of certain sites from the grid and replacement with standalone solar-battery systems. As an example, this approach could be cost-effective for remote amenity blocks. Certainly, this approach should be considered for all new facilities where connection costs can be redirected into off-grid CAPEX with little on-going outlay.

Of the larger tariff sites there are two strategies for reducing costs; behind the meter solar installations and self-consumption of export from other Council sites at a reduced fee (see more on this below). While we know there are some sites that are 'no-brainers' for small roof-top solar, it would be better to make decisions based on data and again, we are limited by the lack of energy consumption interval data.

There are now a range of relatively inexpensive smart metering solutions that allow for real-time consumption data to be accessed and analysed. Constructive Energy is currently conducting market research into the most suitable metering solution for Cabonne Shire Council. We will present this to Council once completed. Regardless, all installations of solar and/or electrical upgrades should now be accompanied with a smart meter installation, preferably with embedded load control functionality.

The establishment of internal energy trading will necessitate both upgraded metering devices and identifying a hierarchy applied to sites. That is, answering the question of which sites receive the benefit as export from the 'Virtual Net Metering' increases throughout the day and season. The hierarchy will be based on factors such as consumption profile, overall load, costs and social benefit.

In time, and as the level of available site data improves, it will be possible to implement and accurately measure energy saving initiatives such as retrofits and behaviour change programs and to take advantage of emerging load response initiatives. That is, to receive financial benefit from reducing non-essential consumption during peak times periods for the National Electricity Grid, such as mid-afternoon during heatwaves.

Even in the absence of accurate interval data, for the tariff sites and as a result of site visits, we can be confident that BtM solar will be both financially attractive and physically appropriate at each of the 6 sites listed above. Preliminary modelling has been completed in section 4.2 below.

4.0 Renewable Energy Options

4.1 Medium scale solar arrays

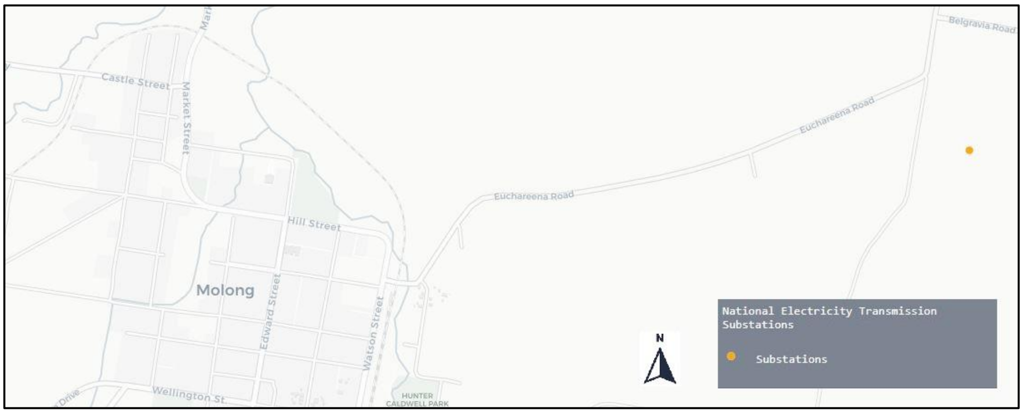
When identifying a potential location for standalone medium scale renewable energy installations, it is important to consider proximity to suitable power lines, transformers and electricity substations; close range of a substation or appropriate 'feeder' can lead to more cost-effective grid connection for larger arrays.

Larger solar installations require more research and modelling than those installations below 5 MW because they can have a disruptive and damaging impact on the network. Facilities under 5MW require an intermediary licenced market participant to sell into the National Energy Market but currently avoid extensive Australian Energy Market Operator (AEMO) reporting requirements. Once the 5MW threshold is broken, these additional costs, along with increased implementation costs such as network fault protection works, typically result in systems of around 8MW to stack up financially.

There is another threshold within the Essential Energy network at 1MW, below which the potential network impact, and hence approval process, is significantly easier and less costly. Solar installations below 1MW are not regarded as High Voltage customers whereas arrays over 1MW require Connection Investigation Services Agreements that will incur costs in the order of $25,000 to $250,000, including detailed engineering and High Voltage design.

The desktop analysis identified that there are two Electricity substations located within the CSC boundary. One substation is located on the North-Eastern edge of Molong, adjacent to the Molong golf club and showgrounds. The other is situated approximately 2.5km from the Manildra township, on the Eastern corner of the town, off Henry Parkes Way. If CSC pursues a larger array, say 5MW, then proximity to these substations may be helpful, however the smaller the array, the more opportunities available for suitable connection points.

Based on visual inspection by CE, the most obvious opportunities for arrays in the order of 1MW appear to be the Molong STP, The Cumnock STP and the Mildura showgrounds. CE recommends completing a Preliminary Network Enquiry at each of these locations to identify the available capacity. Initial informal enquiries indicate that facilities in the order of 1MW are likely possible, at these locations.



Map 2. Substation location (Molong) source: National Renewables Map Jan20

The commercial development appetite for medium to large solar arrays has reduced from a peak in 2018 of around 20 GW as uncertainty relating to the daytime market price has increased. There are now periods where solar supply exceeds market demand, and this is pushing the pool price down resulting in the so-called 'duck curve' already evident in South Australia. In the past, the market price average was reliably above the cost of production making solar projects profitable but now there is an increased risk of a revenue shortfall. This issue has been exacerbated by network constraints resulting in Market Operator curtailment of export from large solar farms. This reinforces the case for more, smaller, solar arrays withing the Distribution network.

Developers usually seek to secure revenue by locking in customers with a fixed price Power Purchase Agreement, however for Councils the opportunity exists to create an internal arrangement. With supply matched to demand and a floating market price, the Council is less concerned with what the energy price is at any point in time and more concerned about the transactional cost. That is; if the NEM price is high then increased costs of consumption are offset by increased revenue for the array. Equally, low prices reduce revenue to the array but save on expenditure at sites. To avoid excess export at low value it is important to match the solar array size to demand, noting that the opportunity exists to increase the pool of customers by signing up local Commercial and Industrial facilities. Of course, once the array is paid off, Council has access to electricity at negligible cost (refer to the section "Council as energy retailer" below).

Understanding this model is critical to the decision for Council to invest in a medium scale array as without it, CE would not currently advise Council to proceed with a large solar project.

Modelling was completed to examine what the options might be for CSC to progress a mid-scale array. Local climate data was used to project solar generation and aggregated to monthly figures. These were mapped against actual usage for the 2018-19 financial year. The following chart represents annual consumption segmented for large/contract sites, tariff sites, combined usage and the percentage of usage likely to currently occur in daylight (solar production) hours.

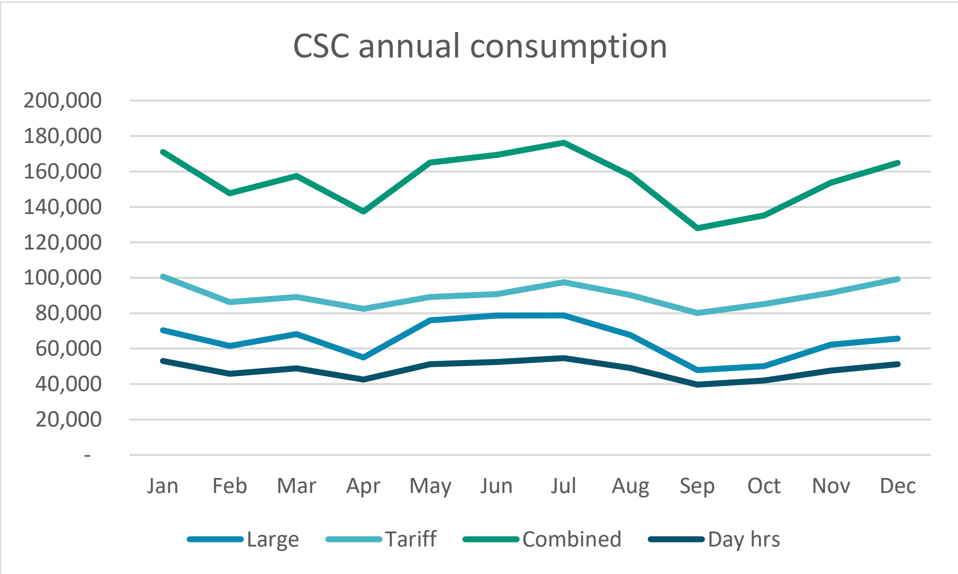


Chart 8. CSC annual consumption profile

We now need to understand how this profile interacts with the wholesale or spot price on the National Energy Market. The charts below indicate that, on average to date, summer is a good time to be selling solar energy into the market as the price is relatively high – particularly in the peak heat of mid-afternoon. In shoulder seasons daytime export is of lesser value than it is in winter but in all three seasons there is a distinct peak at the start and end of each day.

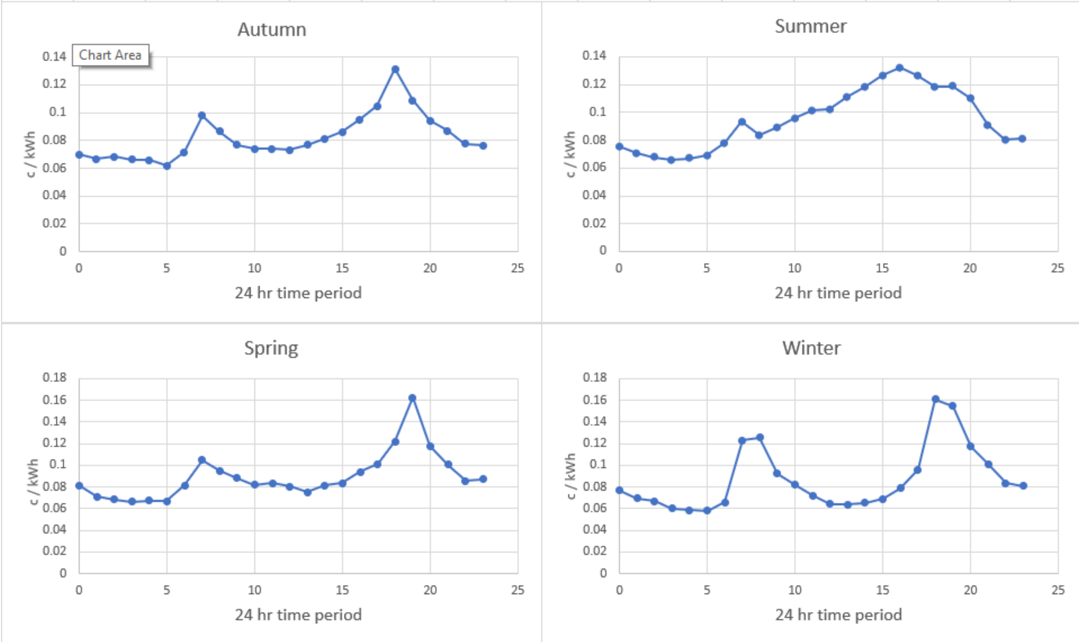


Figure 1. Seasonal average NEM spot price charts

We now examine two scenarios for the purpose of informing decision making around the objectives and scale of a stand-alone CSC solar array. For the sake of illustration all scenarios assume that CSC is happy to pay itself 10c/kWh for solar energy which represents a saving of approximately 4c off retail and that export is also purchased by a third party for 10c or sold at average NEM Spot market prices for the 2019 financial year. We have also modelled the array install cost at $1.45 per watt which is inclusive of all project costs. The ability to account for energy generated and shared over multiple assets is referred to as Virtual Net Metering (VNM) and in this case simply means CSC selling to itself.

Without getting bogged into the detail in the table below, our analysis compares the financial case for Council self-consuming the energy versus finding a consumer willing to enter a PPA – which would need to be at around 11ckWh to equate with the other approaches. Not surprisingly, the key variables for financial return are install cost and purchase price.

		Array Size	1350	kWp	CAPEX	$ 1.45	per watt	$1,957,500								
									Purchase	Save	Sell					
	Solar Production		Revenue	Council consumption					$ 0.10	$ 0.04	$ 0.10			Alternative revenue models		
	kWh/m2	kWh/m	@ 11c/kWh	Large	Tariff	Combined	Day hrs	Export	Int'l rev.	retail savir	Exp. rev.	Sum value	Ave spot	100% spot	VNM	Self + spot
Jan	7.42	211,494	$ 23,264	70,435	100,628	171,063	53,029	158,465	$ 5,303	$ 1,061	$ 15,846	$ 22,210	$0.1346	$ 28,172	$ 22,210	$ 27,698
Feb	6.34	179,285	$ 19,721	61,513	86,171	147,684	45,782	133,503	$ 4,578	$ 916	$ 13,350	$ 18,844	$0.0971	$ 16,255	$ 18,844	$ 18,458
Mar	5.3	155,615	$ 17,118	68,182	89,183	157,366	48,783	106,832	$ 4,878	$ 976	$ 10,683	$ 16,537	$0.0934	$ 15,631	$ 16,537	$ 15,829
Apr	4.076	132,678	$ 14,595	54,930	82,520	137,450	42,609	90,069	$ 4,261	$ 852	$ 9,007	$ 14,120	$0.0840	$ 13,613	$ 14,120	$ 12,682
May	2.936	123,039	$ 13,534	75,941	89,096	165,037	51,162	71,877	$ 5,116	$ 1,023	$ 7,188	$ 13,327	$0.0842	$ 10,578	$ 13,327	$ 12,195
Jun	2.256	95,823	$ 10,541	78,620	90,747	169,366	52,504	43,319	$ 5,250	$ 1,050	$ 4,332	$ 10,632	$0.0986	$ 11,981	$ 10,632	$ 10,572
Jul	2.516	114,836	$ 12,632	78,720	97,508	176,228	54,631	60,206	$ 5,463	$ 1,093	$ 6,021	$ 12,576	$0.0768	$ 9,647	$ 12,576	$ 11,182
Aug	3.52	131,828	$ 14,501	67,676	90,209	157,885	48,944	82,883	$ 4,894	$ 979	$ 8,288	$ 14,162	$0.0894	$ 11,224	$ 14,162	$ 13,283
Sep	4.724	141,523	$ 15,568	47,868	80,101	127,969	39,670	101,853	$ 3,967	$ 793	$ 10,185	$ 14,946	$0.0882	$ 14,285	$ 14,946	$ 13,742
Oct	5.964	169,325	$ 18,626	50,205	85,081	135,285	41,938	127,387	$ 4,194	$ 839	$ 12,739	$ 17,771	$0.0917	$ 15,350	$ 17,771	$ 16,713
Nov	6.692	184,591	$ 20,305	62,287	91,407	153,695	47,645	136,945	$ 4,765	$ 953	$ 13,695	$ 19,412	$0.0892	$ 14,446	$ 19,412	$ 17,929
Dec	7.3125	222,642	$ 24,491	65,567	99,349	164,916	51,124	171,518	$ 5,112	$ 1,022	$ 17,152	$ 23,287	$0.0958	$ 20,046	$ 23,287	$ 22,567
	4.9	1,862,679	$ 204,895	781,944	1,082,001	1,863,944	577,823	1,284,857	$ 57,782	$ 11,556	$ 128,486	$ 197,824	$0.0936	$ 181,228	$ 197,824	$ 192,850

Table 1. Summary table of generation and revenue

Scenario 1 – offset daytime use only.

In this scenario we examine what it would look like to meet the daytime usage of all council assets with a mid-scale solar array. We would do this on the basis of minimising exposure to the spot price and maximising self-consumption - as Council gets to decide how much to pay itself for energy in this time (as per above, we have assumed 10c). The limiting month is June when solar generation is at its lowest, so the array has been sized to meet this demand - 52,504 kWh.

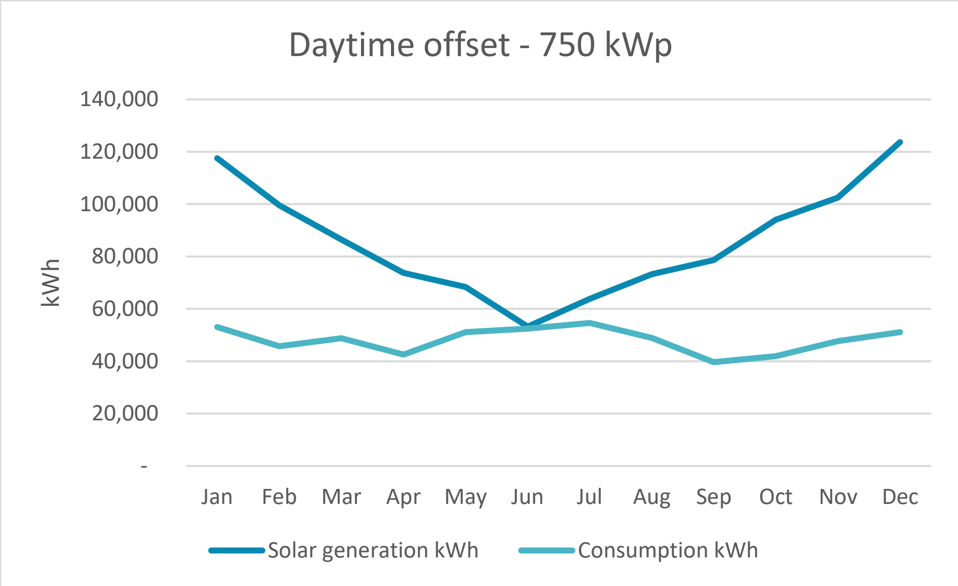


Figure 3. Solar generation matched to daytime consumption – 420kW array

Figure 3 indicates that in order to meet the likely consumption at the 'worst' time of year for solar generation, i.e. June, every other month will generate in excess of Council's own consumption. The array size to deliver this scenario is about 750 kW. The corresponding revenue charts are shown below.

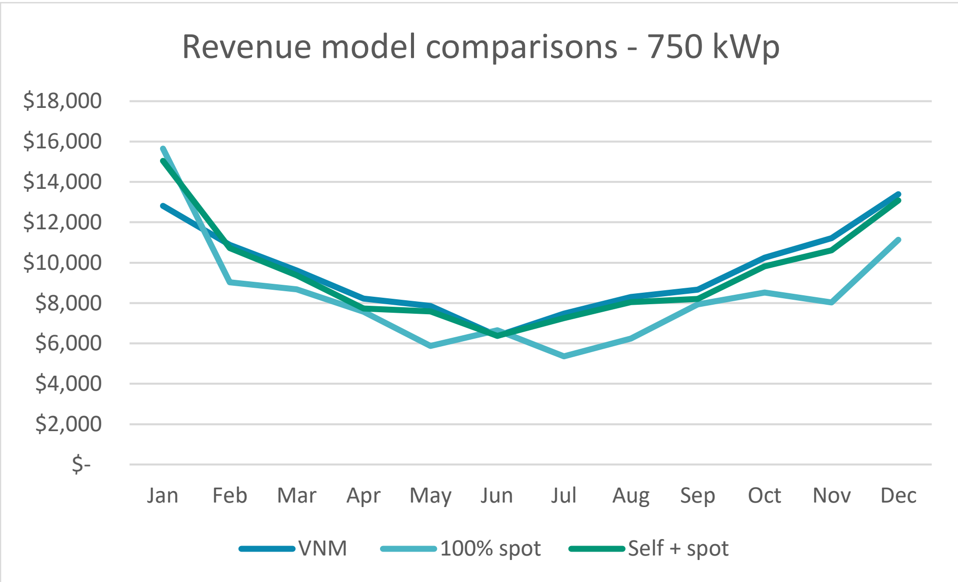


Figure 4. Intersection of monthly revenue/value curves for a 420kW array

Figure 4 displays the annual revenue profiles associated with a 750 kW array.

- VNM stands for Virtual Net Metering which is the term to describe the model where council sells power to itself from the array at 10c/kWh, saves about 4c/kWh on the retail tariff and sells all excess to local businesses/homes for 10c/kWh.
- 100% spot indicates revenue associated with selling all array generation into the National Energy Market (NEM)
- Self + spot indicates a hybrid model where CSC sells energy to internal sites first and then all excess to the spot market

Scenario 2 – offset full consumption.

In this scenario, we consider that Council has elected to fully offset their energy consumption on the basis of creating a revenue stream to offset unavoidable usage and to reach 100% renewable status in terms of carbon abatement. The size of an array to achieve this is approximately 1350 kW.

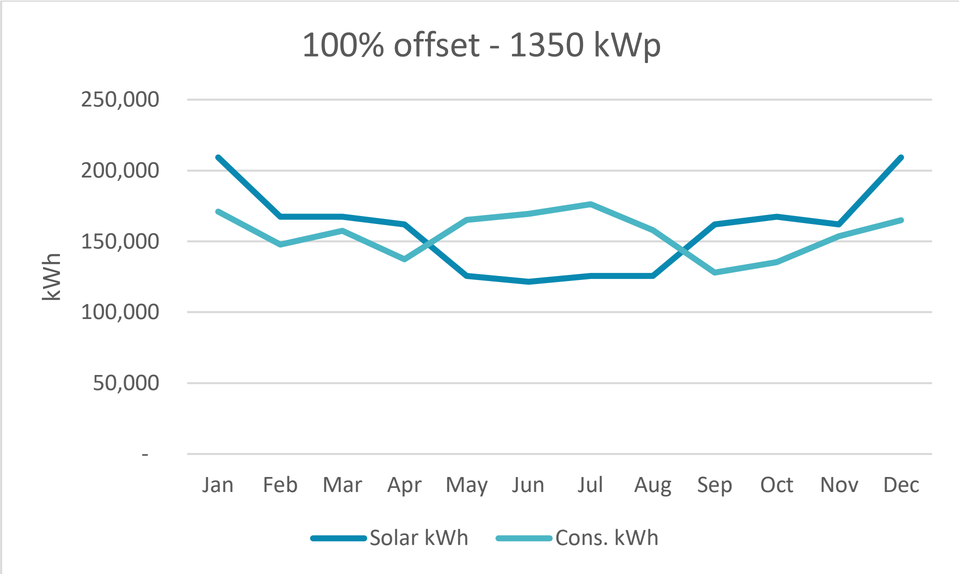


Figure 5. Solar generation matched to daytime consumption – 1350 kW array

Figure 6 indicates that the bulk of all energy consumed, 24 hours per day, both exceeds and is less than the amount generated depending on the season. In terms of annual volume however the curves are equivalent. The corresponding revenue charts are displayed below.

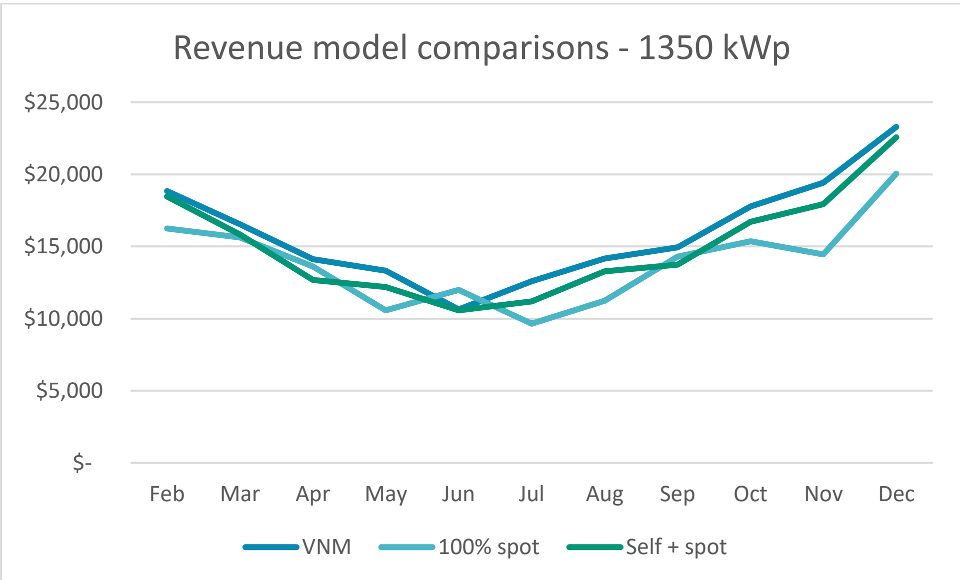


Figure 6. Intersection of monthly revenue/value curves for a 1350 kW array

In comparison to the 750 kW model, Figure 6 shows improvement in the VNM curve compared to Self + spot. Both curves outperform open exposure to the spot market.

Working off the assumptions in Table 1 for the establishment of the three distinct approaches, the following table makes it easier to see the sum value of each approach.

Total Offset - 1.86 GWh	1350 kWp				
Month	Solar gen. kWh	Total cons. kWh	VNM	100% spot	Self + spot
Jan	209,250	171,063	$ 22,210	$ 28,172	$ 27,698
Feb	167,400	147,684	$ 18,844	$ 16,255	$ 18,458
Mar	167,400	157,366	$ 16,537	$ 15,631	$ 15,829
Apr	162,000	137,450	$ 14,120	$ 13,613	$ 12,682
May	125,550	165,037	$ 13,327	$ 10,578	$ 12,195
Jun	121,500	169,366	$ 10,632	$ 11,981	$ 10,572
Jul	125,550	176,228	$ 12,576	$ 9,647	$ 11,182
Aug	125,550	157,885	$ 14,162	$ 11,224	$ 13,283
Sep	162,000	127,969	$ 14,946	$ 14,285	$ 13,742
Oct	167,400	135,285	$ 17,771	$ 15,350	$ 16,713
Nov	162,000	153,695	$ 19,412	$ 14,446	$ 17,929
Dec	209,250	164,916	$ 23,287	$ 20,046	$ 22,567
	1,904,850	1,863,944	$ 197,824	$ 181,228	$ 192,850

Table 2. Tabular comparison of alternative revenue models

Based on establishment costs of $1.45 per watt, the CAPEX for a 1350 kWp project would be $1,957,500. This figure is based on actual industry performance to date and, while realistic, would need to be tested in the market to establish an accurate budget.

Without completing detailed financial modelling, it is apparent that project revenue is in the order of a 10% yield on investment.

The above 2 scenarios are illustrative of the need for CSC to be clear on objectives in constructing and operating a mid-scale array. The analysis has been undertaken to illustrate concepts, highlight risks and demonstrate the impact of alternative approaches to becoming active in the renewable energy generation space. We have been careful to be realistic and conservative in our analysis however detailed modelling, costing and analysis will be required before investing in a project.

Constructive Energy has completed detailed modelling for another Council who have elected to proceed with this approach based on favourable economic and social returns. The project will reduce current outgoings for energy in the medium term, pay off a 5MW array in just over 9 years, engage local business with lower cost local renewable energy and is projected to deliver a financial dividend of $13 million over 25 years.

If CSC elects to further investigate this concept CE can facilitate the necessary system design and Network Enquiries and work with Council to develop the detailed business plan.

A final point of note is to consider that there may be metropolitan based local governments that would welcome the opportunity to partner with a ‘country cousin’ that can generate renewable energy to offset their consumption. This could be another way of locking in price certainty and revenue to de-risk the business plan.

4.2 Distributed Solar Installation (Virtual Net Metering)

The most conventional renewable energy option for reducing costs is to install 'Behind the Meter' (BtM) solar arrays at strategic locations. BtM solar arrays in both residential and commercial settings self-consume electricity generated during daylight hours, thus avoiding power costs charged on a per kWh basis. Excess energy generation is sold into the network at a negotiated feed-in tariff or shared with other consumers. An ideal site for this type of installation (where a faster return on capital investment can be achieved) should present the following characteristics; -

- High, regular electricity consumption, with most of the usage occurring during the daylight hours.
- Large suitable roof structure, preferably north facing and not shaded, or suitable nearby space for ground/frame mounted solar.

Important Considerations

- It is important to size and design individual systems correctly to maximise savings and return on capital investment.
- The Small-scale Renewable Energy Scheme currently offers significant discounts on solar systems smaller than 100kW. The scheme reduces in value on 31st December each year until it ends in 2030.
- Systems larger than 30kW require additional costs associated with network connection study and permission from the network provider to connect to the grid.

There are currently new technologies and market-place arrangements being developed that allow peer-to-peer solar energy trading between residential properties (VNM as explained above) and the ability to collectively manage multiple installations, known as a Virtual Power Plant. At a small scale, a household can trade their excess solar generation to a property of their choosing at a negotiated price. This system usually requires both parties in the transaction to be with the same retailer and arrangements can be put in place for one-off transactions or longer-term periods.

The integration of battery technology and smart grid software can significantly improve these systems by being able to meet demand during non-solar generating periods. There are pilot schemes in Australia where entire residential housing developments are connected into an embedded network, so residents effectively generate and share power for the net benefit of everyone involved.

Using this concept, it is possible for CSC to develop a Rooftop Solar Virtual Power Plant large enough to power a major portion of Council sites and other businesses and residences in the LGA. Under this model, Council could also subsidise or facilitate the installation of solar and battery systems at selected sites and facilitate customers with the enabling retailer and load control metering devices.

Important Considerations

- All properties/customers operating within the network would need to sign up with the same retailer. The retailer would also need to be involved in setting up and operating the system.
- A specific meter/device is required to monitor and acquit energy usage.
- The project will require a significant effort to recruit customers (which could include customers outside of the LGA if desired).

To illustrate this opportunity CE considered the impact of new BtM installations as part of a holistic program. Site visits and desktop analysis were able to identify some suitable sites for further feasibility analysis and financial modelling.

Identifying suitable solar sites for further feasibility analysis

CE modelled BtM solar on 6 of the contestable sites and the Council Chambers which we chose because of their large, consistent usage profiles.

1. Council Chambers, Bank Street, Molong 100 kWp
2. Health One, Bank Street Molong 100 kWp
3. STP, Wellington Road, Molong 100 kWp
4. Caravan Park, Watson Street, Molong 20 kWp
5. Cudal Office, Main Street, Cudal 50 kWp
6. Water Pump, Googodery Road, Cumnock 100 kWp
7. Molong Depot, Molong St, Molong 100 kWp

CE integrated the capacity for a virtual network and imagined that CSC charged themselves 10c/kWh for energy consumed at the retail tariff sites (which would be a saving in the order of 3 – 4c /kWh).

The table below is a summary of the collective financial impact if these projects were to proceed. Energy production was modelled on rule-of-thumb figures, financial impact was calculated using current tariff structure and CAPEX was assumed at the middle of the scale which results in a realistic outcome.

Usage costs	$ 0.14
Feed-In	$ 0.10
Installed cost per W	$ 1.35

SiteName	Comments	Btm System size	Total daily production kWh	On site gen/yr	% self consumption	Self cons kWh	Avoided purchase	Export	Exp. value	Inst cost	Tot revenue	Payback (simple)	Yield
103 BANK ST MOLONG	Suspected gross metering issue + possible Contract negotiation	60	240	87600	70%	85904	$ 12,027	1696	$ 170	$ 81,000.00	$ 12,196	6.64	15%
WELLINGTON ROAD, MOLONG	STP Great opportunity	100	400	146000	30%	22103	$ 3,094	123897	$ 12,390	$135,000.00	$ 15,484	8.72	11%
Caravan Park Watson Street Molong	Some energy efficiency opportunities and on-site solar - inclu solar sades?	20	80	29200	30%	20788	$ 2,910	8412	$ 841	$ 27,000.00	$ 3,752	7.20	14%
MAIN STREET CUDAL	Significant energy efficiency opportunities + good on-site solar	50	200	73000	70%	45484	$ 6,368	27516	$ 2,752	$ 67,500.00	$ 9,119	7.40	14%
Googodery Road,Water pump Cumnock	Or equivalent site	100	400	146000	50%	29341	$ 4,108	116660	$ 11,666	$135,000.00	$ 15,774	8.56	12%
Molong Depot, Molong St Molong	Great shed roof space and looks to be good transformer capacity (out back of shed)	100	400	146000	70%	33469	$ 4,686	112531	$ 11,253	$135,000.00	$ 15,939	8.47	12%
	TOTAL	430	1,720	627,800		237088.8	$ 33,192	390711	$ 39,071	$ 580,500	$ 72,264	7.83	13%

Table 2. Distributed solar model example

It should be noted that the resultant yield of 13% is low for BtM commercial solar (while much better than the bank!) because we have modelled sites for largest possible array per site, not highest financial return. It should also be noted that some of these sites may not be allowed to install the full nominated size array because of network limitations and there may be additional limitations and expenses associated with commissioning solar at these sites – such as electrical upgrades. The project would also involve replacement of all meters which may or may not be met by the retailer and has not been factored into the project costs.

In order to progress the case for distributed solar installations Council will need to complete the following;

- Essential Energy enquiries on all possible sites to establish actual feed-in capacity
- Engineering analysis of potential roof structures to ensure safety compliance
- Electrical investigation to ascertain the likelihood of wiring and meter board upgrades
- Retailer willingness to engage in VNM/Peer-to-peer trading

It may also be desirable for Council to facilitate the involvement of other organisations and individuals in a Council-wide virtual network however this can become complex and should be modelled in more detail. It would also be advisable to plan this with the engagement of service/community groups and the business groups.

There are essentially three options for progressing BtM installations;

1. CSC Capital investment – savings invested to immediately reduce operating costs
2. Project finance – taking advantage of low interest rates in a cash-positive structure
3. 'Rent to buy' – Third-party installs and operates until nominated hand-over

Constructive Energy can assist council with services to deliver this approach if desired, ranging from developing the detailed business case to market testing and managing implementation and commissioning.

4.3 Council as Energy Generator / Retailer

CSC has the land, load and grid capacity to install and operate a medium scale solar power plant in the order of 1MW and a number of buildings on which to spread an equivalent amount of roof-top solar. The inevitable question regarding this option is how to consume the generated energy in local assets and how to maximise financial benefit from selling the excess. As a Council owned and controlled asset, a solar PV facility has the potential to generate energy for self-consumption and a revenue stream to off-set unavoidable consumption costs such as street lighting.

Clearly, if it were not possible to consume renewable energy 'behind the meter' then the next best thing would be to supply the excess energy to other Council sites and other larger consumers such as local industry. As described in 4.1 above, Power Purchase Agreements (PPAs) are the most common mechanism for this to occur to date. However, if this is done, it is still necessary to pay for the "poles and wires" either by paying the network owner-operator a fee or through owning the network. It is unclear at this point if discrete rural energy networks will ever be 'for sale', however, an embedded network constructed and owned by Council, such as for a new greenfield development or an industrial estate, already has precedent.

Power Purchase Agreements have been established and tested in the Australian context and are a feasible option for CSC to consume energy from their own solar generation, or any other arrays for that matter, however they do require integration with a 'friendly' retailer and monthly reconciliation of estimated versus actual generated/consumed electricity. For simplicity, it may be possible to find a local large consumer that agrees to purchase all energy generated from a CSC array.

A third option as indicated above, and one which CE has expertise in, would be for Council to effectively operate as a retailer, choosing to purchase energy from its own solar array at an agreed price, but also to purchase energy from the National Energy Market and then choose the level of price mark-up on-selling to themselves. While there are benefits in removing the retailer's margin through purchasing wholesale, the risk of this approach is that the pool price may, or will at times, be higher than the relevant standard tariff. Our modelling has shown for previous years that wholesale consumers tend to be better off overall, but this is not guaranteed. To mitigate against this risk, the ability to control loads automatically would limit exposure to any price spikes. In other words, if the price is high outside of solar production periods, then we switch things off! The other key mitigating factor would be integration of battery storage which could be used as an economic tool to play the market or to load shift (see below).

To further illustrate the concept, we have compared the amount CSC actually paid to power the Molong Office at the retail tariff versus what would have been paid at the market spot price. *Note that this only applies to the retail component of the bill.*

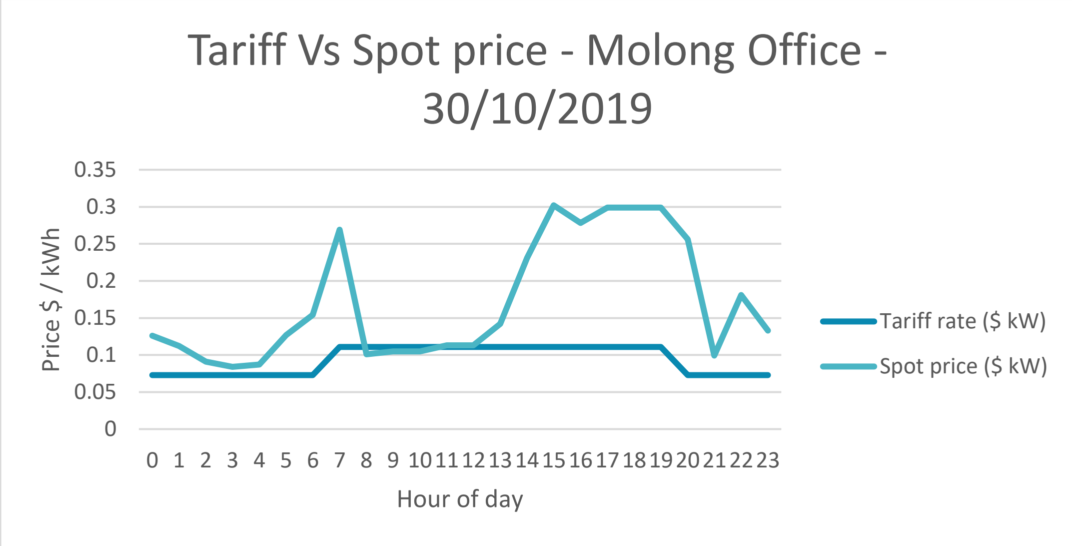


Figure 7. Instantaneous price comparison – higher spot

Figure 7 illustrates the fixed time of use tariff versus the wholesale market price of electricity that a retailer would have paid to purchase electricity for supply to the Molong Office on the 30th October 2019. On this day the retailer has lost money in supplying CSC because they've already agreed to charge you a lower price at that time. The quantum of that loss can be calculated multiplying the price with the amount of energy consumed, leading to the chart below.

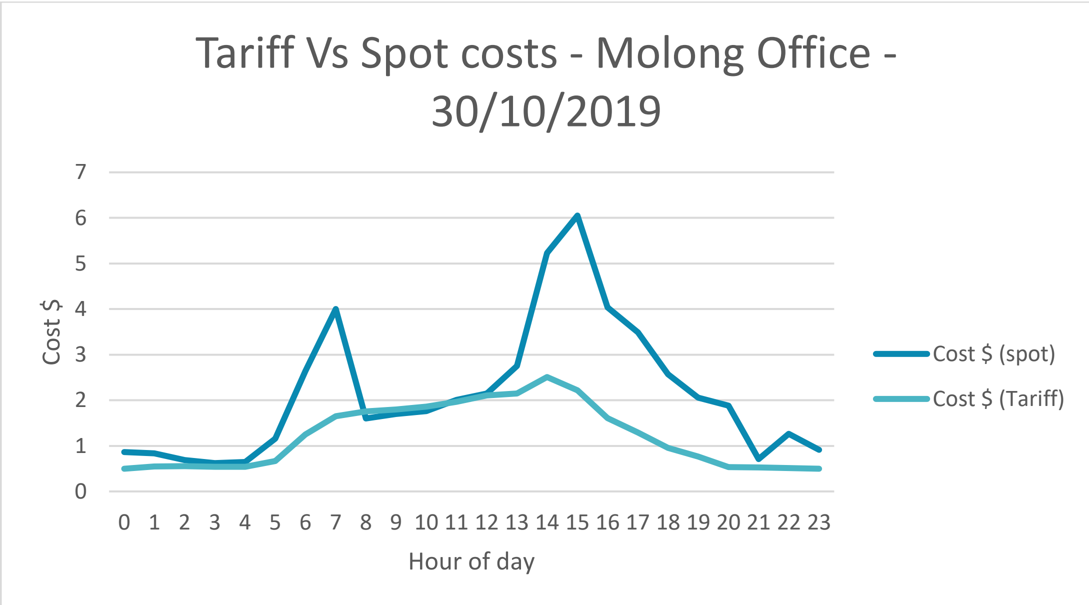


Figure 8. Site cost comparison – higher spot

The area under each of the curves represents to total amount paid for the 24-hour period and equates to $51.65 at wholesale prices and $29.29 at retailer tariff rates (which CSC actually paid on that day). Based on this evidence on might conclude that purchasing electricity wholesale is a bad idea but let's look at another day.

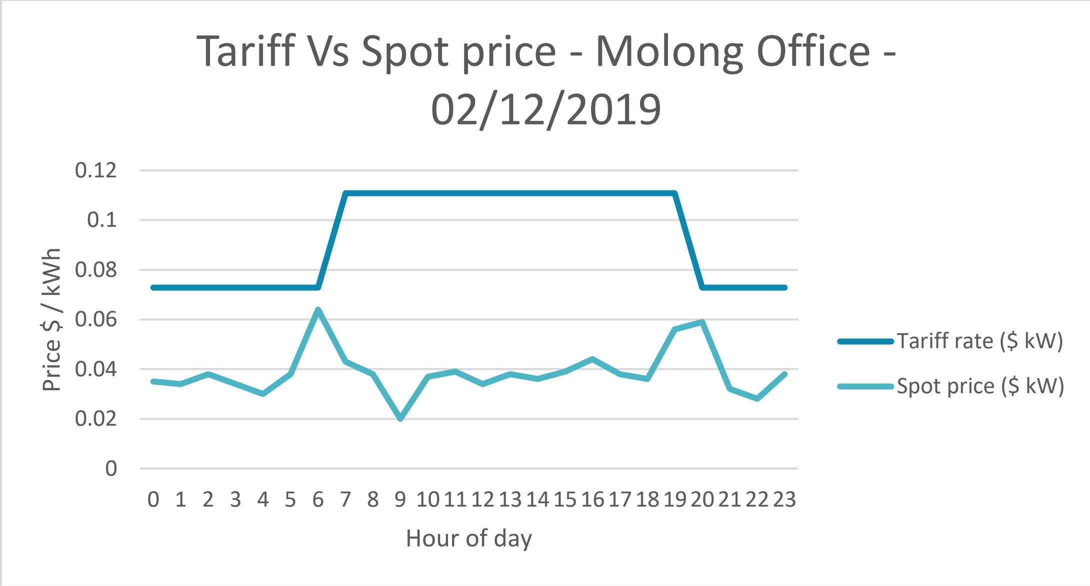


Figure 9. **Instantaneous price comparison – higher tariff**

Figure 9 illustrates a time when the market price was hovering around a 4c average, well below the agreed tariff for the entire day. Below we see the cost implications for this scenario.

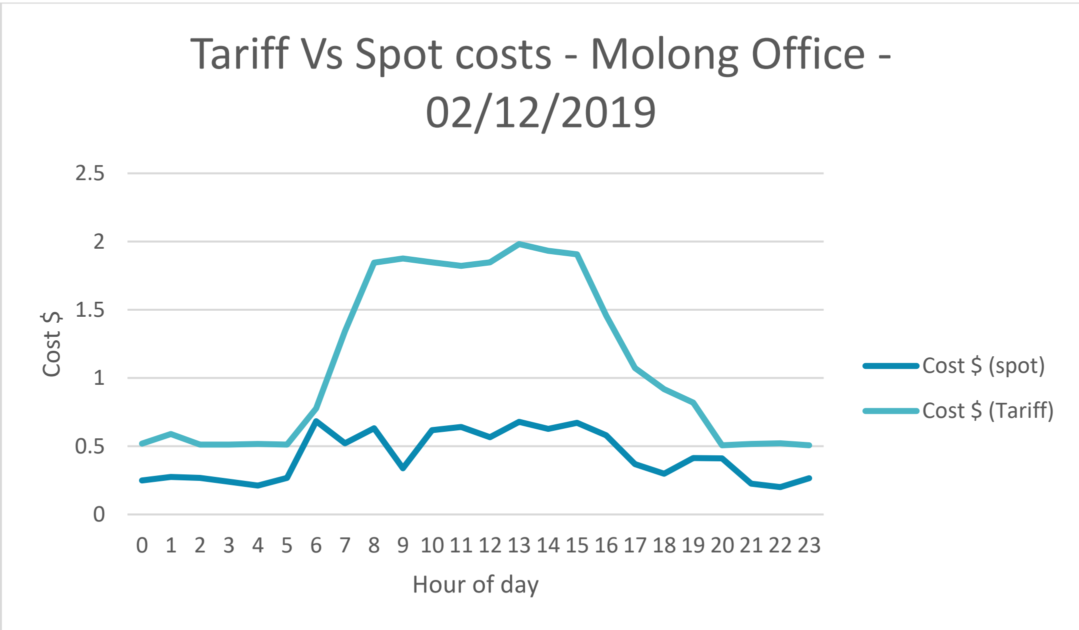


Figure 10. Site cost comparison – higher tariff

Through the tariff rates Council paid $26.66 for the electricity to run the office that day versus $10.25 had the cost of the market been reflected in the pricing.

The retail mechanism for this arrangement exists and is already offered in the market as "Cost Reflective Pricing" or "Price Pass Through" contracts. Perhaps unsurprisingly though it is not common because clients need to understand the potential risk of being exposed to a market. It is this risk that is managed by the retailer who takes a gamble in charging a rate that they think will keep them ahead over time. We only have data for 8 months at the Molong office however by applying the tariff and spot pricing over this period the following emerges.

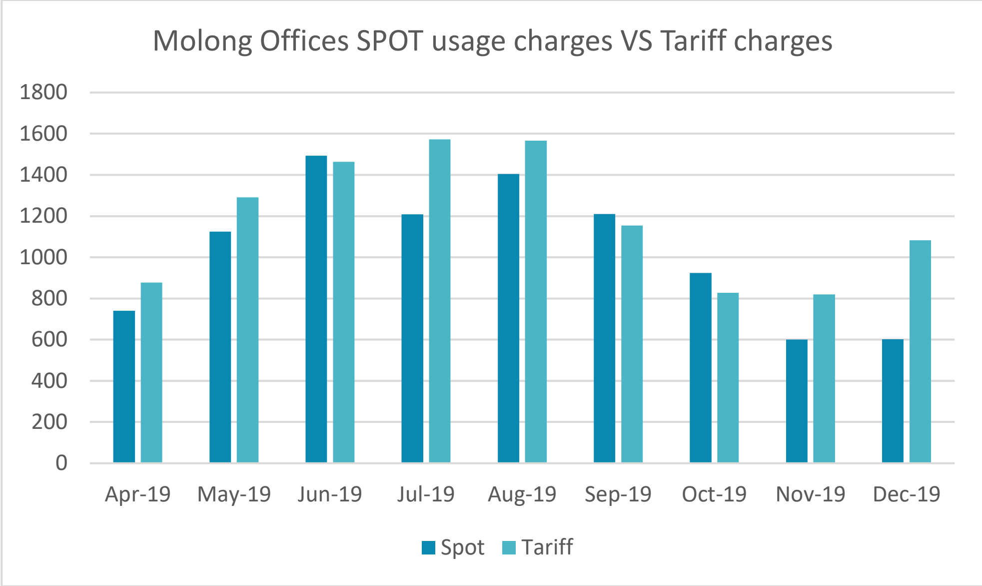


Figure 11. Site cost comparison – monthly totals

Molong Offices	April	May	June	July	August	September	October	November	December	Total
Cost on SPOT	$ 740.75	$ 1,123.84	$ 1,493.65	$ 1,209.26	$ 1,404.69	$ 1,210.02	$ 924.06	$ 600.43	$ 601.62	$ 9,308.31
Cost on Tariff	$ 877.53	$ 1,290.69	$ 1,463.65	$ 1,572.57	$ 1,566.92	$ 1,154.30	$ 827.37	$ 820.04	$ 1,082.13	$ 10,655.19

Table 3. Site cost comparison – monthly totals

Figure 11 and Table 3 both represent the same data clearly showing that, overall and for that period, the tariff cost of $10,655 was higher than the spot cost of $9,308 meaning that the retailer effectively made a margin of $1,347.

It is important to note that the missing 3 months may have altered the balance, but we can assume that retailers don't like to lose money! Past analysis for sites with complete data sets indicates that market exposure usually ends up costing less overall.

Also critical to note is that, coupled with a solar or renewable generator and load controlling capability, Councils offset high market prices at sites with high revenue from sale of energy into the spot market at the elevated price. On the flip-side, lower revenue for the solar array also means lower costs for Council sites.

The primary purpose of bringing this to the attention of CSC is to be aware of both the opportunity and consequence of 'stepping into' the generator retailer space. Part of the on-going role of Constructive Energy is to guide and support Council decision making, in regard to establishing projects, negotiating deals and managing renewable energy assets to optimise benefit.

To enable this requires CSC to engage with a generator-retailer willing to facilitate sale of energy into the National Energy Market and to enter into a cost reflective pricing mechanism. CE has facilitated this arrangement previously with Engie Services and Simply Energy.

It should be noted that no local government currently operates as a generator-retailer in New South Wales however this has only been the case since the last of the County Councils ceased to operate in the 1990's. Conceptually, the 'Council retailer model' is a case of 'back to the future' and yet still a major disruptor to the status quo. In our opinion the drivers for such a model are very strong, including financial gain and self-determination.

Interestingly, an example of where Council has successfully operated as a retailer, exists in the telecommunications industry. The Southern Phone company was formed in 2002 and was a successful collaboration of 35 regional Councils providing mobile, fixed-line and data services to the benefit of regional Australians. Their website states that … "since 2008 we've delivered more than $15.8 million in dividends and grants for the benefit of regional communities".

Southern Phone has acquired and services over 100,000 customers with the vast majority located within regional Australia. In December 2019, Southern phone was acquired by AGL Energy Ltd, providing each of their shareholders $785,000 return from their initial investment of $2 (source Southern Phone Jan20).

4.4 Energy Storage

Batteries have become synonymous with energy storage, which is an increasingly critical part of optimising the economic and environmental benefits of renewable energy generation. The enduring problem with intermittent renewable energy generation is reliability of supply, a factor which has been improved dramatically at the time of writing by the improving economics around battery storage.

The emergence of technologies that can offer utility scale storage at a price point within a 10 year pay-back is significant. It is now technically feasible to operate 'off grid' at scale, however, taking all Cabonne Shire Council's sites off the grid is not desirable for a range of reasons and at present would increase the cost of supply. However respected industry energy analysts suggest that price parity for this scenario could occur in the next 5 years and it will be worthwhile for CSC to consider this scenario with their high use sites in the next 5-10 years.

There exists a range of non-battery storage technologies available including flywheels, compressed air, pumped hydro, hydrogen and capacitor systems but the most prominent 'market ready' batteries are chemical based. The battery market is continuing in price decline as various providers and technologies vie for market share. In addition, the impact of batteries on the grid is not well tested in practice so case studies will have important flow-on impact.

An additional form of storage may be available in the form of heat or cold where potential solar export can be redirected to pre-chilling cool rooms or heating hot water. This facility usually involves additional technical equipment and/or IT control.

The business case for energy storage becomes apparent through understanding the Spot Price of energy on the National Electricity Market or NEM and differential Time of Use pricing.

At its most simple, batteries can purchase energy from the grid or a renewable energy source when it is cheap and sell at the time it is most expensive. The figure below illustrates this market profile in winter when it is usually at the most extreme. Clearly, if a storage facility can purchase at 6c/kWh and sell at 14c/kWh then there is 8c/kWh available to pay for the capacity.

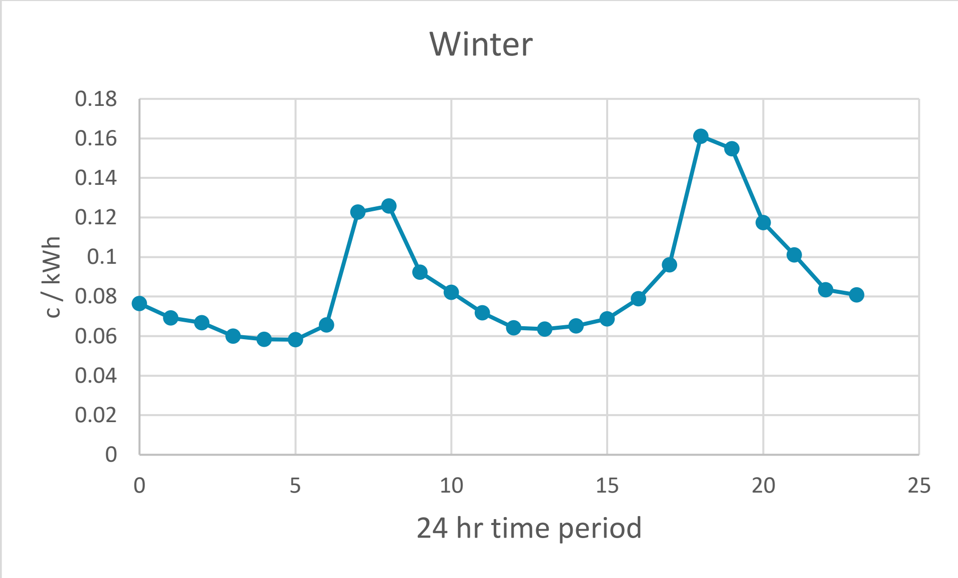


Figure 10. Spot market fluctuation winter profile

In addition to the above illustration of simple arbitrage, grid storage has the ability deliver Frequency Control Ancillary Services (FCAS) to the network. This involves management of the device/infrastructure to help the Market Operator deliver on Standards for frequency, voltage, network loading and system restart processes. These services are delivered through a separate market and can be worth considerable revenue. Unfortunately, it is difficult to forecast the value of these market accurately at a small scale however this can be regarded as an 'upside' similar to the delivery of Demand Side Participation (see Section 2.12 below).

In addition to economic and operational impacts, energy storage can be of higher importance when used to protected critical infrastructure or services. This already occurs in the form of diesel stored in tanks to run back-up generators – useful and economic because of the relatively low cost of diesel generators and infrequent use of the supply fuel. If CSC is considering energy security for critical infrastructure, then the reduced cost of storage and ability to install a renewable source that can save or generate money at all times may be smart. Combined solar/wind/battery/generator sets are already commercially available.

There are other reasons to integrate batteries, including control and monitoring. For example, if every BtM solar installation included a Tesla Powerwall, this would automatically provide data and control measures plus a degree of redundancy/security in the case of blackouts. A trial of 1200 households in Adelaide equipped with a Tesla Powerwall and rooftop solar, operating a virtual network, is proving successful in providing cheaper energy to householder partly because the system as a whole can be controlled and derive revenue from demand management to support network stability.

Battery modelling is complex and falls outside of the scope for this REAP. Our recommendation is that batteries should be seriously considered as part of any renewable energy project and at the very least, projects should be made 'battery ready'. Detailed modelling based on reliable existing and projected usage data will be required to develop a business case for investing in batteries.

4.5 Energy Efficiency Measures

The desktop analysis and site visits identified that there is potential for an immediate reduction in electricity consumption through implementation of energy efficiency measures. Simple behavioural/operational changes as well as integration of new technologies can be combined to achieve significant cost reduction, increased efficiency and a lowered carbon footprint. Estimated savings range from 5 to 15% per site. In addition, reduced demand results in smaller capital expense to construct renewable energy infrastructure for offsetting the demand.

Of significance to this issue is the low level of staff awareness, in general, relating to the amount and cost of energy consumed. Energy monitoring, reporting and integration into staff performance can reduce consumption by 10 to 30%.

The addition of metering and control devices would significantly enhance the case for energy efficiency.

4.6 Electrification of fleet and plant

The development of battery technology and in particular, greater energy density, has been driven by two significant market forces; transport and power tools. With Tesla most prominently spearheading the 'mainstreaming' of fully electric cars, as opposed to hybrid drive trains, all major brands are now developing Electric Vehicles (EVs). Many countries internationally have incentives and targets for EV uptake and China leads the world with development and sales, particularly in the heavy vehicle sector.

*"*For a GVW of less than 16 tonnes, an increasingly wide selection of all-electric trucks is reaching the market. In fact, major postal and package delivery companies, including DHL, UPS and FedEx, are expanding their fleets, and the Swiss and Austrian postal services have pledged to transition to all-electric fleets by 2030 or earlier." (source, International Energy Agency 2019)

For regional councils, the immediate challenges of model availability, range anxiety and relatively high prices are likely to abate by about 2025 (unless government incentives are established before then) as competition increases.

The relevance of EVs to this plan is particularly apparent when considering export of surplus generation and the fact that within the decade, Council will be producing energy for essentially no cost. Even at modest c/kWh prices, the operational savings are clear as illustrated in the table below.

Internal Combustion Engine (ICE)			Battery Electric Vehicle (BEV)		
Fuel efficiency	7	L/100km	Power efficiency	16	kWh/100km
Fuel cost	$ 1.40	per L	Electricity cost	$ 0.10	kWh
Annual running cost	$ 1,470		Annual running cost	$ 240	
Annual km	15000		Savings with EV	$ 1,230	per annum

However, because the fuel costs are marginal in the context of greater CAPEX, even considering reduced servicing costs, at present the financial case for EVs is not compelling. That said, CSC may decide that there are other reasons to factor, such as carbon reduction, research, leadership, etc and these may outweigh the reduced financial case. CE conceives that the 'tipping point' for wide scale adoption will occur when the price gap for equivalent ICE cars reduces to around 15%.

Aside from fleet cars, there is perhaps a more compelling case to look at electrification of heavy vehicles. The City of Casey in Victoria has commenced garbage collection services with an all-electric truck and many factories already use electric forklifts. Again, the case for these will be made more compelling in years to come if Council has the ability to set its own pricing for the electric 'fuel'.

Cordless power tools and light plant such as lawnmowers are also the focus of many manufacturers. For example, Makita have allegedly ceased all R&D into petrol powered tools. While these tools and plant use a small amount of energy in comparison to cars for example, there are operational advantages in not having to deal with mixing fuel and small engine maintenance.

The most obvious conflict with solar energy and electric powered vehicles is in the time of use – that being the overlap of solar generation and daylight working hours. This can really only be managed through the use of batteries and/or by analysing which vehicles/plant can be charged during the day.

An additional issue with EVs arises in relation to charging capacity; not just where to place them but the engineering behind delivering large amounts of energy quickly. So called 'superchargers' require large amperage, not always available through the existing grid, and therefore can incur significant costs to establish. If Council chose to power all the Council vehicles with self-generated solar power this would require a significantly larger array than currently forecast.

The view of Constructive Energy is that no immediate action is required in relation to EVs but that the case for them should be reviewed in 2 – 3 years.

4.7 Pumped Hydro

Pumped Hydro is emerging as a preferred dispatchable energy source, particularly over longer timeframes, due to its flexibility and low carbon emissions. Using combined pump/turbine plants, water is pumped from lower reservoirs to higher ones at times of plentiful or cheap energy and then released at times of peak demand when the price for electricity is high. Medium scale Pumped Hydro is likely to become an important 'product' in future markets as a buffer or insurance against high power prices and to time-shift large solar production from the middle of the day until night-time.

The Cabonne Shire Council region contains hills and disused facilities that may be appropriate for pumped hydro schemes. Council water security initiatives should also consider energy production as part of their remit.

At this stage, we do not recommend action related to this option, however, it should be 'on-the-horizon' particularly as government grants and programs roll out in support of dispatchable energy projects in the near to medium term future.

4.8 Bioenergy

CE understands that there are multiple primary producers and commercial operations, operating within the Cabonne Shire that produce waste that can be used as feedstock for bioenergy. Most prominently Manildra Group has received $5.38 million in funding from the Australian Renewable Energy Agency to install and operate a biomass fired boiler.

CE understands that there are also primary producers who may be interested in gas production from bioenergy for process heat and/or electricity. Council should be a participant in these conversations because of the ability of bioenergy to be a dispatchable form of renewable energy that can be used to augment the energy supply for entire townships in a regional location e.g. Molong and surrounds. The Australian Energy Market Operator has identified bioenergy as part of the 'future mix' of energy for Regional Australia and Cabonne Shire presents as an excellent candidate for the integration of this technology for both commercial gain and grid stability.

4.9 Microgrids

Microgrids are going to play a large role in future new greenfield developments in regional Australia. The costs of installing and firming renewables are now competitive and, in some circumstances, much cheaper than installing and maintaining the poles and wires to new remote locations.

An article in ABC News recently reported significant interest in micro-grids and energy sharing in a variety of applications from small townships to university campuses to remote communities (See ABC News 4th December 2019)

For CSC, microgrids should be considered for any development likely to have a few or more meters connected to the network. If Council is the enabler, then it is likely to result in reduced operating costs for sub-meter customers and an on-going revenue stream.

It may also be that micro-grids can enable better provision of power and services to villages within the CSC area.

A simple case study of Cargo is illustrative. In this example it is very difficult to complete detailed modelling (and outside the scope of this report) however the fundamental test would be to establish if a microgrid could be operated at or below the current operating costs for the community and, if so, what triggers exist in relation to pricing. This high-level overview assumes that the microgrid maintains a connection to the network but has embedded generation and storage capacity.

The following table represents estimates on the number and type of buildings in Cargo and approximate (based on national averages) and known daily loads.

Load	**No.**	**kWh/yr**	**kWh/d**	**kWh/d total**
Homes	110*		20	2200
Businesses	3		50	150
STP	1		50	50
Water supply	1		20	20
Streetlights	1	12000	32.88	32.88
Fire shed	1	400	1.1	1.1
			Total	**2453.98**

*source 2016 ABS Census

Table 7. Estimated daily loads in Cargo

Without metering data it is impossible to know the impact of seasonal variations on the average demand, however we have envisaged that the microgrid should be able to supply all of this demand for most of the year, apart from a month or so in winter. Rough modelling of Cargo's demand indicates that a solar array in the vicinity of 650kW be appropriate.

To enable provision of power overnight we have considered a battery with enough capacity to store and then release this demand for 12 hours.

The following table outlines approximate costs for solar and battery provision along with the revenue based on existing pricing for Cargo residents.

Solar	System size	650		kW
	Installation cost	$1.40		per kWp
	=	$910,000		
	reduced to daily rate at		14	year Payback
	=	$178		per day to finance
Battery	Cost	1 megawatt 12 hr		
	Installation cost	$1,000,000		
	reduced to daily rate at		11	year Payback
	=	$249		per day to finance
	O&M	$10		per day
	Total cost	**$437**		per day
Revenue				
	Energy sale price	28		c/kWh
	Volume	2453.98		kWh/d
		$436		per day

Table 8. Conceptual costs and revenues related to a Cargo Microgrid

The outcome of our high-level analysis indicates the following;

- The costs and revenues are roughly equivalent however there has been no incorporation of costs to purchase or replace the existing network. This would be an interesting study; would Essential Energy be interested in relinquishing control of these parts of their network – known to be costly to support? Could the current High Voltage infrastructure be replaced with undergrounded Low Voltage cables?
- If installation costs fell to 80c per watt solar and $600,000 for the battery, a daily difference of $177 results, or ~$65,000 per year which begs the question, if amortised over 10 years, could a low voltage grid be constructed for $650,000?
- There are a range of open questions such as who is responsible of ownership and operation of the microgrid? Would the project result in revenue to support provision of services locally?
- There would need to be compelling social and practical drivers for this approach to be viable – such as repeatedly interrupted power supply, extensive damage to existing network due to bushfire for example.
- The project could be delivered in a single location or distributed across all residences with on-site solar-battery packs – which would have its own pros and cons.
- The case is not compelling for immediate actions but should be kept ‘on the horizon’.

4.10 Off-grid facilities and critical infrastructure

Many remote communities and mining operations are currently installing independent generation facilities across the country. A good example of this has occurred in remote farming communities around Esperance WA. In 2015 a large bushfire caused loss of life and property, including large swathes of the local electricity distribution infrastructure. In agreement with the local community the electricity provider (Horizon Energy) has installed a virtual microgrid with each customer having their own solar production and firming capacity (battery). Locals have confirmed that the outcome for them has been stable and reliable power at equivalent cost (source: ABC news Oct 2019)

We recommend that serious consideration is given to installation of solar, battery and backup generation capacity for any new developments planned by CSC where access to the network may be problematic or expensive. Further, this approach can provide energy security for critical infrastructure in the event of natural disasters.

For example, as indicated above it is already viable to install BtM solar at the Molong STP. CE recommends that CSC consider the relative importance of energy security at this site, and other critical infrastructure, as this may be the significant motivation that weights the business case towards proceeding.

4.11 Retail arrangements

Contracts can be negotiated with energy retailers for specific tariffs to be applied to their energy consumption. As described earlier in section 4.1 and 4.4, PPA's are the most common arrangement in relation to renewable energy.

The CSC has a variety of sites that have large and consistent consumption, and this has provided a great start point for negotiations in the past and through well run tendering processes resulted in sharper competition between each of the energy retailers and hence better pricing. We also understand that a local expert has provided advice as to the best tariff for smaller sites, reflected in the multiple providers and contract structures for small sites.

As CSC implements the recommendations of this REAP plan, such as distributed solar installations and batteries on select sites, CSC can become a net generator of electricity which is then sold back to other CSC sites, the community and local industry. This changes the relationship with retailers who are already being disrupted by the 'prosumer' revolution affordable solar has created.

We recommend that Council be careful in engaging with any retailer over a long term and ensure fair exit conditions and the ability to reduce consumption. Ideally any new retail agreement needs to enable Council to sell excess energy production to the retailer at a market or negotiated price, whilst purchasing electricity consumption at a fixed low price during peak times. The contract should also enable peer-to-peer trading and the operation of a Virtual Power Plant.

Proposed changes to network operating rules will see smaller operators such as Councils able to participate in high value demand responses, such as being paid to reduce demand or produce electricity at times where the network is stressed. Any supply agreements should account for this into the future.

Because the sector is rapidly changing it is difficult to provide definitive guidance in respect to retailer contracts. That said, there is also significant innovation and opportunity emerging such as the model described above enabling CSC to effectively operate as a Generator-Retailer.

An ideal agreement would incorporate both elements, so Council is able to negotiate 'certainty' and savings with electricity production and consumption, ultimately benefiting the CSC community. The retailer would provide customer support and billing facilities and in return the Council could assist the retailer with their brand promotion and customer acquisition in their local government area.

Our recommendation going forward is that Council be increasingly wary of simple bulk purchasing contracts for electricity as these approaches can limit the capacity for Council to save or offset usage (usually a 20% reduction cap before fees apply) and to gain from participating in the new distributed energy economy.

4.12 Contract site cost reduction strategies

Regardless of the presence of renewable energy infrastructure, the hierarchy of cost reduction activities is;

- Install smart meters at sites
- Monitor and enable load shifting
- Use less energy through efficiency and operational gains
- Seek competitive pricing

The addition of renewable energy behind the meter allows one to;

- Generate and consume on-site
- Purchase less from market
- Sell excess to generate revenue

The most common ways to reduce consumption include;

- Tech/equipment solutions such as Variable Speed Drives, Voltage Optimisation, Lighting upgrades, HVAC renewal.
- Building fabric upgrades such as improved insulation, sealing, shading.
- Behaviour change including programs that incentivise staff via KPIs/rewards.

True to the adage "What we inspect we improve and what we measure we manage" - in all cases, it is critical to have transparency, in real time, on energy consumption.

Unless driven by a carbon-reduction imperative, the application of on-site renewable energy behind the meter is dependent on the ability of the system to be 'paid back' via savings from avoided consumption. The ability to monitor consumption in real time, analyse data, justify interventions and report on savings is critical and can only be achieved with appropriate metering. CE has expertise in implementation of monitoring and control devises and strongly recommends CSC pursue this.

4.13 Demand Side Participation (DSP)

Demand Side Participation presents an opportunity for Council to participate and financially benefit from the scheme.

The Australian Energy Market Operator (AEMO) has forecast elevated risk to electricity supply over the next 10 years. AEMO is forecasting interruptions to electricity supply during peak summer periods.

To mitigate against future disruptions, and to contribute to the network wide solution Council (a participant) can enter into contractual arrangements with AEMO, in which Council agrees to the curtailment of non-scheduled energy consumption or provision of non-scheduled generation in response to the NEM demand for electricity.

- Examples include industrial facilities that are exposed to the wholesale price and elect to reduce electric load at times of high prices, consumers that agree to let their battery be controlled by a third party or are incentivised to switch off air-conditioners, and small non-scheduled generators that have the ability to produce electricity at these times, offsetting local consumption (source: November 2019 AEMO Demand side participation forecast and methodology).

We recommend that Council explore opportunities to have excess solar and battery production enabled during these peak periods, for financial reward.

5.0 Proposed Renewable Energy Projects

CE has developed the following tables to summarise the results of our investigation and present the rationale for our recommendations

Project	SMART metering and load control installations across all Council's energy consumption sites.
Ranking	**Immediate**
BCA	CE investigations have revealed that there would be an immediate and long-term benefit to CSC to install smart metering and load control devices at priority sites. This project is a dependency for the other high priority Renewable Energy projects. It will enable Council to accurately trade excess energy production between Council sites, align Council operations to low peak charges and load control all non-essential energy consumption, during heatwaves. Meter installation costs may be tied into a retailer agreement or shared with a metering services company.
Community will benefit from this project	- Smart metering and load control enable the Council to become a 'smart' energy consumer and energy 'sharer' with the Cabonne Community. - Council will be able to redirect energy expenditure to other capital works that are more beneficial to the community.
Logic	Currently Council has effectively no visibility on its energy usage profile. This hampers any sensible decision making that can be made by Councillors and the Council Executive in reducing energy consumption costs and becoming intelligent in energy usage. Installing smart metering is a relatively low capital investment (if any) and any costs will be quickly recovered through Council reducing excess energy consumption and any wasted energy.
Effort – next steps	We recommend that budget be allocated in FY20 budget for this project. CE has already commenced on pricing this project for Council and will share 3rd party costings once completed.

Project	Medium scale solar (~1MW) with Council as retailer mechanism (VNM)
Ranking	**Immediate**
BCA	CSC has multiple locations where a potential Medium scale solar array with storage could be constructed, with solar A suitable solar energy system could be sized to accommodate CSC's peak seasonal profile. Energy produced from a medium scale solar site is 'sold' back to Council sites at a tariff which both pays back the array CAPEX and reduces electricity outgoings for Council. Project sizing is governed by site and infrastructure constraints and CSCs appetite to engage with local businesses and residents. CE experience shows these projects deliver yields in the order of 7 – 12%
Community will benefit from this project	- Council will reduce uncertainty and price pressure relating to energy. - Access to affordable, reliable electricity in the CSC LGA would be a driver to stimulate the local farming economy and to attract more businesses to the LGA. - In the longer term, Council can choose how to allocate 1MW of essentially 'free' energy to optimal benefit.

Logic	A medium scale solar build would provide Council with a new long-term revenue stream with an attractive ROI, particularly given that Council has access to cheap infrastructure finance. This project represents low financial risk. As previously modelled the payback period on such infrastructure is anywhere between 5-12 years as determined by Council. The lifespan of this build is upwards of 30 years and requires low operational expenditure.
Effort – next steps	Full site assessments, preliminary network investigations and detailed business case preparation.

Project	BtM Solar and battery installation at the major energy consumption sites.
Ranking	**Immediate**
BCA	Our desktop analysis has revealed that there are over 7 sites where Council will be able to receive a financial benefit from a solar and battery BtM installation. - In order of priority: 1. Council Chambers, Bank Street, Molong 2. Health One, Bank Street Molong 3. STP, Wellington Road, Molong 4. Caravan Park, Watson Street, Molong 5. Cudal Office, Main Street, Cudal 6. Water Pump, Googodery Road, Cumnock 7. Molong Depot, Molong St, Molong - Council will own the energy asset(s) within a range of 5-8 year payback period. Preliminary analysis indicates a yield of around 13% however there are unknowns that may reduce this figure.
Community will benefit from this project	- Council will be able to redirect energy expenditure to other capital works that are more beneficial to the community. - By implementing BtM Council will be able to share excess energy across all Community amenities at below market rate e.g. Pools, Halls, Kiosks, etc
Logic	The technology and business model now support Council to move from being a passive energy consumer to be a net generator of energy. The approach is well-established and has been successfully implemented by many NEM based Councils. With Council's access to cheap finance and with short payback periods an investment in renewable energy infrastructure is a sound investment for Council. BtM PV Solar installations come with 80% production warranty over 25 years for an asset that Council will be able to own outright within 5-8 years. BtM solar requires very low Operational expenditure over the lifetime of the installation. BtM PV solar can be augmented with battery installations.
Effort – next steps	Complete due diligence and prepare the business case, for a 100kW BtM solar installation at the Council Chambers. The business case should also cost/model battery integration for peer-to-peer sharing with other Council assets including the Charles McCarron baths in Canowindra. NB: Council needs to consider the potential diminishment of the mid-scale array case through reducing the amount required to buy from the array.

Project	Energy Efficiency measures implemented across Council locations
Ranking	**Immediate**
BCA	While some positive work has been completed, there are multiple locations where energy efficiency initiatives will have an attractive ROI, mostly relating to building fabric (especially shading) and lighting. Lighting upgrades frequently pay back within 2 years while other measures such as HVAC renewal require detailed analysis to define costs and benefits.
Community will benefit from this project	- Council will be able to redirect energy spend to other capital works beneficial to the community. - Council will reduce their carbon footprint.
Logic	This is considered an easy win for Council in reducing their energy consumption. LED lighting installation and more efficient heating\cooling will immediately reduce energy consumption and reduce the CAPEX for any renewable energy projects.
Effort – next steps	We recommend that CSC's procurement processes specify/preference high efficiency devices for new and replacement devices and, engage a third-party audit/assessment specialist to develop a list of costed savings measures. There are a range of quality suppliers available from the State Government through their Energy Saver Website.

Project	Energy Contract negotiations. Renegotiating with existing providers and/or engaging with novel retail approaches.
Ranking	**Mid term**
BCA	This has been given a ranking on "Mid-term" as it is dependent on Council aligning all their existing energy contracts and on which projects Council chooses to enact as a result of this Plan. The CSC negotiation position will also benefit when CSC has excess BtM energy to be sold back to the grid. Given that the market is volatile but currently trending down there may be strong cases emerging for renegotiating contracts.
Community will benefit from this project	- Council to negotiate with the preferred retailer, an offer specific to CSC ratepayers only. A best in market deal. - Ratepayers and the community will be able to leverage Council's strong negotiation position. Council is a large consumer of energy and sought after as a client by many of the Energy Retailers.
Logic	Council will be able to negotiate a better retail agreement through displaying willingness to engage in novel approaches that de-risk retailer services and/or lead to increased customers.
Effort – next steps	Align all existing contracted sites subject to contract termination dates. At an appropriate time, involve current retailers in plans for RE projects as there may be penalties or opportunities to negotiate around.

Project	Microgrids for CSC villages – special case study on a township.
Ranking	**Mid term**
BCA	The Cargo village is a prime small candidate for the first implementation of a Microgrid within the CSC LGA due to its size. However, Cabonne has many other villages that worth consideration.
Community will benefit from this project	The community would directly benefit from more reliable energy supply. More reliable energy supply can encourage commerce and deliver better living standards as well as greater energy security in the face of natural disasters. Some communities may also be motivated by the carbon emissions reduction and self-determination elements.
Logic	Cabonne contains several relatively isolated villages away from large capacity electricity infrastructure. Essential Energy finds these villages expensive and

	difficult to service and in parts of Australia the network operator is already removing end-of-line villages from the grid. Ideally villages could remain connected to the grid but would benefit from additional energy reliability and revenue generated locally through a micro-grid and Council or Community owned power plant. The remote township of Kalbarri in WA is successful example of a remote town developing their own microgrid (source: Western Power Nov 2019).
Effort – next steps	Business case development in 2020 – 2023

Project	Electrical Vehicle (EV) Fleet and Electrical Vehicle charge stations
Ranking	**Longer term**
BCA	While currently not attractive economically the global development of EVs is progressing rapidly. There is now a cost benefit for Council to consider changing the ICE (internal combustion engine) vehicle fleet over with EVs. This project would also need to include the installation of further EV charging infrastructure. EVs can be charged during off-peak times or with Council's excess energy generation. There is also future potential to have the EV fleet as contributors to a Virtual Power Plant managed by CSC. Co-funding of EV fast charge stations also exists for local government with the NRMA.
Community will benefit from this project	- Having multiple EV fast charging infrastructure located in the CSC is a tourism drawcard to the country region. - Council supported EV infrastructure and EV fleet, will quicken the transition away from ICE vehicles directly reducing Council's and CSC community's transport costs and emissions.
Logic	Preparation for the future where EVs make up most of the transport in the LGA.
Effort – next steps	CSC to invite / install further fast charging infrastructure. CSC to prepare for the transition to an EV fleet in 2020's on an 'as-needs' basis. Begin a trial with a vehicle and charging station linked to a solar project with export. Implement changes to procurement processes to ensure a smooth EV transition commences.

5.1 Project ranking template

An outcome summary project table has been created with a listing of potential projects and areas of enquiry. While CE holds a view on which are most important it is clearly the role of CSC to prioritise and integrate as appropriate. In order to complete the table, it is important to consider the project ranking framework.

- Benefit/Cost – does the project have positive financial impact?
- Leadership – will the project stimulate positive change in others?
- Community benefit – how does the wider community benefit from this project?
- Logic – is the project defensible, sound, ethical, enduring?

PROJECT SUMMARY AND RANKING TABLE

Activity/Outcome	Summary	Ranking	Responsible
ENERGY EFFICIENCY			
Monitor consumption:	Engineering are responsible for reviewing energy usage at all sites and of key equipment/assets.		
Reporting and performance	Energy use for sites/assets is reported in regular section meetings and efficiency forms a component of staff Position Descriptions		
Procurement policy	Energy consumption rates are considered in the procurement of any new equipment or servicing and maintenance of existing items. This includes new buildings and vehicles.		
Retrofit strategy	Building modifications will be carried out at least in part for the purpose of reducing energy consumption.		
Planning	CSC promotes energy efficiency in design through the planning phase where applicants are encouraged to adopt Guidelines for factors including – insulation, glazing, orientation, primary equipment, water use, etc		
Product broker	CSC applies knowledge and purchasing power to support residents and businesses with products that reduce their energy consumption		
Street lighting	CSC works with Essential Energy, etc to replace existing streetlights with efficient alternatives.		
SOLAR ENERGY			
Mid-scale solar array	CSC instigates detailed planning and project design to own and operate a mid-scale solar array matched to consumption		
On-site Solar for Council assets	CSC installs solar panels on (or nearby) Council owned sites ‘behind the meter’ sized to minimise purchase		
Education and Leadership	CSC makes it easy and safe for residents and businesses to install solar.		
Micro-grids	CSC develops new industrial and residential estates with the capacity for Council owned micro-grids and reduced energy costs to constituents from Council supplied electricity		
Generator /retailer models	CSC engages actively in leading the advent of energy sharing/virtual power plant metering		

	where Council and constituents can be the beneficiaries of local renewable generation 'in front of the meter.		
Industry support	Local industries are encouraged and supported to offset energy demand with commercial solar installations and/or to purchase Council generated energy at a competitive rate.		
HYDRO ELECTRICITY			
Hydroelectric generation	CSC remain on the lookout for opportunities		
BIOENERGY			
Bioenergy	CSC is home to many carbon-rich agricultural and primary production feedstocks capable of generating bioenergy. As a dispatchable energy source, this may be an important part of the local energy mix in the coming years. CSC should foster and collaborate with local businesses developing bioenergy.		
TRANSPORT			
Plant and Transport	Keep a watching brief on development of battery powered tools, electric and hydrogen powered plant and electric vehicles noting a likely exponential rise in adoption from 2025.		
ENERGY STORAGE			
Critical Infrastructure	Battery storage will be investigated to both maximise the value of solar generation and to provide back-up energy security for key services.		
Batteries for load sharing	Where Council creates/controls micro-grids, battery storage will be investigated to provide power sharing and grid stabilising faculty		
Medium scale array	Storage must be integrated into any proposal for developing a solar array to enable load shifting and to mitigate market risks if/when CSC becomes a generator-retailer		
Virtual Power Plant	Distributed batteries are supported as part of developing a community wide VPP.		
Energy Resilience	Batteries storage to be integrated with all 'Greenfield' installations to provide energy resilience against extreme weather events, e.g. bushfire or storms.		

6.0 Constructive Energy

Constructive Energy (CE) was founded in 2018 in the regional city of Bathurst (NSW). We are a renewable energy strategy and energy management firm.

Constructive Energy has a combined experience of over 25 years' worth of renewable energy and energy efficiency expertise.

Our key focus is to assist regional local government organisations with their transition towards a renewable energy future.

Since forming, Constructive Energy has:

- Developed Renewable Energy Action Plans for 5 local governments.
- Developed the detailed business case and commenced project delivery of a $7.6 million, 5 MW solar array.
- Completed several major funding applications for renewable energy projects with multi-State and national consortia including microgrid feasibility with the Murray Darling Association, Queensland Farmers Federation and Cotton Australia (result pending).
- Delivered energy efficiency training to builders in Australia and the US.
- Presented on renewable energy at several conferences and forums.

Our service offering includes:

- Renewable energy and energy efficiency strategy
- Small and medium scale renewable energy installation and project management
- Energy contract management and renewable energy procurement
- Outsourced energy management and energy consumption reporting

Our stated goal by 2030 is to:

- Assist Local Government to install and own over $60m in renewable energy infrastructure.
- Facilitate the micro-grid, VPP and behind-the-meter transition across regional Australia
- Deliver 20m tonnes in Carbon abatement.