Junee Shire Council
Renewable Energy Action Plan

Completed by Constructive Energy Pty Ltd

February - 2021

Contents

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 Junee Shire Council and energy retailers 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

Junee Shire Council (JSC) is an innovative and progressive Local Government that supports the adoption of new and improved technologies to reduce energy costs and emissions, making Junee a great place to live. JSC have engaged Constructive Energy, a regionally based consultancy to prepare the Junee Shire Council's Renewable Energy Action Plan (REAP).

Constructive Energy have completed a process involving staff interviews, meetings and workshops, literature review, site visits, data collation and interrogation, modelling, market research and high-level business plan/feasibility development. As a result, we have identified a range of projects and initiatives designed to meet the unique objectives, constraints and most importantly any opportunities for JSC to sustainably adopt renewable energy.

Junee Shire Council shares many concerns common among local governments in relation to energy, such as cost control and uncertainty about how to engage with new emerging renewable energy technologies and business models.

Renewable Energy is an enabler that can provide Council with cost control and additional revenue streams, whilst reducing carbon emissions and pollution.

The key recommendations of this report are:

1. A behind-the-meter (BtM) solar array installation, with battery(s) and EV charger at Junee Junction Recreation and Aquatic Centre (JJRAC), section 4.1.3.
2. Detailed concept modelling for a medium scale solar array, section 4.1.1.
3. Council to continue investment in Energy Efficiency measures to reduce Council energy consumption, section 4.2.
4. Investment in smart metering and energy load control at key Council facilities, section 4.3.
5. Adopt new retail arrangements that allow Council to share energy across Council facilities and\or business and the Junee community, section 4.6.

Shorter-term objectives include the adoption of renewable energy at Council's high consumption facilities, prioritising the Junee Junction Recreation and Aquatic Centre (JJRAC).

Medium term objectives include the option for Council to operate a midscale solar array to offset 100% of Council electricity and gas usage.

Longer term objectives include the adoption of Electric Vehicles (EV) and supporting community through provision of cheap, clean electricity, making Junee Community 100% renewable. Council has also demonstrated willingness to work with local businesses and community groups, including Junee Lamb, Junee Correctional Centre, and the Junee Community Power inc.

While a full range of renewable energy technologies are explored, CE finds the most obvious opportunity in solar PV, following essentially one of two pathways, Behind the Meter (BtM) distributed energy or a mid-scale solar installation on one or multiple Council or partner sites.

Energy Storage should be considered as part of the evaluation of every project for its ability to provide flexibility and adaptability in future energy management. This is particularly true if Council elects to follow the distributed energy route.

The accessibility of energy consumption data is poor across Council assets with little real-time monitoring available. Smart metering upgrades are an immediate priority even in the absence of any other activity as this represents a 'no regrets' strategy in both providing data for decision making and future proofing the Council for smarter energy trading and management.

The energy retailing sector is changing dramatically, and Junee Shire Council is well positioned to take advantage of emerging models in valuing and sharing renewable energy. Capacity now exists for JSC to effectively operate as a 'generator-retailer' and to use excess energy to underpin services or affordable energy to local business and industry.

Energy efficiency should not be forgotten as this both reduces the CAPEX required to achieve cost control and, if the right generator-retail deal is brokered, will result in additional value for Council.

Vehicles, plant and equipment represent a challenge which can be managed basically through offsetting or substituting fuels depending on financial factors, the appetite of Council for innovation/leadership and the practicality of developing alternative fuels in Junee.

Constructive Energy are of the opinion that becoming 100% renewable is not only achievable, but that it makes economic sense to do so and will improve the fitness of Council for the future on multiple levels. We recommend that Junee Shire Council adopt this Renewable Energy Action Plan and use it to gain or leverage government and private sector investment.

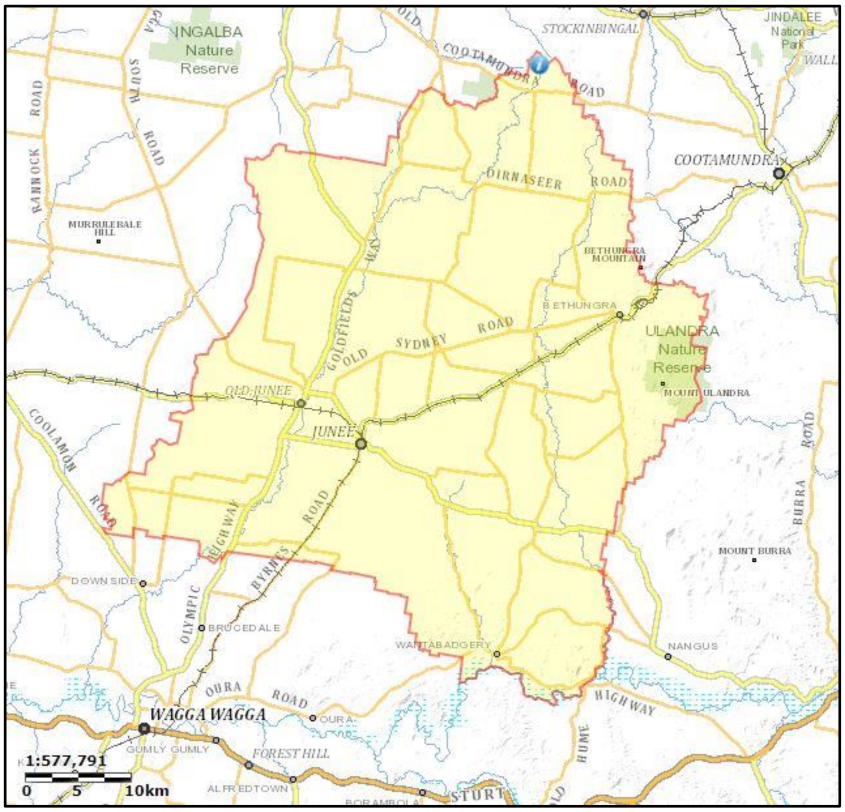
Constructive Energy is passionate and dedicated to the integration of renewable energy in Regional Australia for the advantage of local communities. As such, we are available as a 'critical friend' to Council on an ongoing basis. Constructive Energy can assist in grant submission, business case development and project delivery that Junee Shire Council may require. 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 Junee Shire Council (JSC)

Junee Shire Council (JSC) is a Council located in the Riverina region of NSW. The Junee region has a population of 6,295 recorded during the 2006 Census (Australian Bureau of Statistics, 2016 Census).

The Council covers approximately 2030 km2 and is located within the Essential Energy distribution network.



Map 1. Junee Shire Council boundary – (source: https://maps.six.nsw.gov.au/ - November 2020)

1.2 Purpose Statement

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

Junee Shire Council (JSC) supports innovation in energy use and delivery for the purpose of sustainability, improved cost control, demonstrating leadership within the community and doing Council's bit to reduce emissions.

In context of the above, the purpose of this Plan is to provide strategic direction into the specific opportunities and pathways for Council to meet these objectives as part of the Junee Shire Council Combined Delivery Program and Operational Plan 2020-2024.

1.3 Junee Shire Council Objectives

Junee Shire Council has developed a Renewable Energy Action Plan, with the following objectives:

- To make Junee a 'great place to live, with a healthy civic pride'.
- "Council to lead by example with innovative technologies and processes, including energy management and environmental sustainability" (Junee Delivery Program and Operational Plan 2019-2024).
- Sustainability "manage our human, built and financial resources wisely … and embracing energy efficiency and reducing, reusing and recovering waste" (Junee Delivery Program and Operational Plan 2019-2024).
- Reduce the Council's Greenhouse Gas footprint (Junee Delivery Program and Operational Plan 2019-2024).
- To attract and retain people and businesses to Junee township and district.

1.4 Decision Making Framework

The following framework was developed in consultation with Junee Shire Council 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

For Council to power the entire organisation operations using 100% renewable forms of energy, we start by quantifying where energy is consumed, how much and in what form.

Electricity

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

	No. of Sites	kWh	MWh	% usage	Cost $	% cost	c/kWh	GHG (tonnes)
Contract	2	570,771	571	65%	$ 119,173.84	57%	21	462
Tariff	21	302,580	303	35%	$ 89,996.74	43%	30	245
Total	23	873,350	873		$ 209,170.58			707

Table 1. Contract site VS Tariff site summary

In FY20, the 2 Contract sites consumed 571 MWh of electricity compared to 303 MWh consumed by the 21 Tariff sites as is shown in the Table 1.

While the major 'contract' sites represent 65% of energy usage, they represent 57% of the overall energy costs. This initial analysis indicates that the electricity c/kWh rates are within the anticipated range of what we would expect based on JSC consumption.

For comparison, most Councils we have worked with have their electricity $/kWh within the range $0.20-$0.30 per kWh. For FY20 JSC paid $0.20 per kWh for Contract sites and $0.29 per kWh for Tariff sites. Both are within the anticipated range.

Scope 2 greenhouse gas emissions have been calculated referencing the National Greenhouse Accounts 2020 and show that Council emitted approximately 707 tonnes via indirect emissions from consumption of purchased electricity.

Vehicles, plant and equipment

Next, we investigated the quantum of energy (equivalent) of liquid fossil fuels that has the potential to be fully or partially offset by locally sourced renewable energy.

Council has already taken a leadership in this space and has invested and adopted Hybrid Vehicles as part of the passenger vehicle fleet. There is also a strong appetite within Council to continue to be "first-movers" and innovators and to continue to adopt EVs (Electric Vehicles) and FCEVs (Fuel cell electric vehicles – Hydrogen), as this new technology emerges.

JSC own and operate a significant register of motor vehicles and other plant and equipment to perform the various day-to-day operations of Council. We reviewed the 2020 inventory and have grouped these into 3 categories:

Description	Total
Road Vehicles	46
Heavy Plant	19
Minor Plant	85

Table 2. Summary of plant Council operated vehicles and plant (energy consuming) November 2020

It can be difficult to accurately calculate the annual consumption of the liquid fuels consumed however a broad-brush approach was taken to estimate annual Council consumption: -

Financial year	Approximate Litres consumed p.a.	Approximate kWh p.a.	Total Scope 1 GHG emissions (tonnes)
FY 20	212,173	2,239,613	577
FY 19	244,628	2,582,185	665
FY 18	248,800	2,626,222	677

Table 3. Fuel consumption 2020

If we assume that Diesel consumption accounts for 80% of liquid fuel consumption, then we can calculate that there was approximately, 212,000L of liquid fuel consumed in FY20 and approximately 577 tonnes of Green House Gases scope 1 emissions.

Later in the report we discuss, options on how and when Council can move towards to powering the vehicles, plant and equipment with renewable energy and displacing liquid fossil fuels.

Gas

JSC has only one major site that consumes gas – Junee Junction Recreation and Aquatic Centre (JJRAC). The JJRAC is a large consumer of gas and has invested in large gas boilers to heat the aquatic complex. Historically gas boilers are the most cost-effective way to heat community swimming pools. However, in the medium-term, Australia faces some challenges with domestic gas supply (as has been widely reported in the press). Market predictions anticipate severe supply shortages on the East Coast as early as 2025, coinciding with the Bass Strait fields being exhausted. In the REAP we have focussed on potential ways that renewable energy could be used to replace the large amount gas at JJRAC.

Below is a snapshot of the JJRAC gas consumption and we included the equivalent in grid consumption electricity (kWh).

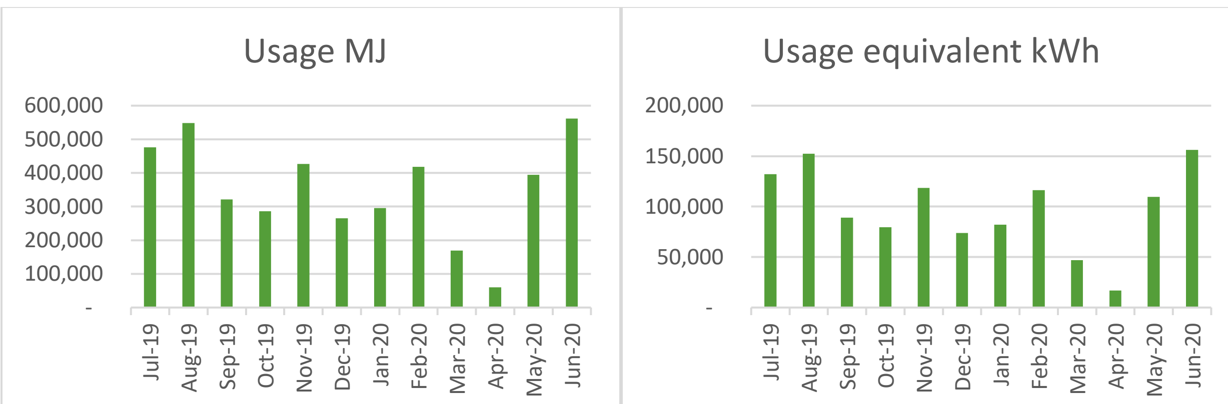


Chart 1. JJRAC monthly gas consumption & Equivalent kWh electricity consumption

Further summarised in the table below: -

Date	Usage MJ	Charges ex GST	$\MJ	Usage equivalent kWh	Equivalent c\kWh	GHG CO2 tonnes
FY20	4,222,163	$ 103,393.61	$ 0.0245	1,172,832	$ 0.0882	217.57

Table 4. JJRAC consumption 2020

It must be duly noted that Council has negotiated extremely competitive pricing for supply of gas at the JJRAC with gas energy prices well below their electricity comparison.

The quantum of 'gas' energy consumed at JJRAC is substantial, and any upward movement in the gas prices, exposes Council to budget pressure. It is not unconceivable that by 2025 gas prices may have double or trebled. As outlined later in the report, it would be prudent for Council to start considering other renewable energy options for JJRAC, when contracts expire, and gas equipment approaches end-of-life.

Energy Approaches

Constructive Energy has examined the entirety of Council's assets and operations with the view to develop a pathway for Council to maintain a leadership role and to continue to adopt Renewable Energy. We have considered 4 broad approaches.

1. **Seek 100% renewable power.**

   Simply seek renewable electricity suppliers and move to electrify vehicles and as much plant and equipment as possible.

2. **Find alternate fuels.**

   Seek suppliers of biogas and biodiesel to operate existing plant and equipment.

3. **Make your own.**

   Establish Council as a Generator-Retailer of electricity and small-scale producer of transport fuels from waste.

4. **Replace versus offset.**

   Substitute non-renewable for renewable energy where practicable and support off-set activities/projects for remaining energy-related emissions.

It should be noted that the Australian Energy Market Operator and many industry commentators expect the National Electricity grid to be 50% renewably powered by 2025 and 90% renewable around 2030.

In effect, if carbon neutrality is the key driver, this results in JSC having a legitimate 'do nothing' approach – other than purchasing offsets. However, this strategy renders JSC as a 'price taker' only and goes against Council's objectives for adopting innovation and being a community 'first-mover'.

This report examines opportunities for Council to become investors and long-term financial beneficiaries of energy infrastructure in the process of becoming 100% Renewable.

2.0 Contract Site Analysis

2.1 Contract Site Overview

The following table lists all contract sites with their usage and annual costs. 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 first review 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	GHG tonnes	Cost $	c/kWh
Junee Streetlights	Origin Energy	257,698.65	209	$ 49,472.23	$0.1920
Rec Centre	Origin Energy	313,071.89	254	$ 69,701.61	$0.2226
		570,770.54	**462**	**$ 119,173.84**	$0.2073

Table 5. Junee Shire Council usage and costs for Contract sites

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

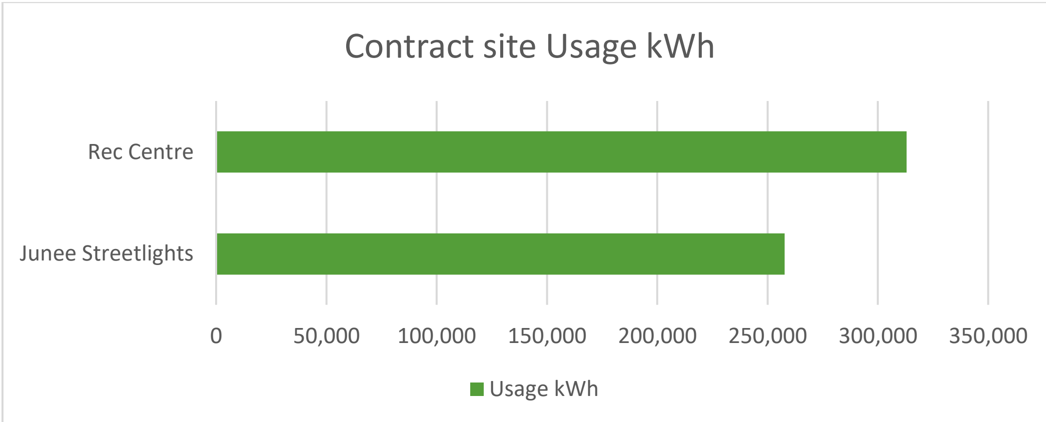


Chart 2. Contract site usage

The two largest consumers of energy for Council, by a significant margin, were the Unmetered Streetlighting and the JJRAC Rec Centre. Chart 2 demonstrates the financial justification for Council to adopt the 'make-your-own' energy approach, as will be discussed in detail later in this REAP (section 4.3.3).

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 JJRAC and provides a detailed breakdown of the charges for electricity supply to this site.

DETAILED CHARGES

ENERGY CHARGES

Energy Charges	Quantity	Unit	Rate	Unit	MLF	DLF	Amount $ (Ex GST)
Peak	4,785.480	kWh	6.240000	c/kWh	0.97570	1.06910	$311.49
Shoulder	10,238.960	kWh	6.240000	c/kWh	0.97570	1.06910	$666.46
Off-Peak	19,218.040	kWh	4.231000	c/kWh	0.97570	1.06910	$848.18
Sub-Total							$1,826.13
GST							$182.62
Total Energy Charges							$2,008.75

NETWORK CHARGES

Network Provider: CNRGYP | Tariff: BLNE22AU

Network Charges	Quantity	Unit	Rate	Unit	Amount $ (Ex GST)
Volume					
Peak	0.000	kWh	0	c/kWh	$0.00

Network Provider: CNRGYP | Tariff: BLND3AO

Network Charges	Quantity	Unit	Rate	Unit	Amount $ (Ex GST)
Demand and Capacity					
Shoulder Demand (kVA)	90.62	kVA	8.973900	$/kVA	$813.21
Peak Demand (kVA)	82.35	kVA	9.918600	$/kVA	$816.79
Off-Peak Demand (kVA)	83.45	kVA	2.169900	$/kVA	$181.08
Fixed					
Network Access Charge	31	Days	14.832200	$/Day	$459.80
Volume					
Off-Peak	17,405.880	kWh	2.303000	c/kWh	$400.86
Shoulder	13,498.560	kWh	3.562000	c/kWh	$480.82
Peak	3,338.040	kWh	4.018600	c/kWh	$134.14
Sub-Total					$3,286.70
GST					$328.67
Total Network Charges					$3,615.37

REGULATED CHARGES

Regulated Charges	Quantity	Unit	Rate	Unit	DLF	Amount $ (Ex GST)
AEMO Participant Charge	34,242.480	kWh	0.039300	c/kWh	1.06910	$14.39
AEMO Ancillary Charge	34,242.480	kWh	0.046100	c/kWh	1.06910	$16.88
Sub-Total						$31.27
GST						$3.13
Total Regulated Charges						$34.40

ENVIRONMENTAL CHARGES

Environmental Charges	Quantity	Unit	Rate	Unit	Published Certificate %	DLF	Amount $ (Ex GST)
ESC Charge	34,242.480	kWh	3.200000	c/kWh	8.50	1.06910	$99.58
SREC Charge	34,242.480	kWh	4.000000	c/kWh	21.73	1.06910	$318.20
LREC Charge	34,242.480	kWh	8.775000	c/kWh	18.60	1.06910	$597.51
Sub-Total							$1,015.29
GST							$101.53
Total Environmental Charges							$1,116.82

<u>Example Invoice for Contract Site (JJRAC)</u>

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

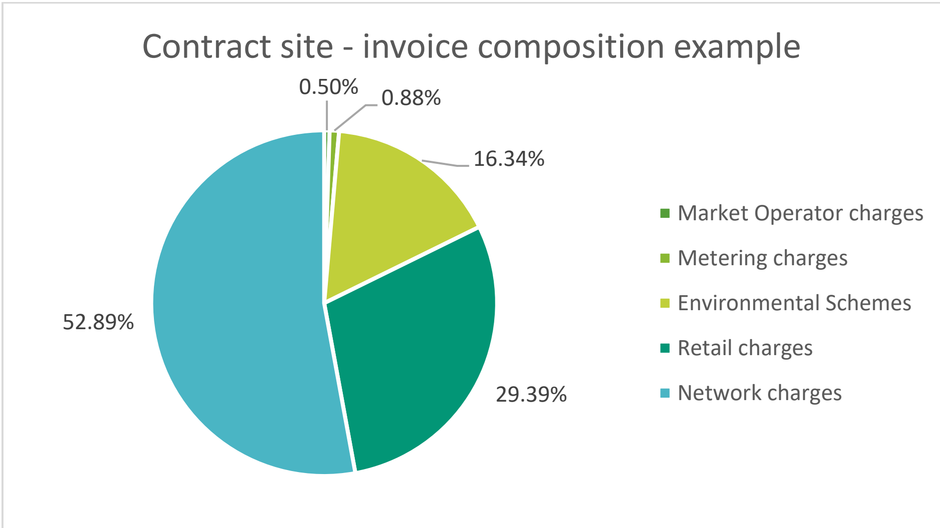


Chart 3. Contracted sites bill comparison (Jan 2020)

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.
- 30% 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 15%, or, in the above example $912.96 vs $1,825.
- The reason that 'behind the meter' (BTM) projects are attractive is because they reduce all elements of the bill though reducing the full 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 Junee large usage sites.

The most cost-effective time of day to consume electricity is in the Off-peak period from 10pm to 7am. Shoulder times (9am-5pm) and Peak times (7-9am and 5-8pm) are charged at higher rates and in the case of JSC, these rates are equal. In many cases peak is charged higher than shoulder.

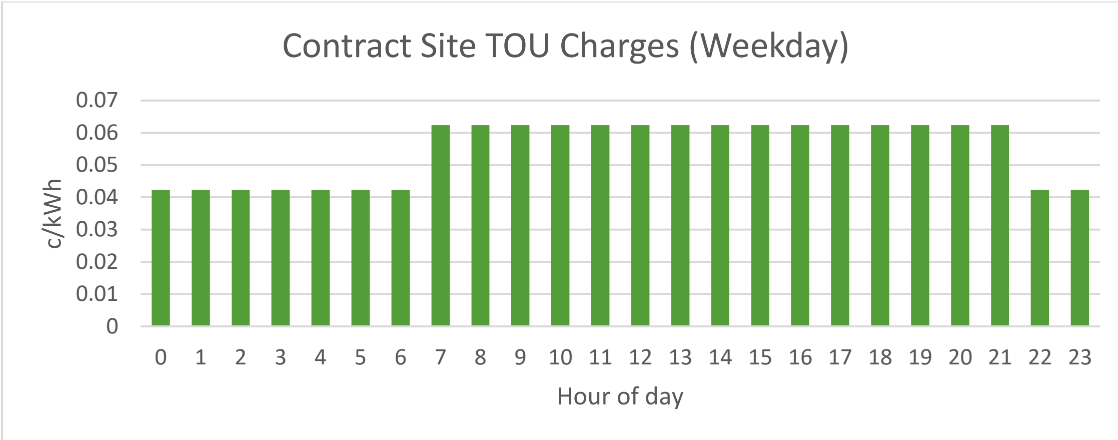


Chart 4. Contract Sites - Time of Use retail charges

Finally, the differential between Peak and Off-peak charges can also provide the economic rationale for battery storage and/or behind the meter load shifting.

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. A 2c differential as exists currently for JSC is unlikely to make this viable.

3.0 Tariff Site Analysis

3.1 Tariff Site Overview

Junee Shire Council manages 21 facilities with a National Meter Identifier (NMI). For this analysis we have grouped these sites into areas of common function as shown in the table below. Like the contracted Large Market sites, the simple derivative of annual cost divided by consumption gives an indicative c/kWh and provides metric to prioritise sites that will benefit from a BtM renewable energy installation.

Site group	Annual kWh	GHG tonnes*	Annual cost		c/kWh
Amenities	16,064	13	$	6,576.04	40.94
Council Facility	82,482	67	$	23,571.23	28.58
Hall or community centre	85,795	69	$	26,146.50	30.48
Parks or sports fields	27,783	23	$	10,295.63	37.06
Water treatment and pumping	90,456	73	$	23,407.33	25.88
	302,580	245	$	89,996.74	32.58

*Scope 2 emissions from consumption of purchased electricity

Table 6. Tariff sites cost and usage breakdown

The categorisation used for Table 6.

Site group	Description
Water treatment or pumping	Sewer, septic and water pumps.
Hall or community centre	Halls, community centres and libraries.
Council facility	Administration buildings & depots
Parks or sports fields	Sports facilities, parks and gardens.
Amenities	Toilet blocks & roadside rest areas.

The chart below represents the same information in a manner that allows us to see the groupings that draw the most energy. The major tariff sites being the water treatment and pumping stations and the halls and community centres.

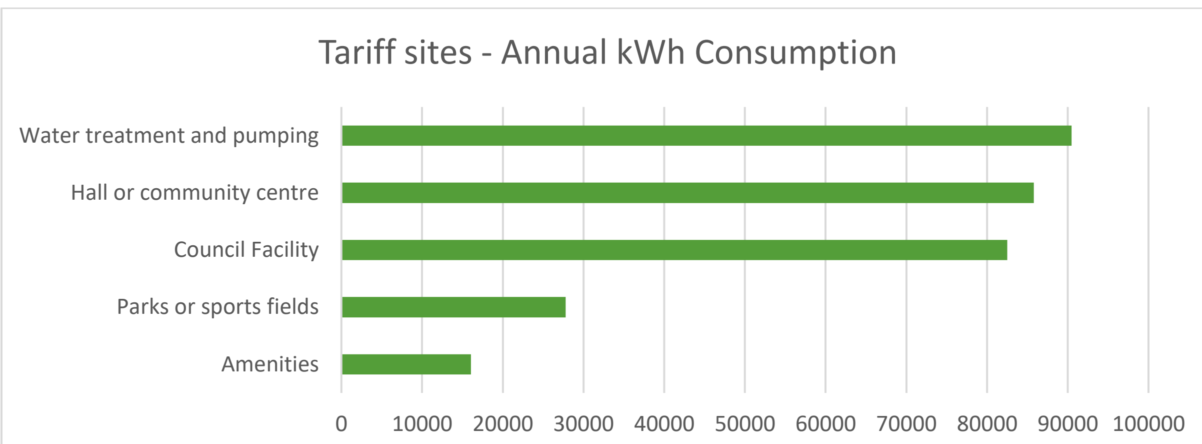


Chart 5. Grouped tariff sites annual kWh usage.

Further insight is gathered by looking into the individual sites that consume the most energy. Table 7, below, displays any sites that consume over 20,000 kWh pear year.

Site Name	Annual kWh	GHG tonnes*	Annual cost		c/kWh
STW Temora Rd	79,206	64	$	19,569.18	24.71
Council Chambers	55,283	45	$	15,374.07	27.81
Junee Library	54,890	44	$	16,437.79	29.95
Council Depot	26,799	22	$	7,624.95	28.45
Broadway Museum	21,030	17	$	6,113.68	29.07
	237,208	**192**	**$**	**65,119.67**	**28.00**

*Scope 2 emissions from consumption of purchased electricity

Table 7. Tariff sites cost and usage breakdown.

Continual tariff review will remain of value for this group of facilities, and all others on contestable tariffs.

Key questions

- Which of these sites is best suited to BtM solar?
- Which sites can change their energy use through either behaviour change or technology?

3.2 Tariff Site Strategy

The c/kWh column in Table 7 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 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, beyond energy efficiency measures there are three strategies for reducing costs; behind the meter solar installations, self-consumption of export from other Council sites at a reduced fee (see more on this below), and time-shifting non-essential consumption to optimise tariff structures.

Behind the meter renewables

JSC has implemented BtM solar installation at the Sewerage Treatment Works. Without detailed pre-solar consumption data available Constructive Energy has not analysed the financials of the STW solar project, however the industry standard for this type of installation is a 4–7-year payback on the array and, at absolute worst case, a 7-10% yield, so much better than a bank!

This STW solar project demonstrates that JSC could adopt this approach across multiple Council facilities. On our site visits, Constructive Energy identified the JJRAC, Council Chambers and the Laurie Daley sports fields as ideal locations for multiple BtM Rooftop solar installations. Each site demonstrates the characteristics, ample roof space, north orientations, no tree shading, and large site consumption although there are questions as to the suitability of the Chamber roof to carry solar panels. The most obvious of these sites is the JJRAC and our bill analysis of this site demonstrated that a significant proportion of its consumption could be self-consumed.

If the BtM approach is adopted, it is possible to maximising production at each site by ‘oversizing’ each solar array however this can be limited by the available roof space and network capacity for export. Oversizing can diminish the ROI for each site although this can be compensated for by internal peer-to-peer trading of the excess energy.

Often BtM solar systems installs are capped at 100kWp, the upper limit to qualify for small-scale solar rebates. However, the business case for BtM solar should always consider the option to 'oversize' as the long-term benefit and ROI may outweigh the initial additional Capex. We consider this as a viable option for JJRAC and have included in the section 4.3.2.

There may be an argument for BtM battery installation at some sites, particularly if paired with solar or small-scale wind, as this will result in the ability to avoid peak tariff charges and participate in emerging demand response opportunities.

Internal energy sharing

Over recent years the capacity has emerged to 'bundle' several solar sites, managing them as a Virtual Power Plant (VPP) and/or to specify pathways of energy sharing between customers and sites e.g., Peer-to-Peer trading. Examples already exist in Australia and conceptually this could be a useful model for JSC. There is a financial advantage in paying one-self for energy and supplying excess from site A to site B for free (although network charges still apply).

The establishment of internal energy trading will necessitate both upgraded metering devices and identifying a hierarchy applied to sites. The hierarchy will be based on factors such as consumption profile, overall load/cost and social benefit. This hierarchy enables Council to optimise the excess summer export from a Council owned and operated 'Virtual Power Plant'.

Later in this report we take this approach and investigate the opportunity to consume energy at every JSC site with electricity which has been generated at a single large site. This enables the pay-off of an array to be made with funds already budgeted to operate Council services and facilities. As for the distributed generation approach, once the single large array is 'paid back' Council can choose to supply to itself effectively for free.

Load shifting

There are advantages in having the ability to control when and how energy is consumed. Most obviously the ability to avoid peak charge periods and optimise lower fee windows however there are also emerging markets for Demand Response. This is where network operators (retailers or network providers) make payments to consumers for decreasing load or providing/choking supply in response to issues managing the entire network. An example would be for a Council to turn off non-essential loads in heatwaves to avoid overloading the network and causing blackouts. These arrangements are negotiated with Council's retailer and the network operator.

This capacity is contingent on equipment installed at the switchboard and a software interface with embedded control logic. There are several suppliers in the market and more emerging with devices ranging from "Super smart meters" which report direct to the electricity retailers and also have load control capacity embedded, through to multiple sub-circuit controllers.

Recommendation: We recommend that all installations of solar and/or electrical upgrades now be accompanied with a smart meter installation, preferably with an embedded load control functionality.

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.

4.0 Priority Renewable Energy Options

As with most things in life, it may be that there is no one silver bullet solution. It is often the case that the best approach is to adopt multiple strategies. As always, it is important to be clear about JSC's core objectives and the decision-making framework in evaluating the alternative options.

In this section of the report Constructive Energy have highlighted the projects we feel stand out given our understanding of JSC objectives.

4.1 Solar

Solar Photo-Voltaic (PV) cells are a proven technology capable of delivering on-site electricity for immediate consumption and/or export. While panel efficiency has improved in recent years, the major factor driving an increase in solar installations has been dramatic reductions in panel costs, combined with government subsidies. The subsidies for systems less than 100kW (Small Technology Certificates or STCs) are reducing year on year until being completely phased out by 2030. Subsidies for systems larger than 100kW exist in a market mechanism (Large Generation Certificates or LGCs) that has been volatile and oversubscribed to date resulting in uncertain and low values.

- Currently the greatest economic impact from solar is to consume locally and avoid purchasing from the grid, Behind the Meter (BtM). The approach works particularly well when the demand pattern of solar use closely matches the intensity of the sun.

These circumstances lead to 2 approaches; several sub-100kW systems distributed over multiple sites and larger mid-scale single site systems in the order of 500kW to 5 MW. These two approaches are detailed below.

4.1.1 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 mid-scale arrays.

Larger solar installations greater than 5MW require highly detailed planning because they can have a disruptive and damaging impact on the network. Facilities that are under 5MW threshold 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 or more to stack up financially. It is likely that the 5MW threshold will change in time as the Market Operator recognises the value in increased mid-scale generation across the network.

There is another threshold within the Essential Energy distribution network at 1MW, below which the potential network impact, and hence approval process, is usually 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 (CISA) that will incur costs in the order of $25,000 to $250,000, including detailed engineering and High Voltage design.

When visiting the Junee Shire LGA and consulting with Council staff, we identified that JSC own and operates multiple locations where a mid-scale solar installation could be located. Ideally Council would own the land for the solar installations, however this is not critical, for example, CE canvassed several businesses in the Junee LGA that would be open to working with Council on locating and operating a medium scale solar array.

The energy market is continuing to evolve, due to the huge uptake of residential rooftop solar and large-scale solar farms entering the market. This change is leading to periods where solar supply exceeds market demand and pushing the pool price down, resulting in the so-called 'duck curve' already evident in some parts of the NEM (National Energy Market) particularly during spring and autumn months.

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 within the Distribution network – provided that there is a customer 'locked in' at an appropriate rate.

Solar developers usually seek to secure revenue by locking in customers with a fixed price Power Purchase Agreement (PPA), however for Councils the opportunity exists to create an internal arrangement linked to the wholesale electricity market. 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 Council 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 "4.4 Council as Energy Generator/Retailer" below).

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

Conceptual modelling was completed to examine what the options might be for JSC 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 2019/20 financial year. The following chart represents annual consumption in aggregate and the percentage of usage likely to currently occur in daylight (solar production) hours. It also includes the equivalent electrical demand for substitution of gas and transport fuels.

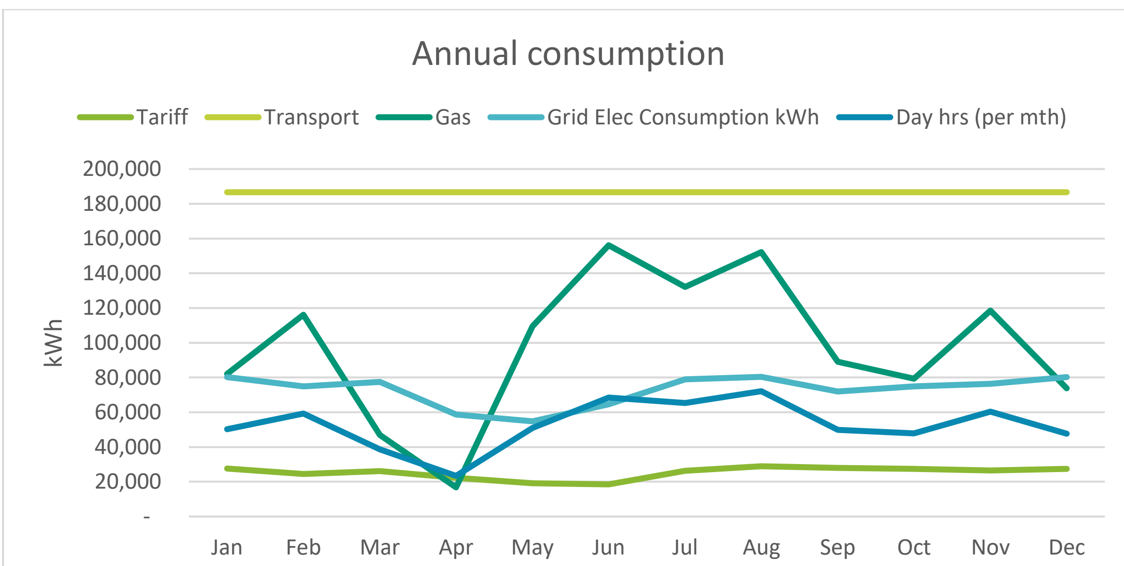


Chart 6. Junee Shire Council annual electricity consumption

The profile is interesting as it visually represents two important factors relevant to solar generation; peak consumption occurs in the summer and winter months and consumption during daylight hours is around 1/3 of total consumption.

We now need to understand how this profile interacts with the wholesale or spot price on the National Energy Market (NEM). The charts below indicate that, on average, summer is a good time to be selling solar energy into the spot market as the price is relatively high compared to other seasons– 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.

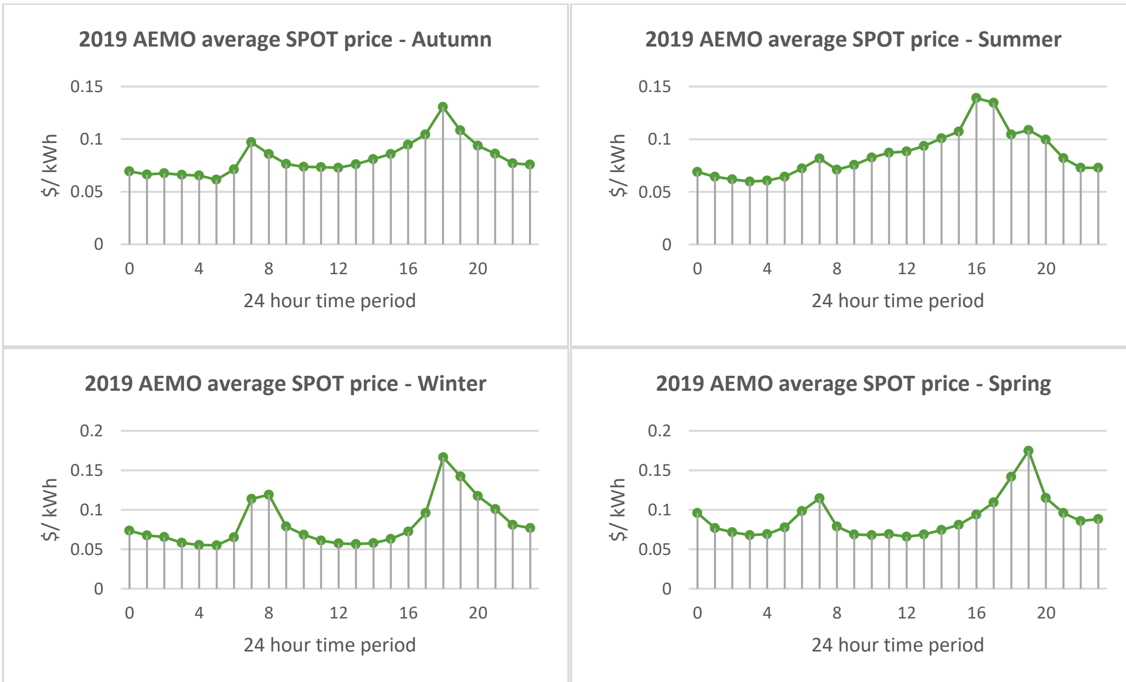


Chart 7. Seasonal average AEMO (Australian Energy Market Operator) spot market electricity price charts

We next examine a scenario for the purpose of informing decision making around the objectives and scale of a stand-alone JSC solar array to enable JSC to be a 100% NET renewable energy consumer. For the sake of illustration, the scenario assumes that JSC is happy to pay itself 8c/kWh for solar energy which represents a saving of approximately 6c off small site retail and that export is also purchased by a third party for 8c. We have also modelled the array install cost at $1.45 per watt which is inclusive of all direct project costs. The figures are indicative only and would require specific modelling for each and any project site because of the wide variability in network connection costs.

Our analysis indicates the improved financial case for Council self-consuming the energy vs finding a consumer willing to enter into a Power Purchase Agreement (PPA) for 8c (more likely around 6c at present) or relying solely on the spot market. Not surprisingly, the key variables for financial return are the install cost and sale/purchase price per kWh.

100% offset Array Size	1500 kWp	CAPEX $ 1.45 per watt	TOTAL CAPEX	$2,175,000

	Array	Council consumption						$ 0.08	$ 0.06	$ 0.08
Month	kWh/m	Contract kWh	Tariff kWh	Gas kWh	Combined kWh	Daytime kWh	Export kWh	Int'l rev.	retail saving	Exp. rev.
Jan	358,571	52,777.64	27,535.51	82,000.10	162,313.26	50,317	308,254	$ 4,025	$ 3,019	$ 24,660
Feb	252,411	50,436.45	24,454.15	116,151.76	191,042.36	59,223	193,188	$ 4,738	$ 3,553	$ 15,455
Mar	200,095	51,400.40	26,060.88	47,014.54	124,475.83	38,588	161,508	$ 3,087	$ 2,315	$ 12,921
Apr	128,347	36,440.56	22,242.28	16,790.13	75,472.97	23,397	104,950	$ 1,872	$ 1,404	$ 8,396
May	88,221	35,670.40	19,112.59	109,583.65	164,366.65	50,954	37,267	$ 4,076	$ 3,057	$ 2,981
Jun	58,199	46,071.53	18,512.39	156,120.42	220,704.33	68,418	-	$ 5,473	$ 4,105	$ -
Jul	68,654	52,534.31	26,330.05	132,160.00	211,024.35	65,418	3,236	$ 5,233	$ 3,925	$ 259
Aug	115,707	51,454.40	28,929.48	152,261.50	232,645.37	72,120	43,587	$ 5,770	$ 4,327	$ 3,487
Sep	160,180	43,914.39	27,973.00	89,136.27	161,023.65	49,917	110,262	$ 3,993	$ 2,995	$ 8,821
Oct	238,583	47,370.88	27,515.75	79,402.30	154,288.93	47,830	190,753	$ 3,826	$ 2,870	$ 15,260
Nov	258,941	49,803.64	26,489.87	118,492.06	194,785.57	60,384	198,557	$ 4,831	$ 3,623	$ 15,885
Dec	329,588	52,895.96	27,423.91	73,720.00	154,039.87	47,752	281,835	$ 3,820	$ 2,865	$ 22,547
Totals	2,257,495	570,771	302,580	1,172,833	2,046,183	634,317	1,633,398	$ 50,745	$ 38,059	$ 130,672

Combined annual revenue	$ 219,476
Simple payback	9.9
Yield	10.09%

Table 8. Conceptual model of JSC midscale array (generation and revenue)

Scenario – 100% Renewable Energy generation matched to JSC's stationery consumption.

In this scenario, we have matched a 1500 kWp array to meet 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 between 1500 kWp.

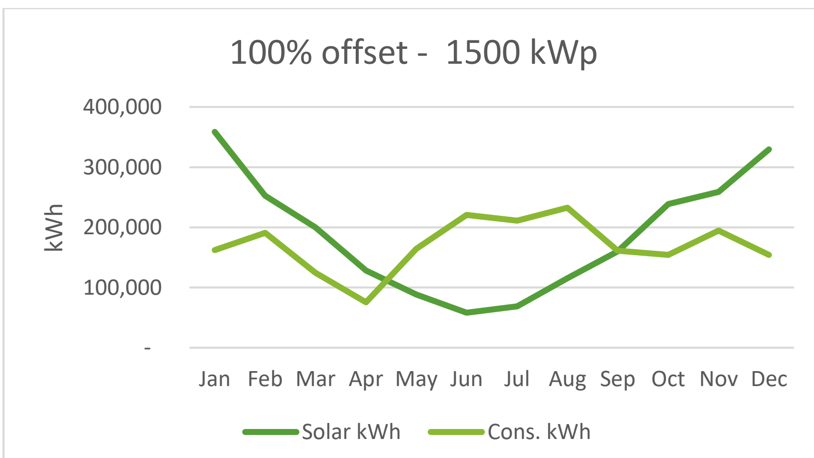


Chart 8. Solar generation matched to daytime consumption – 1500 kWp array

Chart 8 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.

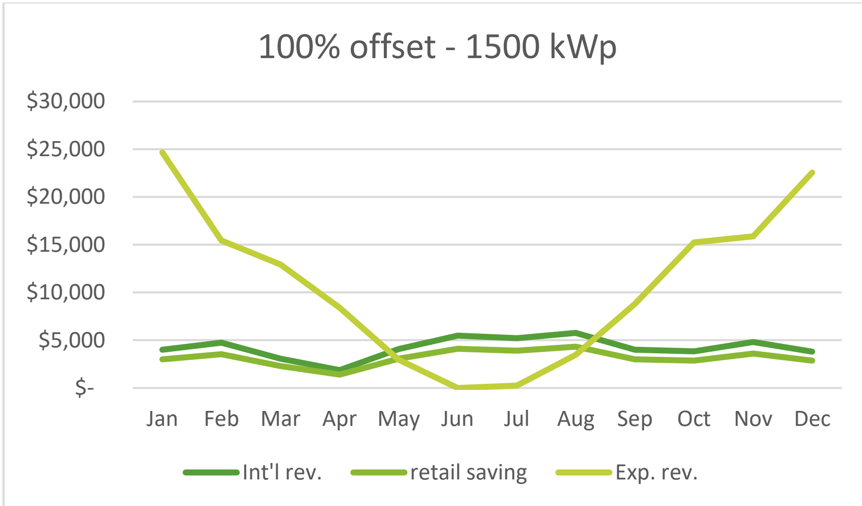


Chart 9. Intersection of monthly revenue/value curves for a 1500kWp array

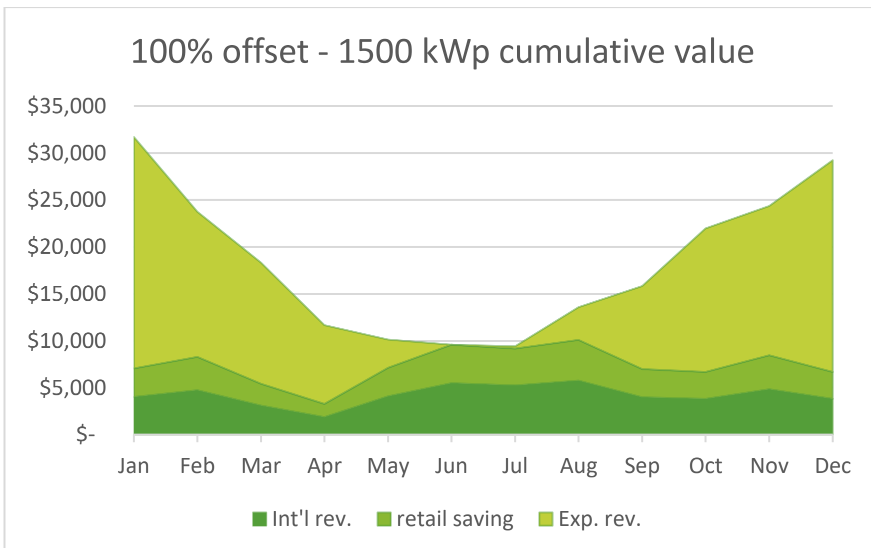


Chart 10. Cumulative value created by a 2200kW array

The above scenario illustrates to JSC the need 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.

That said, our analysis reveals that it is possible for an investment in a single site array of $2.1 million to create annual value of just under $220,000, with Council paying off their own solar farm in around 10 years instead of paying a retailer. After the 10-year point, Council can decide what to do with 2.2GWh of free energy p.a.

Clearly there is also value in being able to vary consumption to be within solar producing hours or in least-cost market hours as referenced in section 4.2 above.

Given that the minimum effective life of a solar array is the warranty period, i.e., 25 years, and in fact usually more like 40 years, Council have the capacity to structure finance over a longer term to deliver increased cash flow now, or as-short-a term as possible to pay off quickly and create an effectively free energy supply. Aside from whatever advances in technology are available at that time in the future, including electric vehicles, there are a wide range of social impacts that could be supported with this low-cost energy.

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 under 10 years, engage local business with lower cost local renewable energy and deliver a financial dividend of ~$13 million over 25 years.

If Junee Shire Council elects to further investigate this concept Constructive Energy 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 maybe city-based local governments that would welcome the opportunity to partner with a 'country cousin' that can generate renewable energy for them to offset their usage. This could be another way of locking in price certainty and revenue to de-risk the business plan.

Recommendation:

Council to proceed with the preliminary site investigations and detailed concept modelling for a JSC midscale solar array.

4.1.2 Distributed Solar Installations & Virtual Net Metering

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

- Identify project drivers as cost, energy-sharing and carbon offsetting will all lead to different answers
- Size and design individual systems correctly to meet the identified objectives
- 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 studies 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 properties, known as Virtual Net Metering (VNM) 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.

Using this concept, it is possible for Junee Shire Council to develop a Rooftop Solar Virtual Power Plant large enough to power a 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 probably need to sign up with the same retailer. The retailer would also need to be involved in setting up and operating the system.
- A revenue grade meter/device is required to monitor and acquit energy usage.
- The project may 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 existing/augmented solar systems and new BtM installations.

Site Name	Annual Site cons kWh	BtM System Size kWp	On site gen /yr	Self cons kWh	Avoided GHG tonnes
JJRAC	313,072	200	268,555	139,649	113
Junee STW	79,206	100	40,876	21,256	17
Council Chambers	55,283	30	44,618	23,201	19
Junee Library	54,890	20	22,410	11,653	9
Council Depot	26,799	20	22,410	11,653	9
Broadway Museum	21,030	15	17,974	9,346	8
Laurie Daley Park Toilets	16,933	5	7,369	3,832	3
Amenities Block Loftus Oval	7,073	20	29,714	15,451	0
Totals	**574,285.25**	**410**	**453,926**	**236,041.52**	**179**

Table 9. Example distributed solar BtM installations

CE integrated the capacity for a virtual network and imagined that Junee Shire Council charged themselves 8c/kWh for energy consumed at the retail tariff sites (which would be on the high side but result in a shorter payback period). The table 10 below is a summary of the collective financial impact if these projects were to proceed.

Council consumption	BtM solar generation		CapEx	Revenue	GHG	Payback and Yield	
Total combined consumption kWh (across all sites)	Daytime consumption	Export kWh	Inst cost *	Tot revenue p.a. (including VNM)	Avoided GHG tonnes	Payback (simple)	Yield
873,350.39	236,041.52	217,884.48	$ 560,500.00	$ 89,877.35	179	6.24	16.0%

*Noting the STW CapEx has not been included in this conceptual modelling

Table 10. Example distributed solar BtM collective financial impact

While these figures are very general, it is evident that there is an improvement in the economic case for roof-top solar when viewed holistically under a virtual network. 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.

It should be noted that the resultant payback and yield on paper achieve an exceptionally good financial return on the investment. However, this approach does not account for the complexity of the multiple solar installation at separate locations. Detailed project and financial planning will be required to firm up actual figures for investment readiness.

Each site location would require detailed network applications, structural and electrical assessments, and may be subject to export limitations or unforeseen wiring upgrades, which would financially impact the project. Furthermore, connection limitations make it difficult for JSC to become truly 100% powered by renewable energy, (873 MWh p.a.) under this model.

Prior to progressing the case for BtM solar installations, it is important for Council to acknowledge that the broadscale implementation of BtM roof-top solar systems potentially cannibalises the case for a mid-sized solar array. Installing multiple BtM solar installations reduces the amount of solar energy that Council can sell to itself in order to secure revenue for the larger project (which may be likely to provide a more significant pay-off in the longer term).

That said, BtM solar is readily achievable and delivers an immediate financial return and it may be that a hybrid of the two approaches is acceptable.

There are essentially three options for progressing BtM installations; -

1. Junee Shire Council 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 provide oversight or facilitation of each of these options if desired.

Recommendation:

The obvious opportunity for JSC is to adopt the 'hybrid' approach. We have identified that there is opportunity for JSC to invest in an oversized BTM solar installation at the JJRAC and to setup the trading mechanisms, whilst developing the business case for >1.5MW Council solar array to be located and installed in the LGA.

The lead time for a midscale solar array is anywhere between 6-24 months. By adopting the 'hybrid' approach, Council can shorten the lead time to receive financial return from a solar installation.

We recommend that during the development of the mid-scale solar array business case, that JSC investigate partnerships and\or energy trading arrangements local commercial and industrial businesses located in Junee, Wagga Wagga and surrounds. There are 'economies of scale' if a midscale solar array can be scaled from 1MW towards 5MW dependent that there is a suitable site, with network connection within the LGA.

Distributed batteries

Battery storage in association with BtM solar can create value through back-up capacity, improved power quality, optimised consumption and export in relation to tariff charges, enhanced demand control capacity and improved monitoring/reporting.

At present many commentators contend that the payback for batteries is too long, however when viewed holistically there are many cases where the yield of a combined solar + storage installation is above 10%. Given the high potential IRR for distributed solar it would be remiss not to consider the opportunity to incorporate energy storage where advantageous. Again, we have investigated a conceptual model of distributed batteries located at Council facilities.

Site Name	Qty Batteries	Battery Capacity /yr kWh	Tot revenue p.a. (including batteries)	Solar + battery Payback (simple)	Solar + battery Yield	Avoided GHG tonnes
Rec Centre	4	19,710	$ 56,130.39	7.34	13.6%	129
Junee STW	1	4,928	$ 8,832.57	9.28	10.8%	21
Council Chambers	1	4,928	$ 9,573.49	7.00	14.3%	23
Junee Library	1	4,928	$ 5,176.31	9.47	10.6%	13
Council Depot	-	-	$ 4,437.18	8.11	12.3%	9
Broadway Museum	1	4,928	$ 4,297.98	9.31	10.7%	12
Laurie Daley Park Toilets	-	-	$ 1,459.06	7.88	12.7%	3
Amenities Block Loftus Oval	-	-	$ 5,883.37	6.12	16.3%	13
Totals	**8**	**39,420**	**$ 95,790.35**	7.66	13.1%	**223**

Table 11. Example distributed solar + battery collective financial impact

Our analysis of solar only BtM installations reveals a collective yield on investment in excess of 13%. The table 11 above indicates that the functionality of 8 batteries can be added to the project with the minimal impact, but still achieving system pay-back well within the 10 yr/3000 cycle warranty of most batteries.

Recommendation: JSC should consider the case for battery storage in association with any BtM solar installation and especially for sites with energy quality or energy security requirements.

If managed collectively, several distributed batteries can not only assist with individual sites, but also enable participation in market and network ‘events’ for which network operators will pay in order to reduce difficulties in managing the grid.

4.1.3 Oversized Behind-the-Meter solar, battery and EV charger installation at JJRAC.

As outlined in the previous section, the ideal site for BtM solar installations are sites with large and consistent daytime electricity use. The Junee Junction Recreation and Aquatic Centre (JJRAC) meets these criteria. In this section we go into detail about the energy consumption profile of JJRAC and the options available to Council to consider specific renewable energy options for this facility.

Assessment

The JJRAC is Council’s largest consumption site (excluding streetlighting). The annual consumption for 2019 was 295MWh. We analysed the monthly consumption of JJRAC to show that there appears to be a consistent use across 12 months, except for April 2020 and May 2020, likely due to reduced activity due to the pandemic (chart 11).

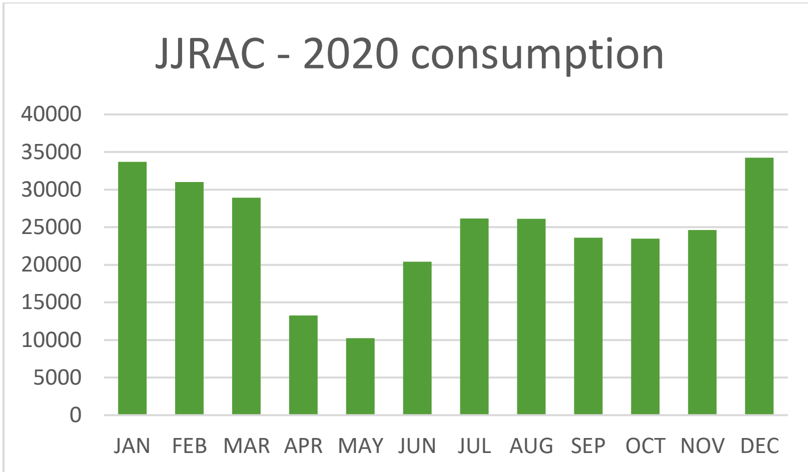


Chart 11. JJRAC annual usage profile (Nov19-Nov20)

Next, we overlayed this monthly consumption with a conception solar profile (chart 12). This visually represents the close alignment between solar generation overlayed with the JJRAC annual site usage.

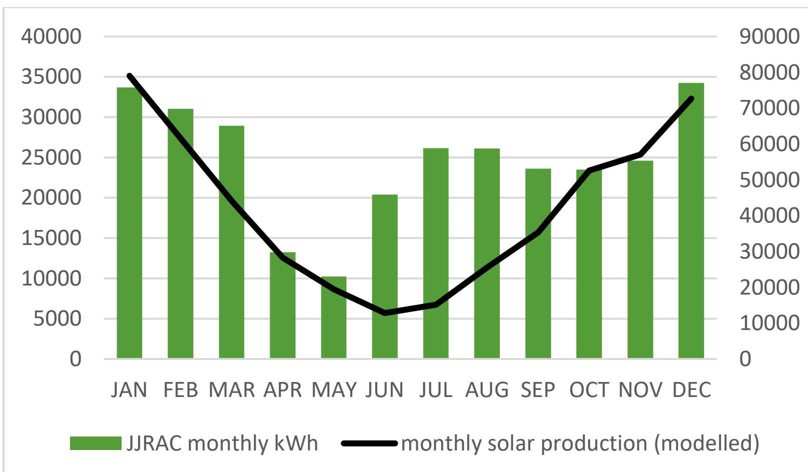


Chart 12. JJRAC annual usage profile with solar modelled (matched to summer)

However, if we assume that the optimal solar system would be sized for 'winter consumption', then this would likely result in substantial solar export during the Summer and shoulder seasons. This is often perceived as a 'problem', however CE see this as an 'opportunity' for Council to send the energy to other Council operated facilities.

Often solar systems are sized to maximise the Behind the meter consumption. However, JJRAC presents the ideal scenario, where an investment in 'oversizing' the array would be beneficial for Council as the excess energy can be traded back to other Council facilities via a 'enabling' retail arrangement (see section 4.4).

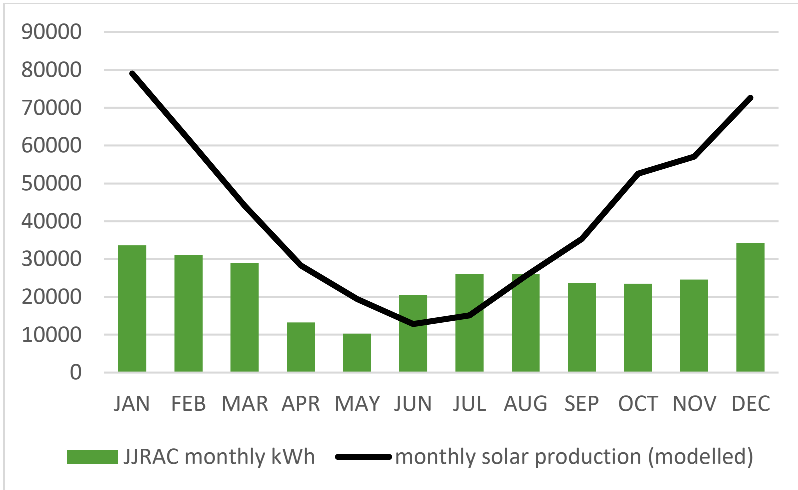


Chart 13. JJRAC annual usage profile with solar modelled (matched to winter)

We would also recommend the case for batteries at JJRAC. This would enable Council to further increase the IRR on an oversized solar installation and provide Council with ability to 'time-shift' energy a consumption at other high tariff facilities.

Oversizing a solar array installation at JJRAC, will also 'future ready' JJRAC for the eventuality of the existing gas boilers reaching end-of-life and the likelihood that they will be replaced with electric heat pumps.

Blayney Shire Council in the Central West have recently undergone a project to replace their gas boilers at their Centrepoint sports and recreation centre, with a hybrid electric heat pump (with gas boosters). The installation of this system has allowed Blayney Shire Council to abate a large proportion of their overall gas emissions and allowing them to partially power the Centrepoint facility with renewable energy. The installation was bundled together into the entire facility upgrade and received State government funding.

A solar installation at JJRAC also presents a great opportunity for Council to prepare for the arrival of EVs. As the JJRAC is centrally located and has available street parking, Council could include a fast charge DC EV charger paired with a Rooftop solar and battery installation. This would be a great opportunity for Council to signal its intention to adopt new emerging technologies and increasing the public amenity of JJRAC.

A JSC Renewable Energy powered EV charger increases Junee township as a desirable destination. Currently the nearest EV chargers are Wagga Wagga and Young. Both the Dept for Transport and the NRMA are assisting local government to rollout of EV chargers and could provide financial assistance with the installation. An excellent example of this has been the installation of a 230kWp solar system and 25kW DC charger at the Phillip Island Nature Parks in Victoria (source: RACV Solar, February 2020).

Next, we analysed the 24-hour profile of JJRAC and found that it exhibits the typical profile for this type of facility. As evidenced in the following chart, there are morning and evening peaks, as the plant heats and cools the buildings over a 24-hour period. Interestingly there is an energy spike in the 11am-2pm window in the summer months, caused, by the extra energy required to cool the building by the HVAC system (heating ventilation and air conditioning). This jump in consumption during summer and daylight hours adds further weight for the case for a BtM solar generation at the JJRAC.

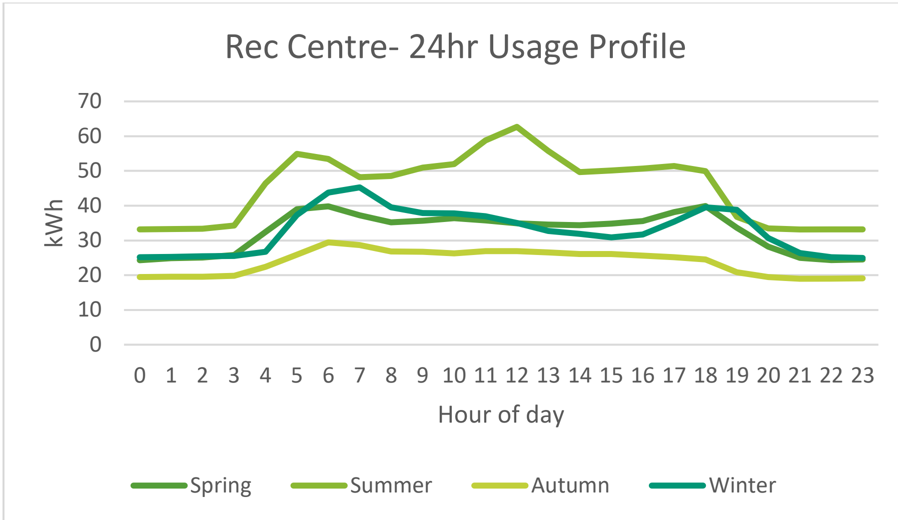


Chart 14. JJRAC 24-hour usage profile

The existing tariffs for JJRAC were analysed and demonstrated that Council has negotiated an extremely competitive rate for this site, the best in market we have come across. Having said this, there remains a strong case for solar at JJRAC, particularly when there is the opportunity to offset large volumes of network and retail charges and a viable method to maximise the sale of the excess daytime production from the array.

CE has made some preliminary enquiries about the feasibility for 'micro'-hydro at the JJRAC. Although the site does move substantial amounts of water per day, the site has no natural head available to generate the energy required to spin a turbine and offset the existing large amounts of grid energy. Similarly, micro-wind is not a feasible option at this site due to its location in town and proximity to surrounding buildings and structures.

The roof structure of the basketball court lends itself to a solar installation due to tilt, orientation and strength (pending an engineering assessment). There's also ample available space to mount a solar system in excess of 250 kWp.

Site recommendation

BtM rooftop solar and battery installation is a 'no brainer' for JJRAC, due to the high site consumption and suitability of the building and site.

Due to JJRAC's available roof-space, location and site energy profile, we would also recommend that JSC consider oversizing the solar array, installing batteries and an EV charger. Batteries will enable a proportion of the energy generated at the site to be 'dispatchable' adding further merit to the business case.

This would be a great result for JSC, if JJRAC can be 100% powered by renewable energy!

4.2 Energy Efficiency Measures

Before investigating alternative sources of energy, maximising energy efficiency should be a primary objective. To reinforce this the following measures are recommended (and to some extent already evident at JSC):

- **Monitor consumption**: Engineering and/or Finance 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.
- **Education**: Junee Shire Council makes it easy for staff and constituents to reduce energy consumption through promotion of strategies and materials that facilitate energy efficiency.
- **Planning**: Junee Shire Council 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**: Junee Shire Council applies knowledge and purchasing power to support residents and businesses with products that reduce their energy consumption.
- **Street lighting**: Junee Shire Council continues to work with other Councils/programs to replace existing lights with efficient alternatives.

Recommendation: That JSC integrate the above strategies into Council operations.

4.3 Smart metering and load control

Australia is transitioning from a centralised grid with large inflexible generation, to a dynamic, integrated and distributed network of coordinated generation and load. With the privatisation and corporatisation of generation and transmission assets, and the opening of retail markets in NSW to competition, the sector is experiencing unprecedented growth in the number and type of generation assets and innovation in technology and retail mechanisms. The days of simply looking for the best kWh price from a limited pool of options, and then forgetting about it, are over.

In this context, data is increasingly important along with the old adage, "*what we inspect we improve, what we measure we manage*".

Retailers are now reluctant to send people into the field to read meters when the automated alternative, digital meters, is less costly and more accurate. So called "Smart Meters" are able to measure consumption in intervals, usually of 30 or 5 minutes, and these can be used to create a consumption profile, as has been completed for this report, but also to enable billing on a cost-reflective basis. Beyond this functionality, a new range of 'super smart' meters are also able to control a number of devices by sending signals to relays on the basis of pre-defined logic.

These load monitoring and controlling devices may or may not also be equipped with appropriate approvals to act as the network meter. In other words, there is a choice to either seek a meter that does everything, or to separate the network meter for billing, and the monitor and control device that provides operational intelligence and control. Both devices usually exist at the switchboard. It is critical that the metering platform can be used to provide close to real-time data through an accessible dashboard which may also eliminate the need for bill-validation platforms.

Recommendation: JSC invest in the roll-out of meters with monitoring and control capacity across all assets with both significant consumption and, ideally, the potential to 'load-shift' or modify loads without adversely effecting operations. It may even be possible to leverage retailer relationships so that the cost is borne, or at least shared, as part of the existing energy supply contract. We suggest that there are approximately 10 sites which should be equipped with smart meters.

4.4 Council as Energy Generator / Retailer

Junee Shire Council has the land access, load and grid capacity to install and operate a medium scale solar power plant in the order of 1500kWp. 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 both 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 4.3 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 JSC 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 excess energy generated from a Junee Shire Council array.

A third option as indicated above would be for Council to effectively operate as a generator-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 (see below). 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 be, at times 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).

It would be possible for Council to apply for its own licences so as to be formally recognised as a retailer however this carries cost in establishment and on-going compliance overheads that are, in our view, prohibitive. While the Local Government Act carries the capacity for Councils to supply energy (as per County Councils of last century) in the current competitive and innovative environment it may be smarter to partner with an existing retailer willing to provide the mechanism.

There are several retail organisations currently delivering 'sleeved' energy trading and facilitating sale of energy into the NEM. Linked to a solar array of course Council would be exposed to purchasing energy from the market for the times outside of solar production hours (dispatchable power and energy storage would change this.) The degree to which Council is exposed to the volatility of pricing in these periods versus having the retail partner set a fixed price to 'hedge' the risk depends on the ability to negotiate a deal.

To further illustrate the concept, we have prepared the charts below overlaying the interval usage at the JJRAC with the NEM Spot price for the same 24hr period. Chart 15 displays each 1-hour interval averaged over a month (Nov) and extrapolated over a 24-hour period overlayed the corresponding Electricity SPOT prices (dotted line).

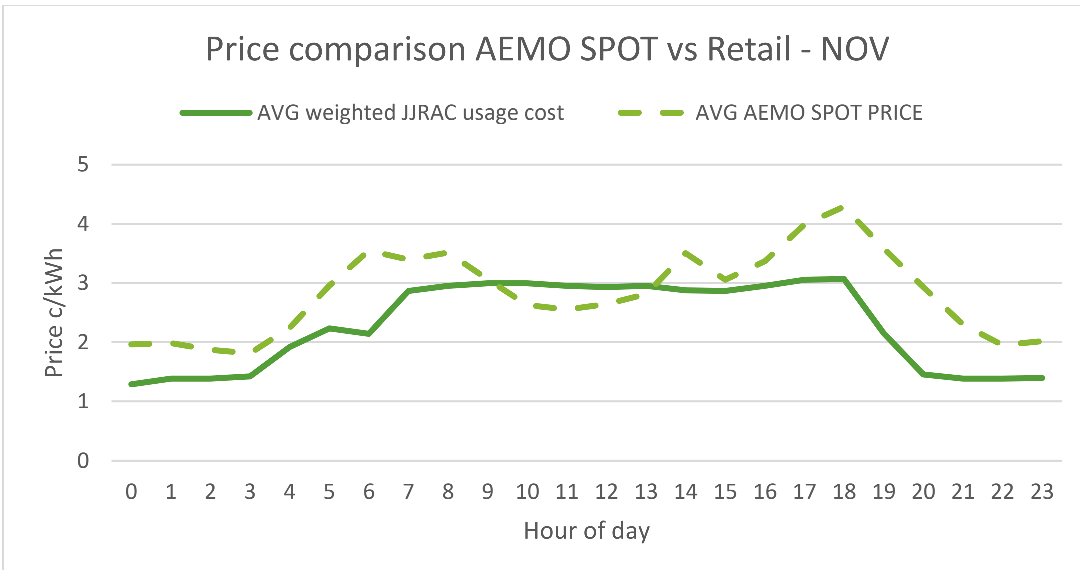


Chart 15. Comparison of JJRAC cost by hour versus equivalent spot market cost November 2019

This example in Chart 15 demonstrated that if JSC paid wholesale price for energy during November, this would have been more expensive that paying the pre-agreed retail tariff. In other words, the retailer took a hit in supplying JSC electricity!

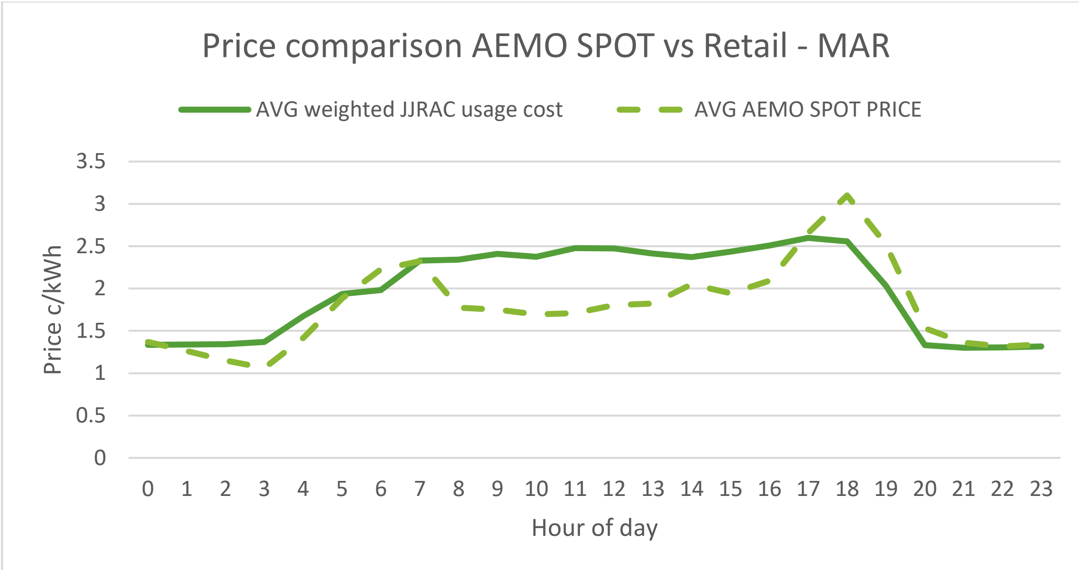


Chart 16. Comparison of JJRAC cost by hour versus equivalent spot market cost March 2020

Chart 16 above indicates a period when JSC would have made a saving purchasing energy at wholesale prices, even considering peaks at the beginning and end of the day. This chart also indicates the obvious opportunity in load control and energy storage – maximising energy consumed from 09:00 to 17:00, avoiding consumption in morning and evening peak periods and aiming to sell stored energy into the market at its highest price.

The primary purpose of bringing this to the attention of Council is to be aware of both the opportunity and consequence of 'stepping into' the generator - retailer space. While there are costs in establishing Councils as generator-retailers the savings and potential revenues are significant. However, even with automation, there will be a requirement for human oversight and this would need to be in the form of internal staff responsibility or outsourced services. Essentially JSC needs someone 'in their corner' to ensure that the generator is performing as expected, the retail structure is delivering value, and that the load controlling logic is optimising self-consumption and minimising external energy purchase.

Part of the 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. Should JSC wish to follow this pathway, after securing the opportunity to deploy or own energy generation assets, the next step would be to test the retail market to identify suppliers willing to engage in this manner. We have previously received positive responses from multiple retailers large and small to assist Council with market participation and energy trading.

It is important to note that, as identified in 4.1.1 above, sizing a solar array to 100% meet Council demand inevitably leads to an export 'opportunity'. This requires JSC to find a market outside itself that values this export. Such a market could be a small number of high-demand industrial users, commercial and retail businesses with daytime usage, and/or local residences. This 'solar power station' model is illustrated below.

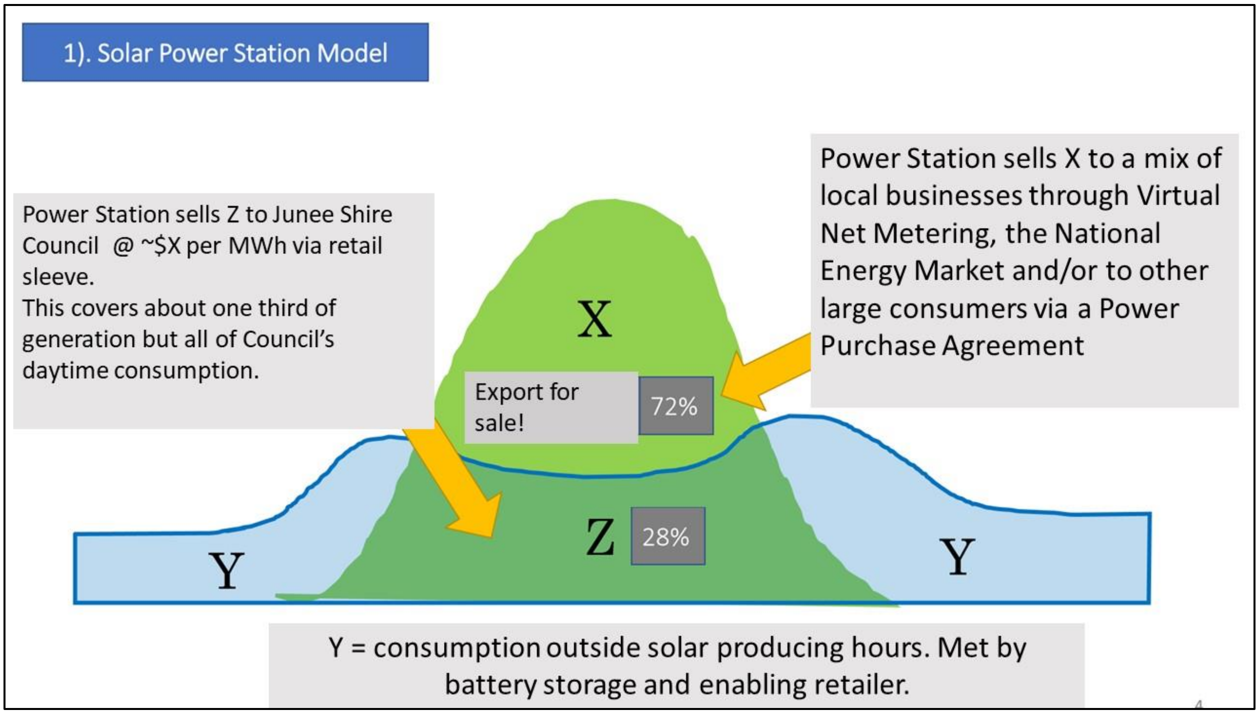


Figure 1. Solar power station model

In reality it is difficult to establish the exact quantum of 'X' in the figure 1 above and to that extent there is a risk in raising the expectations of the last few customers who may never consume much energy from the array. In other words, after 'Z' is fully allocated we can guarantee supply for the first customer but not the last!

The likely management of this issue is to have a certain percentage sold commercially with the remainder exposed to the wholesale market price. Incorporating both elements, allows Council to negotiate 'certainty' and savings with electricity production and consumption, ultimately benefiting the JSC ratepayers and to underpin affordable energy to the local business community. The retailer would provide customer support and billing facilities and in return the Council could assist the retailer with their brand promotion and recognition in the LGA.

Recommendation: If JSC decide to progress the mid-scale 100% offset option, this should be done in concert with a retail partner. JSC will need to come to a position on which local businesses and customers to engage, how and why, e.g., Broadway street traders to assist in providing affordable, local energy.

4.5 Energy Storage

In addition to exploring the various large-scale solar installation options available, it is important to consider integration of energy storage options to bring additional value and benefit to a project. Batteries are an increasingly critical part of optimising the economic and environmental benefits of renewable energy generation and are now affordable to the extent that pay-back periods are usually less than 10 years and can be less than 5 with the right price and market settings.

The battery market is currently in price decline as various providers and technologies vie for market share. In addition, the impact of batteries and their fast response are having an important flow-on benefit to grid stability. Energy storage integration presents the following key benefits to a renewable energy project-

- Load smoothing: battery storage can buffer solar generation peaks and intermittent or variable demand profiles.
- Load sharing: particularly where micro-grids are implemented; battery storage can provide a power sharing and grid stabilising capability.
- Load shifting: supporting the economic case for avoiding purchase of high-cost electricity.
- Load export: smart-meter technology can identify when a system should export onto the grid (when demand and price is high) and when to divert to storage. Under a generator/retailer model, integration of battery technology adds an additional advantage to 'playing' the energy markets.

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 with a 10 year pay-back is significant. It is now technically feasible to operate 'off grid' at scale, however, taking all JSC'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 Junee Shire Council to consider this scenario with their high use sites in the next 5-10 years.

There are other reasons to integrate batteries, including energy security, 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 householders partly because the system as a whole can be controlled and derive revenue from demand management to support network stability.

Recommendation: JSC should model energy storage as part of the business plan in both medium scale and/or distributed solar project options. This modelling should compare a single, mid-scale, grid connected storage device (ideally with the solar array) and multiple smaller behind-the-meter devices.

4.6 Retail arrangements

Junee Shire Council has a several sites that have large and consistent consumption and this has provided leverage for negotiations in the past which, through well run tendering processes, resulted in competition between each of the energy retailers and hence extremely competitive pricing.

The JSC Executive should be praised for seeking and negotiating these agreements and ensuring cost control. For example, the JJRAC has the most competitive rates for this type of facility that we have come across in previous studies.

As discussed above, as Junee Shire Council implements the recommendations of this REAP it is possible to become a net generator of electricity which is then sold back to other JSC sites, the community and local industry. This changes the relationship with retailers who are already being disrupted by the 'pro-sumer' revolution affordable solar has created. However, we appreciate that JSC may not wish develop renewable energy projects themselves and if so, negotiating suitable retail contracts remains important.

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 opportunity emerging in this period of significant innovation so it is important for Council to be clear on wants and needs as, chances are, at least one of the retailers will be eager to attract and retain Council business.

Recommendation: Going forward Council should be increasingly wary of simple bulk purchasing contracts for electricity as these approaches can limit the capacity for Council to save or off-set usage (usually a 20% reduction cap before fees apply) and to gain from participating in the new distributed energy economy. We recommend that Council be careful in engaging with any retailer over a long term and ensure the ability to reduce consumption along with fair exit conditions. 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.

4.7 Transport and plant equipment

4.7.1 Electric Vehicles

Australia lags many other developed nations where electrification of transport is progressing rapidly. 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 in around a 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 comparing a basic hatch-back sedan.

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		15,000		Savings with EV	$	1,230	per annum

Table 12. Comparison between ICE and EV

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, JSC may wish to adopt EVs for a range of other factors, such as 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 and Blacktown City Council have commenced trialling garbage collection services with an all-electric truck (source: governmentnews.com.au, Dec 2020). 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'.

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. This leads to longer charge times and the necessity of charging overnight.

Recommendation: JSC has demonstrated community leadership with the purchase of 3 Hybrid vehicles part of the passenger car fleet. This initiative has already contributed to Council reducing its transport emissions footprint. However, transport fuels do make up the substantial amount of Council's overall energy consumption. We recommend that Council take a medium-term outlook on the purchase of EVs and prioritise solar installations over investing in upgrading the Council passenger fleet to EVs. There are currently large tech changes and price shifts predicted for EV market by as soon as 2025 and Council would be best to consider EV purchases on a case-by-case basis until such time as the EV purchase costs are financially viable.

4.7.2 Hydrogen powered drive trains

It is important to understand the 4 distinct elements involved in production and utilisation of hydrogen as a fuel.

1. Energy Source. This needs to provide regulated, good quality electricity and be matched to full chain production capacity.
2. Hydrogen Production. Classified as 'green' = produced with renewable energy or 'blue' = produced with fossil fuels. Basically, using energy to either split water or hydrocarbons.
3. Gas storage. From short term (buffering in production) to long term and both stationary (as energy storage) or transportable (like LPG).
4. Energy Conversion. Oxidation of the hydrogen to release water and energy in the form of electricity and heat. Most commonly in fuel cells or turbines.

Based on CE research it is possible to purchase existing small-scale electrolysers and produce hydrogen at around $5 - $6 per kg. This could be done at the site of a solar array to produce a transportable form of renewable energy.

The following table indicates the relative value of the hydrogen fuel in application.

Toyota Mirai		
100	km/kg	
5	kg tank capacity	
33	kWh per kg	
165	kWh per tank	
3	kWh per km	
495	km for	$ 25.00
99	km/kg	
7	L/100km	petrol car
34.65	L equiv.	$ 45.05
Truck FB	Scania/Volvo EV	
200	km range	
80	kWh battery	
2.5	km per kWh	
412.5	km for 5kg	$ 25.00
82.5	km/kg	diesel truck
20	L diesel	$ 28.00
Water pump		
100	kW capacity	
3.03	kg H per hr	$ 15.15
25	L diesel per hr	$ 35.00

Table 13. Vehicle and pump performance and cost comparison

It is important to remember that hydrogen vehicles are actually electric vehicles with a hydrogen fuel cell replacing chemical batteries. The advantage of this approach is in energy density and recharge times. A hydrogen powered vehicle can be recharged in a few minutes, just like a standard gas vehicle, and as can be seen in the table above, just 1 kg can move a vehicle 100km.

There is much conjecture about whether EVs or HVs will win the Australian market for renewably powered vehicles however it is the view of CE that each system has strengths and weaknesses. The range and speed of refuelling through existing infrastructure point to an advantage for HVs in regional and remote Australia. Certainly, one Australian company is banking on a solid market - H2X currently plans to produce 20,000 HVs each year by 2025 out of the Illawarra region in NSW.

JSC own and operate a range of plant and equipment for which there are currently no battery-electric or hydrogen-electric powered models available. Caterpillar, Hitachi, New Holland and many more start-up firms are researching and developing renewable powered alternatives to the full range of heavy plant and equipment. Mining companies are at the forefront in much of this development.

The Australian Government is invested in the CSIRO National Hydrogen Roadmap released in 2019 and has leveraged $ billions in private investment to stimulate a hydrogen economy for both internal and export markets. The stated aim in much of this investment is to lower production costs to meet a $2 per kg threshold. Some commentators expect the price to fall from the current $5-6 and reach $3 by 2023.

Recommendation: That Council conduct feasibility studies into a pilot plant and\or vehicle. To delay consideration of single vehicle purchases until such time as the technology is 'market' proven.

4.7.3 Electric devices

Cordless power tools and light plant such as lawnmowers are also the focus of many manufacturers. For example, Makita have announced that they have ceased all R&D into petrol powered tools and will phase out all ICE tools this decade. 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.

Commercial grade brush-cutters and chainsaws are quieter, simpler and deliver instant power with back-back battery systems that can deliver several hours of continuous operation. They are significantly more expensive to purchase however these prices are falling with increased market share. In time we can expect to see a greater range of electric small plant and equipment as the energy density and affordability of batteries improve.

If JSC seeks to electrify small plant and equipment we suggest that a decision is made to, as much as possible, stick with one vendor brand so that battery packs and chargers can be shared. Thought must also be given into the creation of battery e-waste and the non-sense in discarding perfectly functional equipment which may only have occasional use, simply to remove a small amount of fossil fuel consumption.

Recommendation: That Council adjust procurement policy to preference electric plant and equipment for replacement and new purchases.

5.0 Other Renewable Energy Options

5.1 Pumped Hydro

The Junee Shire Council LGA contains enough elevation for a potential pumped Hydro scheme. Any new Council water security initiatives should also consider energy production as part of their remit. Pumped Hydro is emerging as a preferred dispatchable energy source, particularly over longer timeframes, due to its flexibility and low carbon emissions.

Within the recently announced NSW government Electricity Infrastructure Roadmap (November 2020), there included an "additional $50 million in grants are set to be allocated in the forthcoming budget to support the development of new pumped hydro energy storage projects, through an extension of the existing Emerging Energy Program." (reneweconomy.com.au, November 2020).

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.

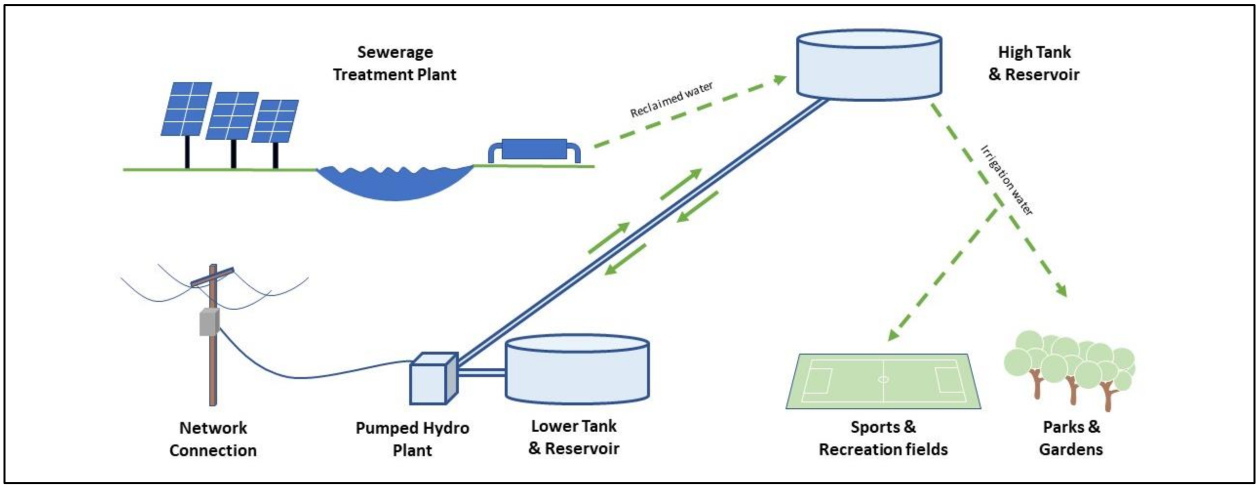


Figure 3. Pumped Hydro in Council setting

If Junee Shire Council elects to proceed with a mid-scale array then an equivalent scale pumped hydro scheme should be investigated in comparison to other forms of chemical battery storage.

Regardless of progressing Junee Shire Council's own solar, it may be that a Council-owned pumped hydro facility would be economic and complement other renewable energy projects in the Riverina region. In the medium term dispatchable energy is becoming increasingly valuable to the National Energy Market, often attracting pricing around twice the value of daytime generation. It is certainly worth the investigation into pumped hydro due to the large uptake of solar generation in the region.

Recommendation: Limited action. We recommend keeping it 'on-the-radar', in light of the recent State government's announcement to provide financial incentives for the uptake of this technology over the next decade.

5.2 Wind

5.2.1 Small Wind Turbines

Small wind turbines are emerging as a cost-effective renewable energy technology. These systems can be beneficial where there is a desire to provide amenities to the public in locations where grid-connections are cost prohibitive. In many cases, the cost to install and operate, these amenities can be significantly less than the grid-connection. It is now feasible to power these sites using off-grid, zero emission RE technology.

There are now several Australian owned companies providing barbecues, shelters and other public amenities furniture with integrated solar, small wind and battery systems.

One Australian start-up Diffuse Energy (https://www.diffuse-energy.com/) has designed and commercialised small wind turbines. Their Hyland 920 turbine has been designed to work side by side with solar and batteries to reliably power telecommunications infrastructure at remote locations. The operating costs for this technology are extremely low, compared to diesel power generation equivalent.

To demonstrate how this technology may be applied for JSC, we have produced a conceptual model of a new off-grid public amenity, using the Wallace-town rest area as an example. This highlights how cost effective the renewable energy technology is whilst providing 24/7 reliable energy with zero emissions.

New amenity	Load	kWh/yr*	kWh/d*
1	New amenity	2097	5.7
	Annual cost	$1,032.00	
	Cost per day	$2.83	
Grid connection			
1	Grid installation CapEx	$30,000.00	
	reduced to daily rate at	10	year Payback
	=	$8.47	per day to finance
	Total cost	**$11.29**	per day
*Usage figures modelled off Wallacetown Rest Area			
smallWind	System size	220	W
1	Daily output	2.1	kWh
	Annual cost	$2,433.33	
	Cost per unit per day (installed)	$6.67	
Solar	System size	2.5	kWh
1	Per W installed	$1.35	
	CapEx	$3,375.00	
	=	$0.95	per day (10 years)
Battery	System size	13.5	kWh
1	Installation cost	$11,700	
	reduced to daily rate at	10	year Payback
	=	$3.21	per day to finance
	Total cost	**$10.82**	per day
	Carbon Offset	1.69857	tonnes p.a.
*Emission factor 2020 (NSW)			

Table 14. Junee Shire Council Off grid public amenity concept

5.2.2 Community Large Wind

There is also the potential for Council to use larger wind energy installations to offset significant amounts of energy usage. Larger installations necessitate more planning requirements with longer implementation timeframes but can provide significant benefits.

A JSC backed community project, in a form similar to the Hepburn community wind energy project (https://www.hepburnwind.com.au/) could play a very substantial role in reducing the Council's emissions footprint. That project delivers around 10 GWh per year - more than 5x JSC's energy consumption. An innovative business model, where JSC has a power purchase agreement (PPA) with the community project could provide the necessary incentives to get the project running and attract external investment, while also allowing JSC to become 100% renewable energy. The approvals process for large scale wind turbines can be slow however and may be cost prohibitive.

Although turbines are available from 100kW to 1,000kW, the economics of wind energy tend to leave out the middle ground, leading to the massive turbines and multiple tower wind farms we see being developed across SE Australia. It may be worth testing the market for a mid-scale turbine in the vicinity of the possible solar farm on high ground, in proximity to usable network infrastructure, and away from residences.

Recommendation: Small-scale wind generators should be considered for any new or existing remote infrastructure. Mid-scale wind generators could be considered as part of a hybrid mid-scale project (which we have not modelled). Local wind farms should be approached to provide renewable energy to Council to fill the shortfall if Council elects to proceed with BtM solar as the only offset strategy.

5.3 Community Virtual Power Plants – community-wide approach

JSC has assisted the development and incubation of Junee Community Power Inc (a not-for-profit), educating and assisting the Junee community in transitioning to renewable energy whilst addressing the pain point of rising electricity costs. The Junee Community Power Inc has an energised volunteer committee and developed an 'empower program', that has received state-wide recognition. The corporation now is self-sustaining and maintains its close links to Council.

This poses the question:

- Can the Junee Community Power Inc, have a role to play in a Junee Community Virtual Power Plant?

As referenced previously in this report, there are currently new technologies and market-place arrangements being developed that allow peer-to-peer solar energy trading between residential properties, known as Virtual Power Plants (VPP). At a small scale, a household can trade their excess solar generation to a property of their choosing at a negotiated price. This system 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.

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

As can be imagined, this approach would require Council to recruit and facilitate a group of 'community partners' with the capacity to install solar that, after whatever self-consumption occurs, results in the equivalent of 0.83 GWh capacity p.a.

An obvious foundation partner organisation for this arrangement would be Junee Community Power Inc. However, it would require alignment of objectives and a clear delineation between the likely roles of each participating party within such program.

CE have previously modelled this for another Council and found the $ per kW installation cost significantly more expensive than the mid-scale array option. This may be mitigated to a large extent if an attractive deal can be constructed for participants to part fund the installation themselves. This approach clearly places Council in the realm of community solar projects and as such, Council needs to be sure they have the appetite internally and confidence in the wider community to become engaged in such an approach. The approach would require detailed modelling, careful structuring, and a recruitment campaign.

Recommendation: JSC decide on the degree to which their renewable action plan should be pursued with discrete projects they can readily control, versus/with a community engaged approach with incentives and a VPP structure with Council as a joint participant.

5.4 Bioenergy

Bioenergy requires organic feedstocks which are digested or gasified in vessels, resulting in a range of simple hydrocarbon gasses (e.g. methane) or liquids (e.g. ethanol). While bioenergy can be applied as a dispatchable energy source, the apparent immediate value to JSC is to adopt bioenergy as a substitute for gas and diesel transport fuels, rather than being burdened with electrifying the HVAC systems and the diesel plant and equipment.

The Junee region has an abundance of feedstocks of organic materials or organic wastes. Residential and commercial waste transported to the waste treatment centre may provide enough feedstock to match Council demand, but this has not been quantified for this report. For example, in simple terms, could the landfill site generate enough methane which, when scrubbed, would be meet part of the JJRAC annual consumption (4,222 GJ p.a.)?

The Australian Energy Market Operator has identified bioenergy as part of the 'future mix' of energy for Regional Australia and Junee Shire Council presents as an excellent candidate for the integration of this technology in a diversified and distributed low-carbon energy future.

Recommendation: Conduct a specific high-level audit of organic waste streams to determine, the basic feasibility whether JSC could consider them as a replacement alternate energy source.

5.5 Microgrids

The term microgrid traditionally applies to a single point of connection into 'the grid' behind which sit multiple metered loads. Examples are shopping centres and some industrial subdivisions.

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. There are also examples where several meters can be consolidated into a single market facing meter and with basic wiring and administrative changes, result in reduced billing due to standing charges.

Constructive Energy is playing the lead technical role in a federal government funded study into the application of microgrids in agriculture with Queensland Farmers Federation and others. Information, analysis and findings can be shared with JSC, if Council, intends to be involved in these types of developments.

Recommendation: For Junee Shire Council, 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-metered customers and an on-going revenue stream to Council.

5.6 Off-grid facilities and critical infrastructure

Many remote communities and mining operations are currently installing independent generation facilities. 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). These installations allow the community and microgrid to operate in an 'islanded' and off-grid state. 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 Junee Shire Council 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 or other supply interruptions. The emerging hydrogen economy can also offer solutions in the context.

Recommendation: That Junee Shire Council consider the relative importance of energy security at key sites and factor this into considerations for BtM installations as this may be the factor that weights the business case towards proceeding.

5.9 Demand Side Participation (DSP)

Demand Side Participation has been referenced elsewhere in the Plan however it does stand on its own as 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, and in particular, interruptions to electricity supply during peak summer periods.

A contractual arrangement can be entered into by Council (the participant) with AEMO, in which they agree to the curtailment of non-scheduled energy consumption or provision of non-scheduled generation in response to the demand of electricity.

- Examples include industrial facilities that are exposed to the wholesale price and elect to reduce electric load at times of high prices. Or large energy consumers that agree to let their battery be controlled by a third party and 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: Demand side participation forecast and methodology).

The mechanisms and regulation for DSP are currently evolving however we can be sure that this will become an increasingly prevalent component of energy retailing and network operation.

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

6.0 CAPEX Funding and Ownership Models

The strong economic return in renewable energy infrastructure is resulting in a range of potential investment options and there is currently significant investor interest which can be leveraged. The following enabling mechanisms all have relevance and precedent within the local government sphere.

Junee Shire Council owned and operated on JSC facilities

Delivers JSC the shortest pay-back and maximum return (cash flow) but JSC carries all the risk (after warranty). JSC may choose to invest existing reserves (including grant funding) or take advantage of low borrowing rates to structure projects as cash-positive from day 1.

Corporate owned

Corporate owned on Junee Shire Council facilities**:** It is common practice for solar companies to offer installation at no cost and to enter into a Power Purchase Agreement (or equivalent lease-type arrangement) that will slightly reduce and lock in a cost for energy over typically a 7 - 10-year timeframe. In this instance the provider carries the risk and maintenance burden but is able to generate a cash flow and profit after the pay-back period. The asset is often gifted to the host at contractual exit e.g., after a 12-year period.

Community Owned on Junee Shire Council facilities

There is a strong movement for community ownership of commercial and larger scale solar plants and many models and organisations exist to facilitate this. The arrangements are similar to corporate investment however the financial returns are distributed to community investors, typically at around 6 – 10%. Community owned solar is seen as a way to engage community and to share economic benefits locally and in many parts of the world a set percentage of community ownership is stipulated as a condition of consent – particularly in wind projects.

Junee Shire Council as provider on/to third parties

Subject to the right agreements and on the strength of business modelling, Junee Shire Council may choose to invest in solar panels on or near industrial sites in JSC and to benefit from a Power Purchase Agreement while supporting local business through reduced operating costs and energy certainty.

Hybrid funding

For certain larger installations it is possible that a range of funders invest in the project. For example, the host/energy user, the community, Council and a third-party commercial operator may all invest in a set percentage share of a project.

7.0 Recommendations and next steps - proposed Renewable Energy Roadmap

There are a large number of pathways available to Council in relation to renewable energy options identified in this report. Some of these may change in priority with the availability of external funding and the moving priorities of governments at all levels. A carbon pricing mechanism or technology stimulus package is one such example.

At the time of writing, CE suggests the following approach be taken, in order of priority.

Energy transparency – smart metering and control

This is a priority initiative for Council as it provides visibility on existing energy consumption leading to energy efficiency measures and allows Council additional control. We recommend Council develop specifications and commence an RFQ process with metering providers.

JJRAC BtM solar and battery installation

We recommend that Council commence developing a detailed business case for rooftop solar at JJRAC. Included in the detailed modelling should be energy storage (batteries) and an EV charging station.

Concurrently Council should run an EOI for a suitable retail partner, which will enable Council to share excess solar production from a JJRAC solar array amongst other Council facilities. This will also be important for the feasibility of a future JSC standalone mid-scale solar array.

Electric Vehicles

Council to invest in installation of an EV charging station(s). The most suitable location would be to install at the JJRAC carpark and to bundle up the EV charging station into the JJRAC solar and battery business case. Project partners could be sought – e.g., a participating energy retailer or the NRMA.

Medium Scale solar

Based on land/network availability there is no immediate clear case for a medium scale solar installation, however we highly recommend that Council continue investigating this as it aligns with Council's longer-term objectives. We recommend that Council engage with the local community and businesses to explore partnerships opportunities. We also believe Council can lay important groundwork by performing analysis of suitable locations and preliminary network enquiries with Essential Energy.

Retail arrangements

Based on both innovation and uncertainty in the market, and Council's intention to increase engagement with renewable energy, we urge caution in participating in bulk energy procurement models. Council should seek energy partners that recognise and reward Councils emergence as a 'prosumer', particularly in relation to the ability to share energy at Council's discretion.

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 7 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 (in progress).
- Presented on renewable energy at several conferences and forums.

Our service offering includes:

- Renewable energy and energy efficiency strategy
- Business case development
- 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 2025 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.