Middleton Group Engineering Pty Ltd
ABN 67 607 858 551

www.middletongroup.com.au

Solar Opportunities Report

September 2022

Client: **Totally Renewable Phillip Island and Energy Innovation Cooperative**
Revision: 0
Project: Phillip Island Solar Farm
Doc no: P22067-G-RPT-0001

FINAL

Revision control

Revision	Date	Description	Prepared by	Reviewed by	Approved by
A	20.08.22	Issue for review	Jason Gomes	Abrar Aziz	Roger Brown
0	20.09.22	Final issue	Jason Gomes	Abrar Aziz	Roger Brown

Disclaimer

This document has been prepared by Middleton Group Engineering Pty Ltd solely for the exclusive use of Totally Renewable Phillip Island and Energy Innovation Cooperative. This document is not intended to be and should not be used or relied upon by anyone else. Middleton Group Engineering Pty Ltd does not accept any duty of care or liability to any other person or entity other than Totally Renewable Phillip Island and Energy Innovation Cooperative. Users of this document should exercise their own skill and care or seek professional advice in the use of the document.

The opinions, conclusions and any recommendations in this report are necessarily based on assumptions made by Middleton Group Engineering Pty Ltd, as described in this report. To the extent the report makes assumptions, these can give rise to discrepancies to the extent that they may or may not represent actual existing circumstances or eventuate to be correct assumptions. Middleton Group Engineering Pty Ltd disclaims liability arising as a result of such discrepancies to the extent such assumptions are such that Middleton Group Engineering Pty Ltd can reasonably be expected to make in accordance with sound professional principles.

Executive Summary

Middleton Group were engaged by Gippsland Community Power Hub, on behalf of Totally Renewable Phillip Island and Energy Innovation Cooperative, to provide a pre-feasibility study for a solar farm and carpark in Phillip Island.

The aim of this study is to provide advice regarding the size of the solar installation for the most economically viable solution, with the primary goal of helping the community achieve greater energy self-sufficiency using more renewable resources.

This report considers the technical and economic viability of a 100kW, 1MW and 5MW solar farm located near the Phillip Island zone substation and Phillip Island Community Energy Storage System (PICESS) on Gap Rd in Cowes and a solar car park at the Cowes Transit Centre.

Phillip Island is supplied via a 66kV sub-transmission line to the Phillip Island zone substation which feeds the wider community via a 22kV distribution network. Section 2 provides an overview of the current power network, population, community solar uptake and community battery on Phillip Island and the economic benefits of the solar farm when supplemented with the PICESS battery.

In section 3, business case elements for solar projects such as solar conditions, potential connection upgrades and details of various Ausnet Services connection processes are outlined. The solar site selection rationale for the solar farm and carpark site is also provided. The main reason for the Gap Rd solar farm is the proximity to the Phillip Island zone substation. This should result in lower network upgrade costs, and reduced planning approvals effort due to existing planning documentations from the PICESS development. Availability of land is a key constraint for solar farms.

The economic viability of the 100kW, 1MW and 5MW solar farm sizes are detailed in section 4 which includes an overview of the system size and location, revenue streams and developer partnership opportunities.

The financial modelling suggests the 1MW and 5 MW system may be commercially feasible – depending on the actual cost of land, equipment selection and revenue model. The section concludes by offering a recommended pathway to consider for a solar farm development.

Section 5 explores the viability of a 29kW solar carpark, ideally located over the eV charging station at the Cowes Transit Centre. The system size was determined on the assumption that the solar carpark would initially cover 12 parking spaces. The high-level costs are discussed including the need for a new, professionally installed carpark canopy which has an estimated cost of around $20k. The canopy makes the system significantly more expensive than a conventional rooftop system. The solar carpark may not be commercially feasible given the increased capital costs for the carpark canopy.

The report concludes by providing an overall summary of the economic viability for a solar farm and solar carpark in Phillip Island.

Abbreviations

Table 1: Abbreviations and definitions

Abbreviation / definition	Explanation
AEMO	Australian Energy Market Operator
APVI	Australian PV Institute
BESS	Battery energy storage system
CER	Clean Energy Regulator
CFA	Country Fire Authority
DNI	Direct normal irradiation
EICo-op	Energy Innovation Cooperative
EPC	Engineering, procurement, and construction
eV	Electric vehicle
HV	High voltage
LFP	Lithium-ion phosphate
LGC	Large-scale generation certificates
LV	Low voltage
PHI ZSS	Phillip Island Zone Substation
PICESS	Phillip Island Community Energy Storage System
PPA	Power purchase agreement
PR	Performance ratio
PV	Photovoltaic
PVOUT	Specific PV power output
STC	Small-scale technology certificate
TRPI	Totally reNewable Phillip Island
TY	Typical year metrological
ZSS	Zone substation

Contents

Tables

Figures

1 Introduction

1.1 Background

Totally reNewable Phillip Island (TRPI) was initiated in June 2018 after a community energy public forum organised by the Energy Innovation Co-operative in partnership with the Phillip Island Community and Learning Centre, Phillip Island Landcare Group, Phillip Island Conservation Society, Boomerang Bags and Plastic-free Phillip Island and San Remo.

Their vision is to be carbon neutral and 100% renewable by 2030 using a framework that identifies six focus areas– Clean energy, Toward zero emissions transport, Carbon farming, Carbon accounting, Food and waste, Education and communication. A solar farm is a signature item from the 'Totally Renewable Phillip Island 100% Renewable Energy Community Pre-Feasibility Study' to achieve energy independence and greater stability of the local network.

The pre-feasibility report suggested a 5MW solar farm would satisfy the total renewable power needs on the island considering population growth and electric vehicles however TRPI are seeking advice regarding the size of the installation for the most economically viable solution.

1.2 Purpose

Totally Renewable Phillip Island are looking to create a solar farm to provide sufficient energy to supplement existing renewable resources and make the community energy self-sufficient.

1.3 Scope

The scope of this document includes, but is not limited to, the following:

1. An overview of the Phillip Island electrical network, population, and current solar installations within the community.
2. Identification of possible locations or areas within Phillip Island that would be best able to contain a solar farm and solar carpark
3. An approximate cost of a proper business case, including potential connection upgrades, network studies, permits required and any other determination to enable the vision to happen.
4. An overall assessment of the economic viability of a properly sited solar farm including the most appropriate size they might consider.

2 Current Phillip Island landscape

2.1 Ausnet Services network

Figure 1 shows the distribution network in Phillip Island.

Phillip Island is connected to the main grid at the 26MVA, Phillip Island Zone Substation (PHI) located by Ventnor Beach Road and Gap Rd, through a 40.9km, 66kV sub-transmission line (red). The island is a power distribution is via 22kV distribution powerlines (purple).

Phillip Island (PHI) zone substation consists of two 66/22 kV 10/12.5 MVA transformers supplying a single 22 kV bus and three 22 kV feeder circuits. The substation supplies approximately 11,000 residential, commercial, industrial customers. In addition to the 66kV line crossing to the mainland there is also a 22kV feed connected into the Island 22kV network, allowing supply of some of the island 22kV from the mainland. There can be many cross connections in the 22kV network to allow operational flexibility. Ausnet do not indicate the normal operational open points in the publicly available information.

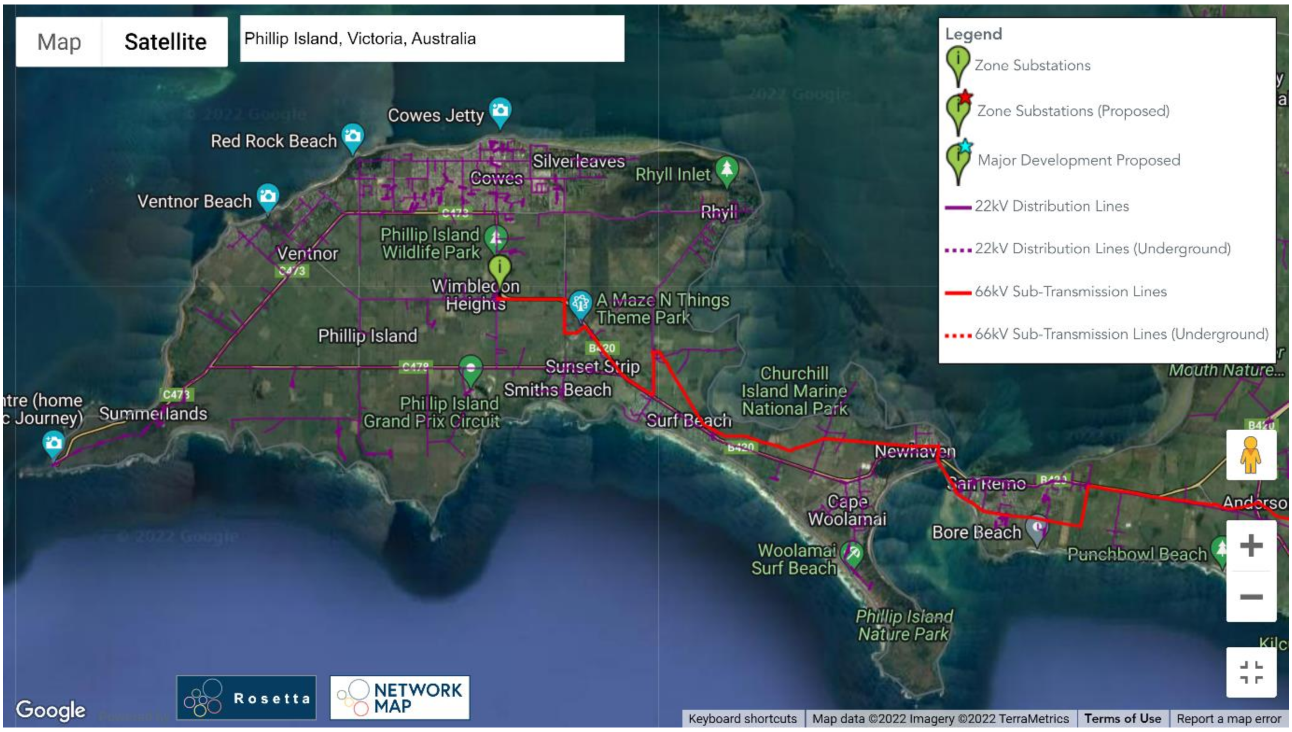


Figure 1: AusNet network map for Phillip Island[1]

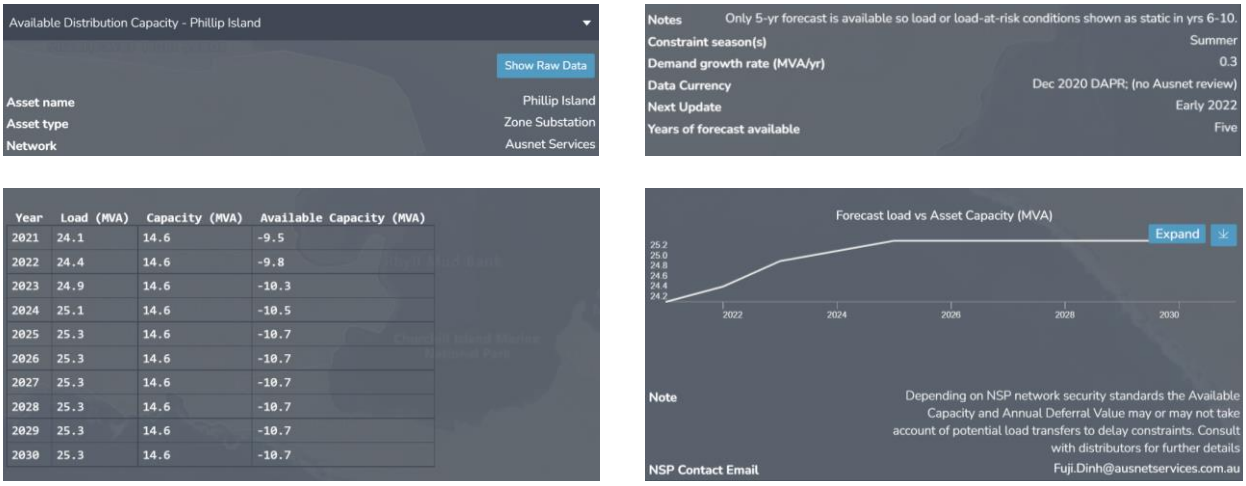
[1] AusNet - Rosetta Data Portal (ausnetservices.com.au)

Figure 2 shows the Phillip Island statistical area for the census, which includes postcodes 3922, 3923 and 3925. In the 2021 census, there were 12,569 private dwellings recorded with an average of 2.2 persons per household.[2]

Figure 2: Phillip Island statistical area used for census statistics

2.1.1 Available distribution capacity

Figure 3 shows the available distribution in Phillip Island based on Ausnet's most recent 2020 dataset, which indicates the available distribution capacity to be -10.7 MVA by 2025.



Year	Load (MVA)	Capacity (MVA)	Available Capacity (MVA)
2021	24.1	14.6	-9.5
2022	24.4	14.6	-9.8
2023	24.9	14.6	-10.3
2024	25.1	14.6	-10.5
2025	25.3	14.6	-10.7
2026	25.3	14.6	-10.7
2027	25.3	14.6	-10.7
2028	25.3	14.6	-10.7
2029	25.3	14.6	-10.7
2030	25.3	14.6	-10.7

Figure 3: Available distribution capacity – Phillip Island[3]

2017 data indicates new generation capacity of 12.5MW and up to 26MW depending on control schemes and studies. A connection application with the required fees will need to be submitted before Ausnet will provide more information. It should be noted, this data does not reflect the impact of the PICESS battery on the network. The next update on available distribution capacity at PHI ZSS is expected later in 2022.

[2] 2021 Phillip Island, Census All persons QuickStats | Australian Bureau of Statistics (abs.gov.au)
[3] NationalMap

2.2 Existing solar installations in Phillip Island

This section provides a summary of the current solar installations in Phillip Island. The data is based on the number of dwellings from 2021 census data and current Clean Energy Regulator (CER) data for the following postcodes:

Table 2: CER solar installation data by postcode

Postcode	Suburb	Installations
3922	Cowes, Newhaven, Rhyll, Silverleaves, Smiths Beach, Summerlands, Sunderland Bay, Sunset Strip, Surf Beach, Ventnor, Wimbledon Heights	Est. dwellings: 9772 Installations: 1954 (4approx. 20% of dwellings)
3923	Rhyll	Est. dwellings: 603 Installations: 172 (4approx. 28.5% of dwellings)
3925	Cape Woolamai, Churchill Island, Newhaven, San Remo	Est. dwellings: 3230 Installations: 821 (4approx. 25.4% of dwellings)

Table 3 shows the total solar capacity installed, for all three postcodes, since 2007.

Table 3: Solar installation size by year in Phillip Island area

Year	Solar capacity (kW)	Annual growth (%)
2007	2	-
2008	6	200.0%
2009	19	216.7%
2010	202	963.2%
2011	799	295.5%
2012	1508	88.7%
2013	2183	44.8%
2014	2779	27.3%
2015	3398	22.3%
2016	4150	22.1%
2017	5288	27.4%
2018	7480	41.5%
2019	9983	33.5%
2020	13025	30.5%
2021	16342	25.5%
2022	17155	(year incomplete)

Figure 4 shows the cumulative solar capacity in groups and installations for all three postcodes since August 2007.

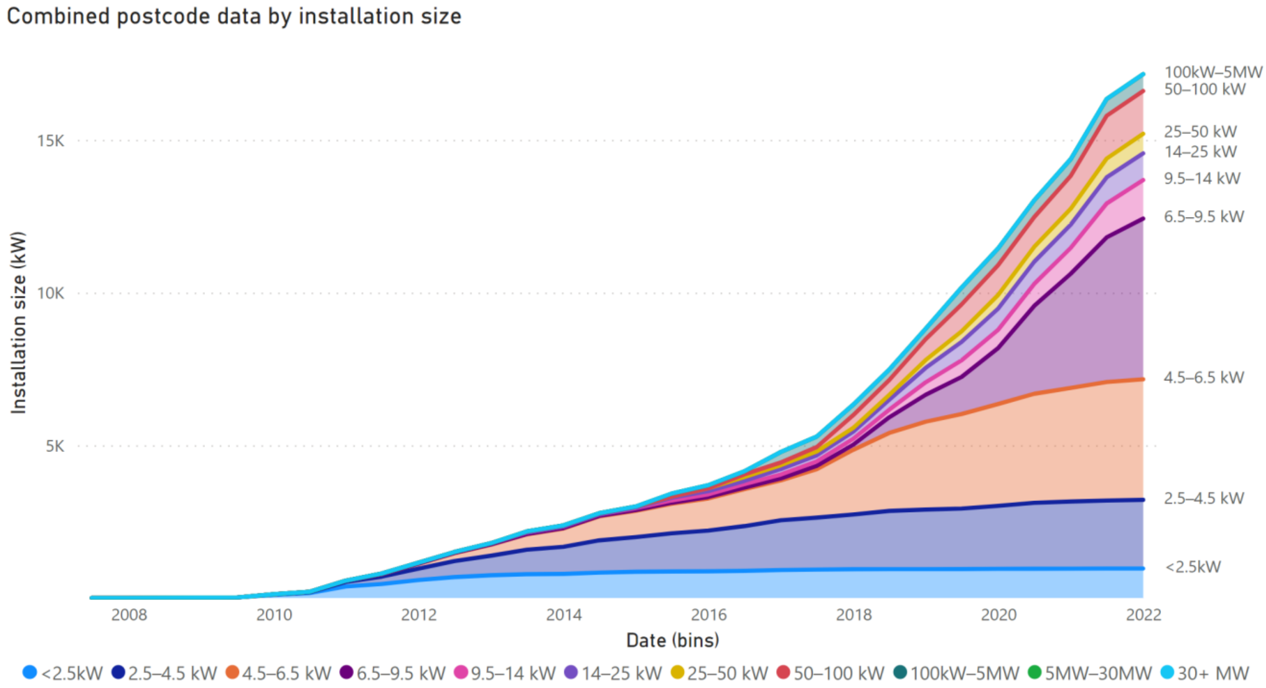


Figure 4: Solar installation by size, for all three postcodes combined

For more details on the current solar installations in Phillip Island, see Appendix B:.

Please note, the following analysis is based on APVI postcode data which includes postcode 3925. It should be noted that San Remo, which falls within postcode 3925 is not considered a part of Phillip Island.

The **highlights** from this data include:

- As of June 2022, there is a total of **17,196kW** installed between **2946 customer installations**. This represents **23.46%** of the total Phillip Island community.
- The **average capacity per installation** has steadily grown from roughly 1.5kW in 2010 to **5.84kW** in 2022 – this represents the average size of a residential solar installation.
- Solar installations sized larger than 100kW contribute to 3.19% of the total installed capacity, or 550kW. From Table 15, it is estimated that three customers contribute to this total – two of which are Newhaven College and Phillip Island Nature Parks – Penguins.

The **key takeaways** here are:

- Small-scale, rooftop solar systems sized between 6.5 – 9.5kW make up the highest portion of solar capacity in Phillip Island, at roughly **30.83%** or 5312kW in total. This represents the high uptake from residential customers in the community.
- Since 2014, solar capacity in Phillip Island has **grown by roughly 29% p.a.** on average.

2.3 Existing renewable energy in the community

2.3.1 Phillip Island Community Energy Storage System (PICESS)

The Phillip Island Community Energy Storage System is expected to be located on Gap Road in Cowes. The land is a newly purchased property owned by council and is the subject of ongoing master planning process.

Figure 5: Phillip Island Community Battery on Gap Rd in Cowes[4]

The PICESS is a 5MW/10MWh lithium-ion phosphate (LFP) battery which is planned to be commissioned in Q3 of 2022. The battery is expected to service the Phillip Island community for 10-15 years.

The battery will not provide power to the network when an outage occurs. It will provide short term performance improvements to the electricity supply – especially during peak holiday periods and hot weather.[5]

Key opportunity: The solar farm business case may benefit if paired with the PICESS battery as it would increase use of locally generated renewable energy on the island. A direct connection via the battery would reduce costs for building the solar farm. This would require a discussion with Ausnet to explore the available opportunities.

[4] Phillip Island Community Energy Storage System | Community | Energy Hubs and Projects | Mondo
[5] Ausnet | Mondo – Phillip Island Fact Sheet

3 Solar opportunities

This study considers two solar opportunities for increasing Phillip Island's renewable energy usage through community solar projects. The two main opportunities explored are:

5. **Small to medium-scale community solar farm**
6. **Increasing commercial solar in Cowes**

The following sections cover the solar design considerations in more detail.

3.1 Solar conditions

Figure 6 shows the long-term average of annual totals of PV power potential at Phillip Island.

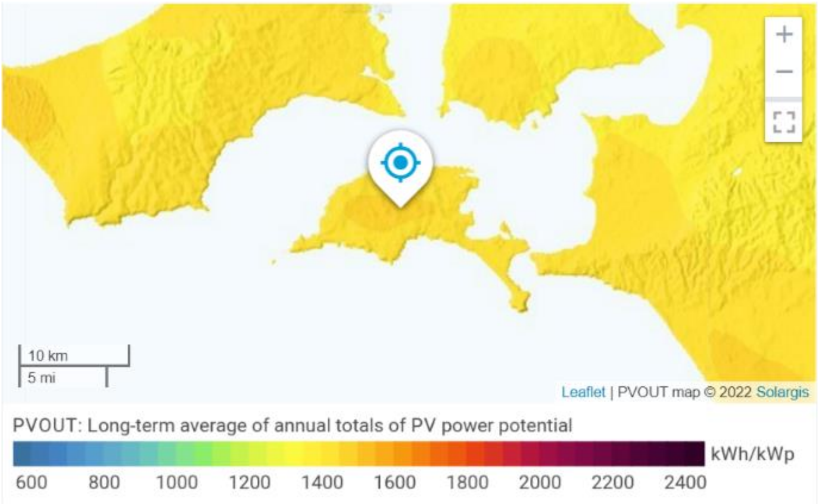


Figure 6: Specific PV power output (PVOUT)

Figure 7 shows the monthly averages for the direct normal irradiation (DNI) at Phillip Island.

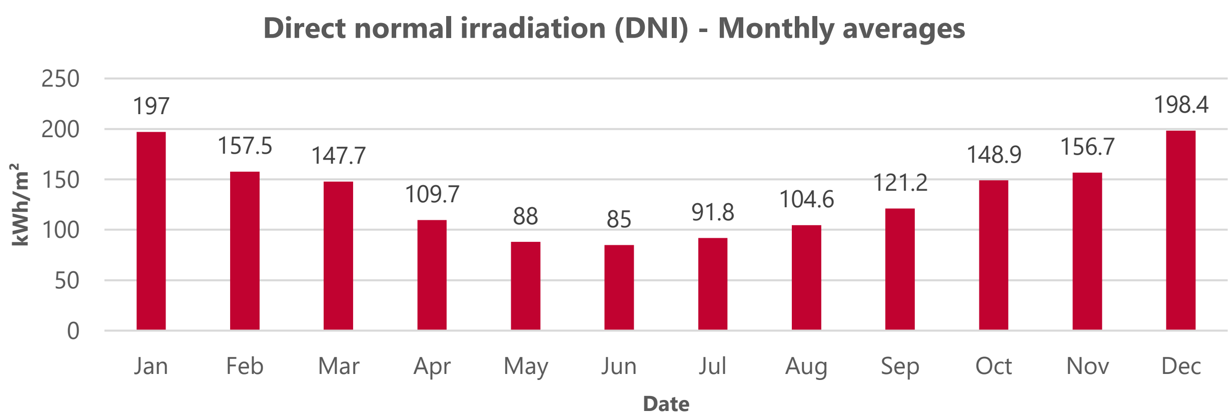


Figure 7: Monthly averages for direct normal irradiation in Phillip Island

Locating a solar plant at Phillip Island can make sense for a net zero community target and placing generation close to load. It is not one of the most optimal locations for solar overall in Australia and Victoria, as shown in Appendix C:. For maximising output from a solar farm and lower land value other locations are better suited for utility scale installations.

3.2 Solar design considerations

Approvals for solar systems depend on the system size[6]:

- **Micro** – less than 5kVA single phase, simple online process with minimal approval required.
- **Mini** – 5kVA to 15kVA three phase. Simple online approval process.
- **Small** – Application required. Increasing complexity based on size bands.
  - 15kVA to 30kVA. Some protection requirements and limitation on out of balance.
  - 30kVA to 200kVA. Additional protection requirements. Small chance of studies being required.
  - 200kVA to 1.5MVA. Similar protection to under 200kVA. Protection and system studies likely to be required.
- **Medium** – 1.5MVA to 5MVA. Protection requires remote trip by Ausnet. Protection and system studies will be required.
- **Large** – Greater than 5MVA. Protection requires remote trip by Ausnet. Protection and system studies will be required. Market registration and NER requirements likely.

To qualify for the Small-scale Renewable Energy Scheme, solar systems must be less than 100kW and a total annual output of less than 250MWh. Under this scheme Small-scale Renewable Energy certificates (STC) can be created based on an expected output of the system. These are available to be traded after the system is commissioned and provide an immediate offset to the initial capital price, making the system more attractive financially.

The opportunities for solar are generally:

1. Small-scale system under 30kW, export limited to 15kW – Simple approval process and likely to be easy to install with limited additional infrastructure. Qualifies for STC credits which helps offset initial capital cost. Offsets locally used power. This will have the best payback and overall benefit and should be considered for all sites. There is a 5kW export limit per phase.
2. Small-scale system up to 100kW, no export limit – A more complex approval process but unlikely to require system studies or complex protection systems. Being up to 100kW this sized system still qualifies for STCs, helping to offset capital costs.
3. 100kW to 200kW – This sized system does not qualify for STCs but does generate large-scale generation certificates (LGC). As such is still provides useful offset, but not as favourably.
4. Greater than 200kW – Connection costs will likely be significant, with system studies and supply upgrade likely to be required. Systems will benefit from maximising the system size to offset the connection costs.

[6] Ausnet SOP 11-16 Protection Requirements for Embedded Generators

3.3 Site selection

The proposed sites for solar developments include:

3.3.1 Solar farm

For a large-scale (up to 5MW) – Council land 100 Gap Rd.

Figure 8: Proposed solar farm site on 100 Gap Rd

The solar farm has been considered at the farmland on Gap Rd due to the close proximity to the zone substation (PHI ZSS) and the PICESS battery located nearby.

Network capacity and upgrades

The PHI ZSS is rated at 26MVA.

To support any renewable generation, the site will need new or upgraded power infrastructure, depending on the specific location.

In general, the costs for the following items may need to be considered:

1. Transformer – capacity depends on the renewable generation capacity
2. Switchboard and meter (part of the new facility)
3. Power lines – Likely OK for the sizes covered here.

A direct connection from the solar farm to the ZSS would present the least issues.

Why locate it near the PICESS battery?

The benefit of locating the solar farm nearby the PICESS or alternative locations, is that many of the required studies for development of the area have been completed and published. These include:

- DELWP application
- Bushfire risk assessment
- Development plans
- Environmental constraints assessment (ECA)
- Environmental management plan (EMP)
- Environmental noise assessment
- Hydraulic report
- Native vegetation removal report
- Planning assessment report
- Flood and hydrological study

Whilst these would need to be revisited for the new purpose of a solar farm they are a benefit.

From the publicly available PICESS planning reports, the developers have confirmed a 300m underground powerline would be required from the Option 3 (shown in Figure 9) site to the PHI ZSS.

Figure 9: Proposed sites for PICESS during early development[7]

A large solar farm in this location could use a similar dedicated connection to the zone substation or potentially share the connection of the BESS, especially if the output of the solar was integrated with the BESS. Battery operation is likely to be anti-correlated with solar output (when solar output is high battery will either be charging or static).

[7] Environmental Constraints Assessment for Proposed Battery Storage Facility at Phillip Island

3.3.2 Cowes Transit Centre

For increased distributed solar on commercial rooftops – **Cowes Transit Centre**, located off Church St and Thompson Ave.

Figure 10: Cowes Transit Centre

A solar carpark has been considered at the council-owned, open parking lot by the Cowes Transit Centre, as shown by the red boxes in Figure 2. The ideal location (shown in green) is by the eV charging station which houses 3 – 4 Tesla and Evolution chargers, as shown in Appendix E:.

The benefit of this location is that this provides additional renewable energy to the transit centre and existing eV charging station and provides shelter for EV drivers accessing the chargers. The installation of a new carport structure to support the solar system adds to capital cost of the project – thereby significantly impacting the financial feasibility. Essentially it is a lot cheaper to install a similarly sized system on a nearby rooftop, if space is available. The shelter does provide benefit to users of the chargers in adverse weather.

3.4 Ausnet embedded generator connection process

The Ausnet Services Connection Policy outlines the connection requirements for embedded generation[8]. The following section outlines the timeline and associated costs for the various Ausnet connection types:

3.4.1 Connections between 30kW to 1.5MW

For systems sized between 30kW and 1.5MW:

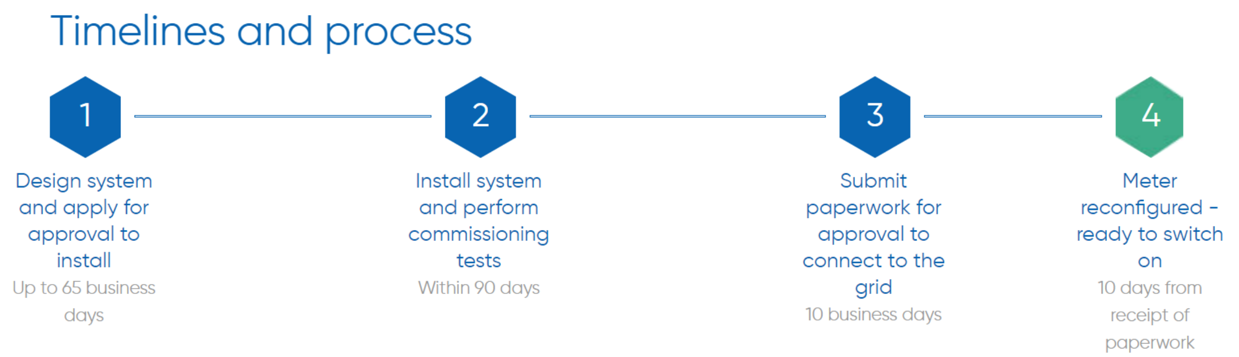


Figure 11: 30kW to 1.5MW connection timeline

Table 4 provides a summary of the timeframe and connection for each stage:

Table 4: Ausnet connection process for 30kW to 1.5MW generation[9]

Stage	Timeframe	Cost payable to Ausnet (excl. GST)
Design system and apply for approval to install	Up to 65 days	Up to 200kW: $2000 200kW to 1.5MW: $3000
Install system and perform commissioning tests	Within 90 days	Only if Ausnet need to strengthen the network, and they will advise of any costs.
Submit paperwork for approval to connect to the grid	10 business days	No costs
Meter reconfigured – ready to switch on	10 days from receipt of paperwork	Billed by your energy retailer, either: $15.11 for electronic meter reconfiguration or, $567.41 excl. GST for a truck visit (if required).

The requirements for the system design will also have associated costs. These requirements include:

- Protection requirements of embedded generators (LV + HV up to 22kV)
- Central protection commissioning test report
- Power quality compliance

[8] Microsoft Word - Connection policy_AusNet Services_Clean_(02 03 17).docx
[9] 30kW to 1.5MW (ausnetservices.com.au)

- Single line diagram

3.4.2 Connections between 1.5MW to less than 5MW

For connections sized between 1.5MW and under 5MW:

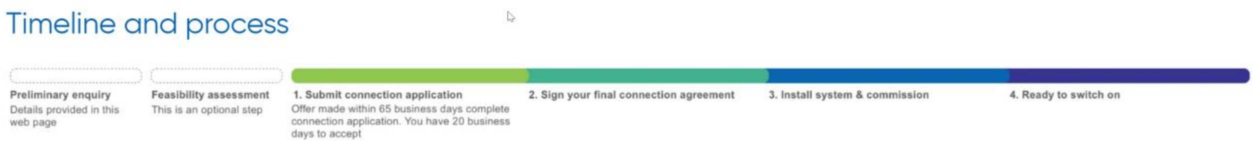


Figure 12: 1.5MW to <5MW connection timeline

Table 5 provides a summary of the timeframe and connection for each stage:

Table 5: Ausnet connection process for 30kW to 1.5MW generation[10]

Stage	Timeframe	Cost payable to Ausnet (excl. GST)
Preliminary enquiry stage	N/A	N/A
Feasibility assessment	20 to 30 business days	Determined on application
Submit connection application	Can take between four to six months, and is usually an iterative process	$12,800
Sign your final connection agreement	Will vary based on contract negotiations.	No additional fees will be charged. The Offer and Contract Execution stages costs are charged under the Letter Agreement.
Install system & commission	Project connection cost per Connection Agreement	Per required Practical Completion date in executed Connection Agreements.
Ready to switch on	Per Connection Agreements	N/A

The detailed requirements in each process also have associated costs. These requirements include:

- Completion of a Feasibility Assessment Form
- Executed agreements
- Network study report
- Connection Application Form, including all nominated items in the form[11]

[10] 30kW to 1.5MW (ausnetservices.com.au)
[11] Forms Template (ausnetservices.com.au)

3.4.3 Other connection fees

Table 6 outlines other connection charges detailed in the Ausnet Services Distribution Connection Policy for negotiated connection services.

Table 6: Connection charges for Negotiated Connection Services[12]

Fees and charges	Routine Connections over 100A[24]	New connections requiring augmentation	Re-arrangement of existing assets	Unmetered supply	Embedded generation
Pre-approval service	✗	✗	✗	✗	✓
Negotiation Application fee	✗	✓	✗	✓	✓
Quoted service charge	✓	✗	✓	✗	✗
Design and construction of connection assets	As required	As required	As required	As required	As required
Capital contribution for network extension	✗	As required	✗	As required	As required
Capital contribution for network augmentation	✗	As required	As required	✗	As required
Charges for meter type	As required	As required	As required	✗	As required
Minor variations/other incidentals	As required	As required	As required	As required	As required
Reimbursement Payment (Pioneer Scheme) - see section 5.7	✓	✓	✓	✗	✗[25]

In parallel to the connection application, the following costs may need to be considered:

- Design and construction of connection assets
- Capital contribution for network extension
- Capital contribution for network augmentation
- Charges for meter type
- Minor variations / other incidentals.

[12] Microsoft Word - Connection policy AusNet Susnervices Clean (02 03 17).docx

4 Opportunity 1: Solar farm

4.1 System size

Solar systems are modular but there are sizes where the best equipment choice changes and can impact the considerations for sizing. If a size greater than several hundred kW is desired, a 22kV high voltage connection may be required. 22kV is a voltage commonly used in large scale solar farms for their internal distribution and there are packaged transformer and inverter options that will provide a most efficient option in cost, procurement, and installation.

In addition to the HV equipment, inverters, and solar panels there are fixed cost for a solar farm that do not vary greatly with system size, including:

- Project development design and management
- Permits
- Connection studies (up to 5MVA)
- HV connection equipment (utility connection)
- HV feed to site
- Site establishment costs
- Site facilities

For example, a smaller solar farm with a single 1.5MW skid will have similar fixed costs to a dual skid 5MW plant but only generate 30% of the revenue. Whilst the capital cost will be lower due to the saving in a second inverter and panels the cost saving is not proportional to the loss in revenue. Smaller systems will find it more difficult to service loans or provide a return to investors.

There is a sweet spot at just under 5MW as this is the largest size that is exempt from the AEMO requirements to register as a generator[13]. This simplifies the connection process and avoids a lot of additional registration and permitting requirements. Exemptions can be granted for systems up to 30MW, but this is not automatic and not if they have a battery.

We have modelled based on 1MW and 5MW sizes so that the results can be relatively easily extrapolated to larger sizes (2MW, 3MW etc). The 1MW solar farm output matches better to the new PICESS battery system as the typical daily output in peak summer conditions can supply the battery capacity.

Physical size is an important consideration. The size indicated for the 1MW plant can also be extrapolated for larger plants. This "indicative" size has been developed using single axis trackers (to maximise output) and generous spacing to minimise row to row shading losses. There is quite a bit of flexibility in mounting arrangements and spacing to adapt to different land or output requirements. Hence it can be important to have a potential location and available space to provide any more detailed configuration and layout information.

4.2 Location and connection agreement

The optimal location for the solar farm would be on land adjacent the HV line next to the Phillip Island ZSS which allows for 22kV connection. This would allow space for the switching station adjacent the solar farm

[13] AEMO Generator-Exemption-and-Classification-Guide

and minimise connection costs and additional permits/land etc. Land near this will be the best for the development. Areas to either side are also practical but will increase project cost for the overhead line, easements and permitting.

The Victorian government has guidelines for the development of solar energy facilities that should be consulted for further considerations on suitable land[14]. The CFA also has guidelines that help inform siting considerations to minimise fire risk and potential planning concerns[15].

Finding suitable land that is or can be cleared near to HV power lines and with a supportive landowner willing to lease the land at a reasonable rate will be a key asset to the development.

4.3 Physical size, arrangement, and costs

There are many options for the arrangement of solar panels to balance cost, space, shading losses, and output.

Figure 13: 5MW Solar Farm Example (Hunter Solar Farm)

Without a location, detailed design, or feedback on network limitations it is difficult to provide a detailed capital cost estimate. Recent supply chain issues in many markets and increased shipping costs mean historic prices may not be a good guide for current pricing.

To make a conservative estimate on the area required the following parameters have been used:

- 600W, 60 cell panels
- Single axis tracking (North/South axis)
- One panels per row – portrait orientation
- 6m between rows (CFA recommendation)
- 4m boundary road allowance (as per CFA recommendation)
- 10m landscaping buffer

[14] DELWP: Solar-Energy-Facilities-Design-and-Development-Guideline-August-2019.pdf

[15] CFA: 220503_Design_Guidelines_Model_Requirements_Renewable_Energy_Facilities_v1.pdf

There are many benchmarks available:

ARENA conducted a study of large-scale solar projects in 2020 and indicated project costs typically around $2/watt, as shown in Figure 14.

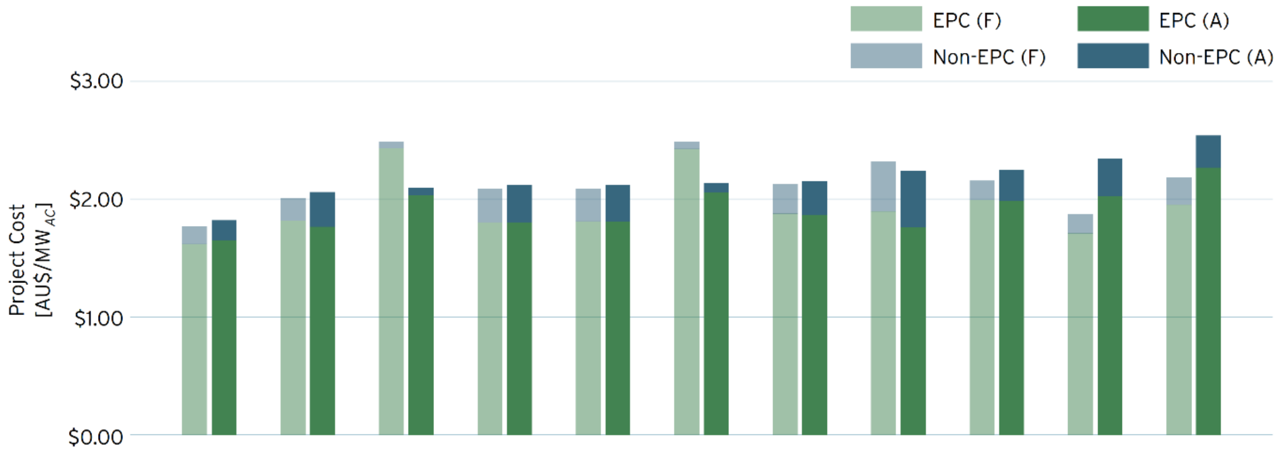


Figure 8. The actual EPC and non-EPC costs compared to what was forecasted at financial close for the LSS Round Projects. These costs exclude liquidated damages and operational expenditure.

Figure 14: Arena Report Large Scale Solar Project Costs[16]

The following items are uncertain, and can contribute to the cost:

1. Confirmation of preferred system size and site location.
2. HV connection distance and complexity
3. Whether a switching station is required
4. For ground-mounted solar, the racking type which includes dual-axis, single-axis and fixed tilted racking.
5. Is the land available and at what cost?
6. The costs for preliminary application and associated requirements.

The benchmark figures include for typical values of these items and so have been used as a reasonable guide at this very early stage.

4.3.1 Solar racking type

Most modern utility scale plants typically use single axis tracking. This provides higher output but will generally use more space.

For a straight-forward ground mounted installation, the costs are an additional 20c per watt greater than the rooftop system.[17]It is estimated solar trackers can increase the system installation cost by nearly 50%.[18]

Dual-axis tracking systems are not as common due to being significantly more expensive than single-axis tracking, with only slightly more production. High wind conditions may impact the feasibility of dual-axis systems, though Phillip Island is not considered a high wind area, as shown in Figure 38.

[16] insights-from-the-first-wave-of-large-scale-solar-projects-in-australia.pdf (cefc.com.au)
[17] Ground Mount Solar Panels - Racking options, Costs | Solar Choice
[18] Solar Tracker Guide: Achieving Longer Sun Exposure (takeatumble.com.au)

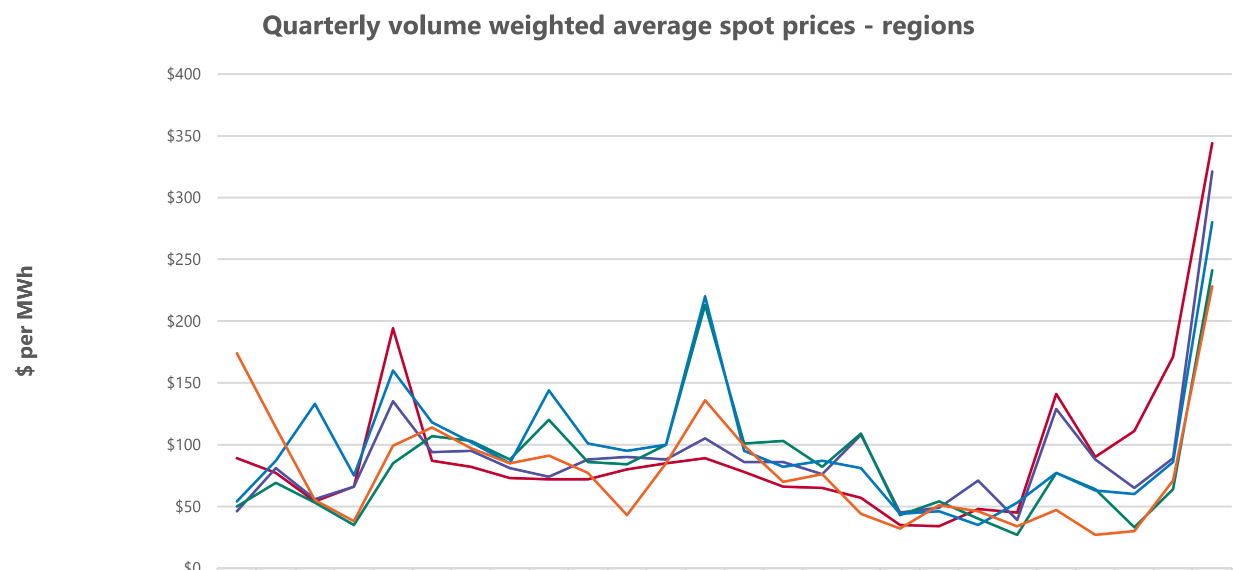
4.4 Revenue considerations

4.4.1 What are the revenue streams?

The potential revenue streams for the solar farm include:

- Power purchase agreements (PPA)
- Solar feed in tariff / exporting back to the grid (front of the meter)
- Community energy usage
- Feed into the battery/energy arbitrage (if combined with batteries)

The solar farm will likely have an operational life of over 20 years. Current solar panels decline in output by less than 0.5% per year, so at year 20 they are still producing about 90% the energy they did when new. Forecasting power prices over 20 years is very difficult. Figure 15 shows the market power price variation over the last few years. Issues in the network such as generator failures or higher gas prices tend to push prices up. A conservative average low value is around $50/MWh which equates to 5c/kWh – about the rate of the current Victorian feed in tariff.



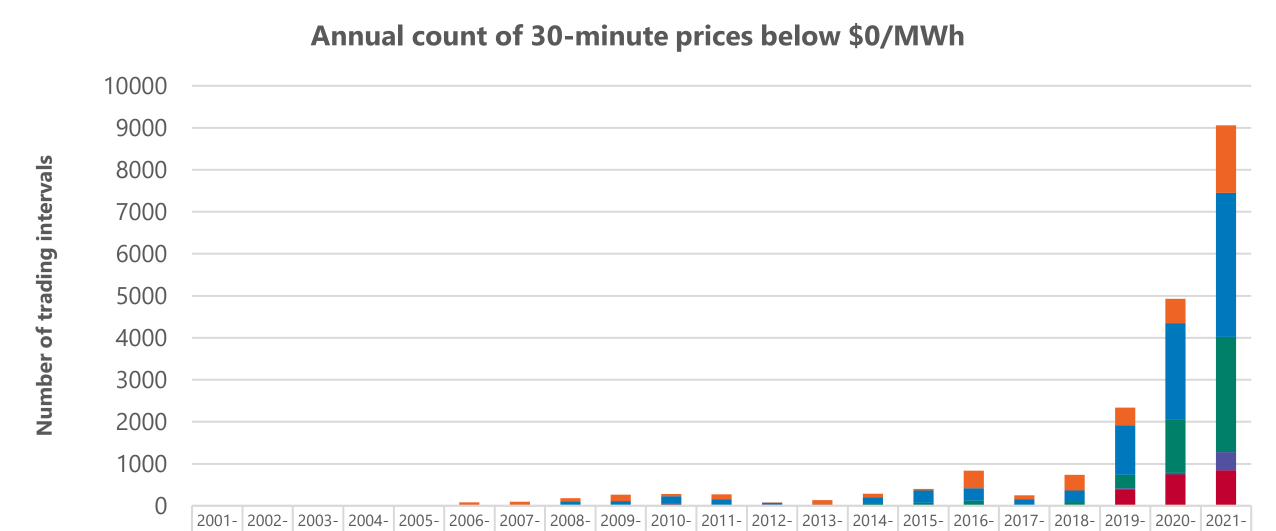
	2016				2017				2018				2019				2020				2021				2022	
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Queensland	$89	$77	$54	$66	$194	$87	$82	$73	$72	$72	$80	$85	$89	$78	$66	$65	$57	$35	$34	$48	$45	$141	$90	$111	$171	$344
New South Wales	$46	$81	$56	$66	$135	$94	$95	$81	$74	$88	$90	$88	$105	$86	$86	$76	$108	$45	$49	$71	$39	$129	$88	$65	$89	$321
Victoria	$50	$69	$53	$35	$85	$107	$103	$88	$120	$86	$84	$100	$213	$101	$103	$82	$109	$43	$54	$40	$27	$77	$64	$33	$64	$241
South Australia	$54	$87	$133	$75	$160	$118	$102	$85	$144	$101	$95	$100	$220	$95	$82	$87	$81	$44	$46	$35	$53	$77	$63	$60	$86	$280
Tasmania	$174	$114	$55	$38	$99	$114	$97	$85	$91	$77	$43	$85	$136	$99	$70	$76	$44	$32	$51	$46	$34	$47	$27	$30	$71	$228

Quarter

Figure 15: Volume Weighted Spot Prices by quarter[19]

There is a risk of lower power sale price, particularly for solar plants. The increased installation of rooftop solar has shifted the minimum demand in the network from the early hours of the morning to the middle of the day. Increasingly wholesale prices can be negative when solar output is high.

[19] Quarterly volume weighted average spot prices - regions | Australian Energy Regulator (aer.gov.au)



	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
Tasmania					0	63	76	81	150	54	123	7	109	93	40	416	86	370	416	580	1606
South Australia	0	4	1	0	0	9	4	75	86	177	120	40	18	154	288	298	139	275	1187	2284	3431
Victoria	1	2	1	3	1	6	2	23	8	14	14	1	6	28	72	118	8	66	317	1281	2745
New South Wales	0	0	0	0	0	0	0	2	8	4	0	1	0	1	1	0	0	0	27	44	427
Queensland	0	1	1	1	6	2	14	4	13	33	17	32	2	15	1	2	15	24	391	742	848

Figure 16: Number of 30-minute trading intervals below $0/MWh[20]

In Figure 16, there are 2750 30-minute intervals where market price was negative last financial year (15.7% of the year). For financial viability it is important to secure a stable and longer term method to sell the power than directly into the wholesale market. Discussion with retailers and the BESS is recommended to explore the options.

For the purposes of this evaluation annual revenue was calculated assuming all electricity generated is exported back to the grid at the current default solar feed-in tariff of 5.2c/kWh and the current LGC price (~$50/MWh).

[20] Annual count of 30-minute prices below $0/MWh | Australian Energy Regulator (aer.gov.au)

4.4.2 Partnership and retailer opportunities

The following partnership and retailer opportunities are examples of retail groups to consider for discussion of both farm financing and development and power offtake agreements.

Examples include:

Komo Energy – particularly relevant is the Grong Grong development. Komo Energy have successfully launched a crowd equity funding campaign to finance the Grong Grong Solar Farm, a 1.7 MW battery ready solar project in regional NSW.

They helped enable almost half the cost of the Energise Gloucester solar farm provide by acquiring $460k in grants from the Regional Community Energy Fund (RCEF)[21].

Indigo Power – primarily a retailer but have worked closely with community groups such as Totally Renewable Yakandandah.

Flow Power – Have worked with renewable Newstead and BREAZE on developments and community offers

[21] Empowering the community | Energise Gloucester

4.5 Options

The following solar sizes were considered and modelled at the Gap Rd site:

Table 7: Solar farm options

Option	Solar system size	Why? – Advantages/Disadvantages
1	100kW	Community owned – The community can fund this project without additional government funding or investor support. Simpler approval process with Ausnet (30kW – 1.5MW). Benefit from STCs – 100kWp is the largest system eligible for STCs.
2	1MW	Simpler approval process with Ausnet (30kW – 1.5MW). Good match for PICESS battery – nearly all generated output could feed to the battery, potentially maximising return. Eligible for the LGC benefits
3	5MW	Not significantly better return than 1MW plant. Oversized for the PICESS battery At 5MW[22] and above, the generator is classified as scheduled and the connection process is more complicated.

Modelling assumptions and outputs

The solar modelling in the following sections have been completed using Helioscope, an advanced solar design software. The modelling estimates have been based on the following:

- 600W, 60 cell panels
- Single axis tracking (North/south axis)
- One panels per row – portrait orientation
- 6m between rows (CFA recommendation)
- 4m boundary road allowance (as per CFA recommendation)
- 10m landscaping buffer
- Sungrow inverter
- Meteonorm typical year metrological (TYM) conditions

The modelling outputs are described in the respective sections, which includes a summary of the system metrics, monthly solar generation, and system configuration. Table 8 provides a description of some key modelling output metrics referenced in the sections below:

Table 8: Helioscope output metrics

Metric	Description
Production	The total energy generated during the simulation, in MWh or GWh
Performance ratio	Performance Ratio (PR) shows the percentage of total potential energy for the array that is converted to AC energy.
kWh/kWp	The total simulation energy generation divided by the system DC nameplate power.

[22]For simplicity MW have been used in this report. Actual ratings will be in MVA.

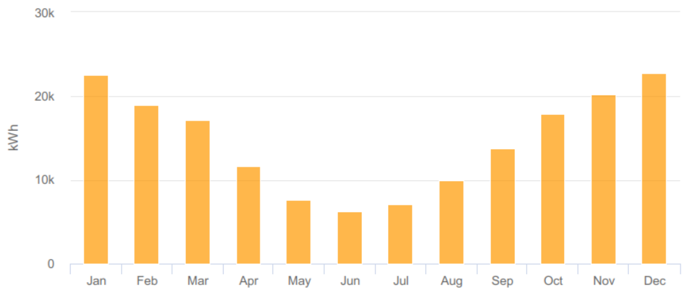
4.5.1 Option 1: 100kW solar farm

Table 9 outlines the key modelling outputs for the small 100kW solar farm:

Table 9: 100kW solar farm system metrics

System metrics	Value
Module DC nameplate	98.4 kW (164x 600W panels)
Inverter AC nameplate	100 kW
DC/AC ratio	0.98
Annual production	175.8 MWh (equivalent to approx. 38 homes[23])
Performance ratio	85.4%
kWh/kWp	1,786.9

Figure 17 shows the monthly solar generation for a 100kW solar farm:



Month	GHI (kWh/m²)	POA (kWh/m²)	Shaded (kWh/m²)	Nameplate (kWh)	Grid (kWh)
January	205.2	272.9	266.5	25,318.0	22,529.6
February	168.3	226.2	221.8	21,014.0	18,871.0
March	150.8	205.4	200.8	18,989.5	17,181.6
April	100.2	137.9	134.8	12,665.3	11,662.1
May	65.8	90.4	88.1	8,208.7	7,630.6
June	53.1	73.9	72.3	6,696.3	6,286.2
July	59.6	82.5	80.8	7,500.9	7,053.3
August	84.2	116.9	114.0	10,704.1	9,982.5
September	114.4	160.7	157.2	14,847.7	13,723.4
October	157.3	210.4	205.5	19,471.9	17,843.6
November	182.8	241.7	236.9	22,458.6	20,307.7
December	209.0	272.5	266.8	25,307.4	22,759.1

Figure 17: Helioscope solar generation forecast for 100kW DC / 75kW AC

Figure 18 shows the 100kW solar configuration which consumes a total area of 0.36Ha (75m x 48 m):

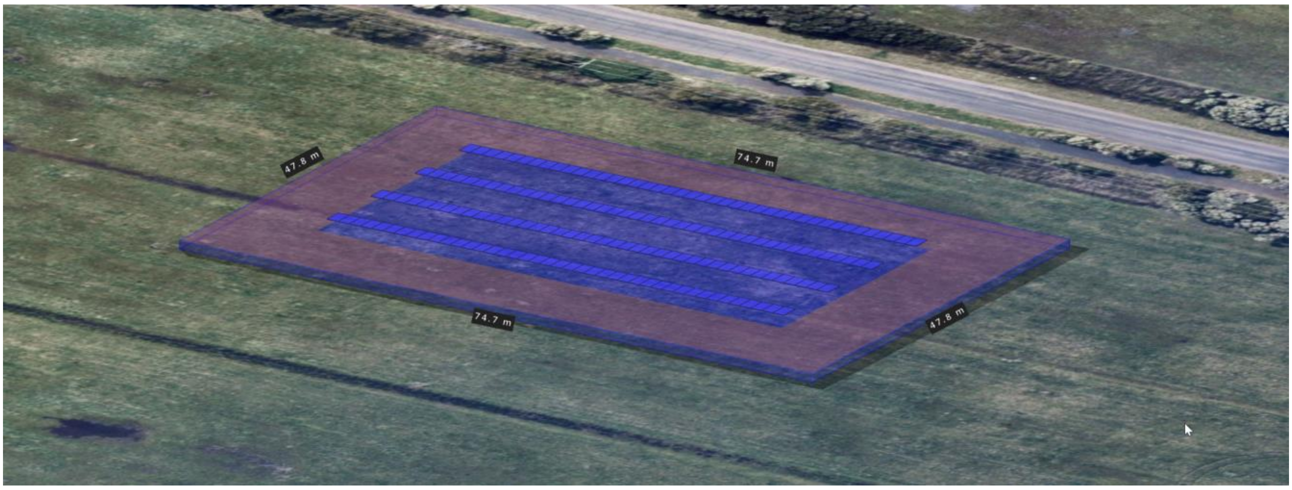


Figure 18: Indicative 100kW DC solar farm located on 100 Gap Rd

For more details, see Appendix H: which shows the annual production report for the 100kW system.

[23] The equivalent houses for annual production are based on the average annual consumption at 4,615kWh for Victorian homes. This also applies for the subsequent sections.

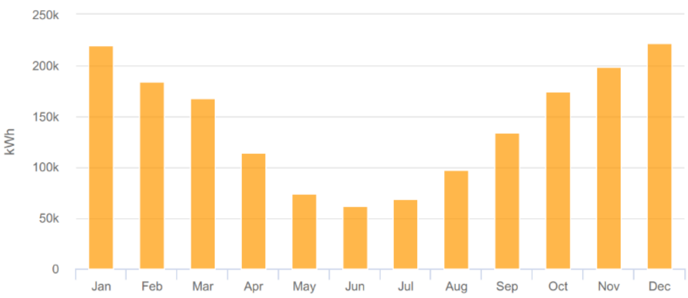
4.5.2 Option 2: 1MW solar farm

Table 10 outlines the key modelling outputs for the 1MW solar farm:

Table 10: 1MW solar farm system metrics

System metrics	Value
Module DC nameplate	982.8 kW (1,638x 600W panels)
Inverter AC nameplate	750 kW
DC/AC ratio	1.31
Annual production	1.684 GWh (equivalent to approx. 380 homes)
Performance ratio	81.9%
kWh/kWp	1,713.7

Figure 19 shows the monthly solar generation forecast for a 1MW solar farm:



Month	GHI (kWh/m^2)	POA (kWh/m^2)	Shaded (kWh/m^2)	Nameplate (kWh)	Grid (kWh)
January	205.2	272.9	264.7	251,178.8	220,026.3
February	168.3	226.2	220.6	208,724.2	184,721.9
March	150.8	205.4	199.5	188,445.7	168,171.9
April	100.2	137.9	134.0	125,685.3	114,378.0
May	65.8	90.4	87.4	81,375.8	74,866.1
June	53.1	73.9	71.8	66,453.8	61,726.2
July	59.6	82.5	80.2	74,440.8	69,281.0
August	84.2	116.9	113.2	106,129.8	97,845.3
September	114.4	160.7	156.2	147,367.9	134,424.2
October	157.3	210.4	204.2	193,217.5	174,584.8
November	182.8	241.7	235.5	223,056.8	198,715.9
December	209.0	272.5	265.2	251,299.9	222,529.2

Figure 19: Helioscope solar generation forecast for 1MW DC / 750kW AC

Figure 20 shows the 1MW solar configuration which consumes a total area of 2.3Ha (187 x 123 m):

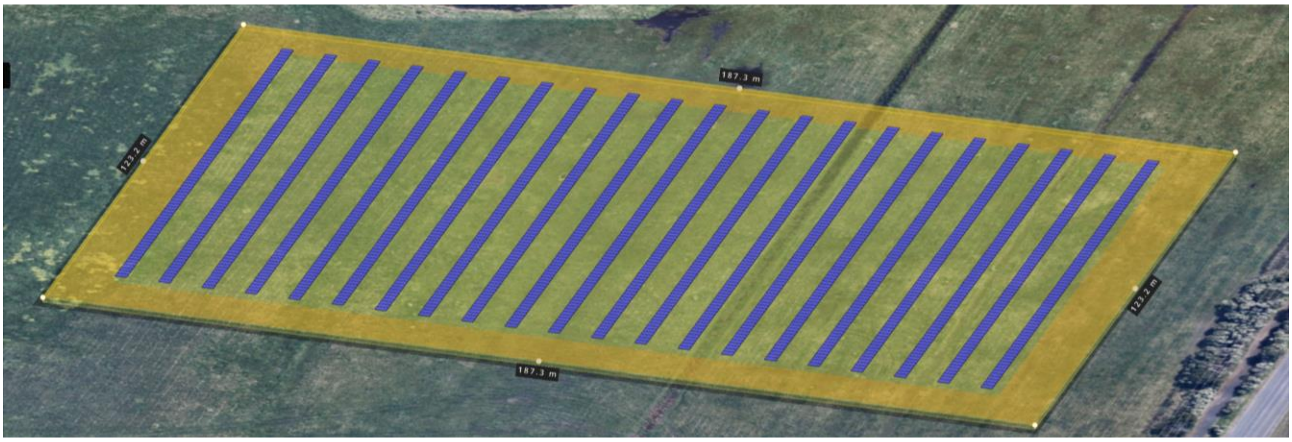


Figure 20: 1MW DC solar farm located on corner of Gap Rd

Note that the 1MW farm would on average generate approximately 6.5MWh of power per day in the hotter holiday months (Dec – Jan) – enough to 65% fill the proposed battery system. Batteries often don't run with a 100% depth of discharge and the 1MW sized solar could likely sell 100% of its output to the battery. The solar size can be further refined based on the battery requirements if an agreement between the two projects can be reached.

For more details, see Appendix H: which shows the annual production report for the 1MW system.

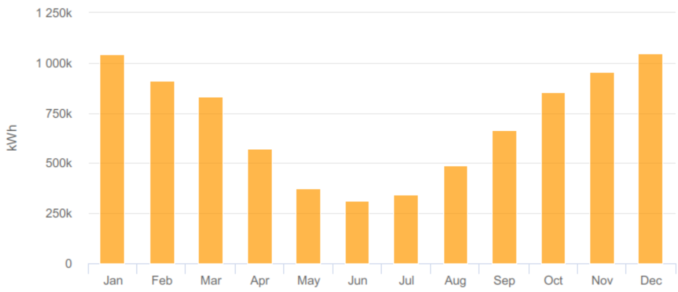
4.5.3 Option 3: 5MW solar farm

Table 11 outlines the key modelling outputs for the 5MW solar farm:

Table 11: 5MW solar farm system metrics

System metrics	Value
Module DC nameplate	4.96MW (8,268 600W panels)
Inverter AC nameplate	3.75MW
DC/AC ratio	1.32
Annual production	8.408 GWh (equivalent to approx. 1822 homes)
Performance ratio	81%
kWh/kWp	1,694.9

Figure 21 shows the monthly solar generation forecast for a 5MW solar farm:



Month	GHI (kWh/m^2)	POA (kWh/m^2)	Shaded (kWh/m^2)	Nameplate (kWh)	Grid (kWh)
January	205.2	272.9	264.8	1,268,430.1	1,046,331.9
February	168.3	226.2	220.7	1,053,997.4	909,963.5
March	150.8	205.4	199.4	950,970.2	832,832.7
April	100.2	137.9	134.0	634,469.0	570,707.5
May	65.8	90.4	87.4	410,607.0	374,191.0
June	53.1	73.9	71.8	335,439.4	308,718.9
July	59.6	82.5	80.3	376,169.2	346,840.4
August	84.2	116.9	113.2	535,614.6	488,082.3
September	114.4	160.7	156.2	744,010.6	668,382.7
October	157.3	210.4	204.1	975,072.8	855,277.2
November	182.8	241.7	235.6	1,126,318.4	956,121.3
December	209.0	272.5	265.3	1,268,881.6	1,050,776.6

Figure 21: Helioscope solar generation forecast for 5MW DC / 3.75MW AC

Figure 22 shows the 5MW solar configuration which consumes a total area of 10.25Ha (392 x 186 m):

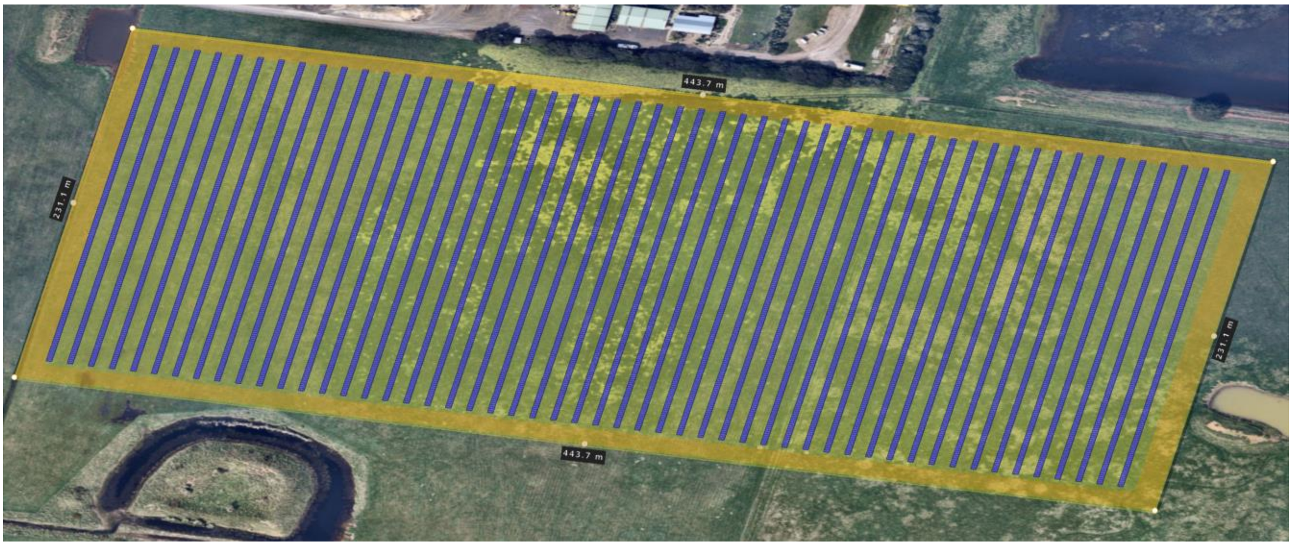


Figure 22: 5MW DC solar farm

For more details, see Appendix H: which shows the annual production report for the 5MW system.

4.6 Financial estimate summary

Table 12 provides a high-level financial estimate case for the proposed solar options:

Table 12: Solar system high-level financial estimation summary

	100kW	1MW	5MW
Output (MWh)	175.8	1752	8410
Capital Cost	$140,000	$1,750,000	$8,750,000
NPV (25yrs)	-$120,000	$270,000	$790,000
IRR (25yrs)	2%	14%	13%
Estimated payback (years)	23	13	13

The capital costs provided are based on industry $/w estimates and depend on the site conditions and specific solar system selection. A detailed feasibility study is required to calculate more accurate cost estimates and would be strongly influenced by the location, cost of available land, equipment, and revenue stream.

The following **qualifications** were assumed for the high-level financial summary:

- For DEVEX and CAPEX costs, a **$1.75M** per MW has been assumed which covers the equipment, installation (incl. relocation and installation cost) and other construction costs.
- For the 100kW system, the capital costs include the STC discount incentive.
- The OPEX costs were based on $21/MWh over the lifetime of the project.[24]
- The land rates were assumed to be $2,000 per year.
- The depreciation was assumed to be 10%.
- The AusNet monthly charges are based on AusNet's Embedded Generation Guide.
- For the 1MW and 5MW system, the revenue is based on the current combined power price[25] – roughly sum of $60 for black revenue (wholesale) and $40 for green revenue[26] (from LGCs).
- For the 100kW system, the standard solar feed-in tariff price of 5.2c/kWh has been assumed.
- The CPI was assumed at 2.5% based on an average of the last 25 years.
- Loan duration of 10 years with a 5% interest rate.
- A discount rate of 5% has been assumed for the NPV calculation.

The **additional costs** may include:

- Transformer upgrade by Ausnet (for larger sizes)
- Switchboard upgrades (likely minimal if required)
- Connection fees, including grid protection or connection studies (unlikely for smaller systems)

[24] Solar Insights - Australian Renewable Energy Agency (arena.gov.au)
[25] Black and Green - Australian Renewable Energy Agency (arena.gov.au)
[26] 2. Large-scale generation certificates (LGCs) (cleanenergyregulator.gov.au)

The annual production is generated from the solar modelling – see Appendix H: for more details.

Sensitivity analysis

The financial modelling showed the following qualifications highly impacted the financial viability of the project:

Parameter	Sensitivity impact
$/MW	The CAPEX was varied between $1.50/MW and $2/MW. The higher the $/MW cost, the less feasible the outcome.
Loan duration	Decreasing the loan duration improves the payback period.
Land cost	The flat rate annual land cost significantly impacts the financial feasibility, especially for smaller size option (100kW).
Power price	For large scale systems (greater than 100kW), the combined power price of $100 was assumed. For smaller (less than or equal to 100kW), the solar feed-in tariff of 5.2c/kWh was used. This significantly impacts the financial viability given there are no savings from offsetting costs from a load.

The tables in Appendix G: show the results from the sensitivity analysis.

4.7 Recommendation

ElCo-op and TRPI will most likely need to acquire additional funding other through government grants or potential investors to pursue any option.

The financial estimates suggest the 1MW and 5MW system is feasible, based on the outlined qualifications. The 100kW solar farm model does not financially stack up, on the assumption that all energy produced will be sold back to the grid at the current solar feed-in tariff.

The community can contribute to the development in many ways:

- Providing social licence. Community support can be very attractive to developers and helps with planning applications etc.
- Providing land or contacts with landowners.
- Potentially providing investors.

To develop the opportunity further we suggest the following actions:

- Engage with Ausnet to understand the system constraints and explore synergies with the PICESS battery.
- Liaise with the community to determine the support for direct ownership.
- Engage with retailer/developers to establish if they are interested in working with the community to develop the farm and to work out the most effective way to sell the power to maximise the financial benefits.
- Seek government funding to assist the development.

To better understand the community energy usage and renewable energy penetration:

1. Engage with C4Net to source the Phillip Island community load and solar export data.
2. Middleton Group can assist with analysing and summarising the community energy usage trends. This includes:
    a. The current energy use of Phillip Island & projected use to 2030.
    b. The renewable energy penetration (%).

5 Opportunity 2: Cowes Transit Centre

5.1 Solar carpark

The Cowes Transit Centre offers four styles of connections, all rated at 7kW, totalling to 28kW. The site has two Tesla HPWCs and two Type 1 GARO chargers. Based on these charger ratings, it is possible the site only has access to single phase power. For a solar system with a single-phase connection there is a 5kW export limit (15kW for three phase systems).

Given the maximum eV charging capacity of 28kW, a 29kW system was modelled using 600W solar panels. The solar carpark model at the Cowes Transit Centre has been considered for 12 parking spaces located by the eV charging station, as shown in Figure 12.

Figure 23: Solar carpark model area

The preferred location is based on the reduced number of trees and vegetation which can have a significant impact of the solar performance, due to shading losses, and to provide shelter for the EV chargers and people using them in adverse weather. The modelled solar carpark has total surface area of 242m^2 (34 x 7.1m) with a canopy height of 4m.

A discussion with Bass Coast Shire Council would be needed to understand the connection limitations.

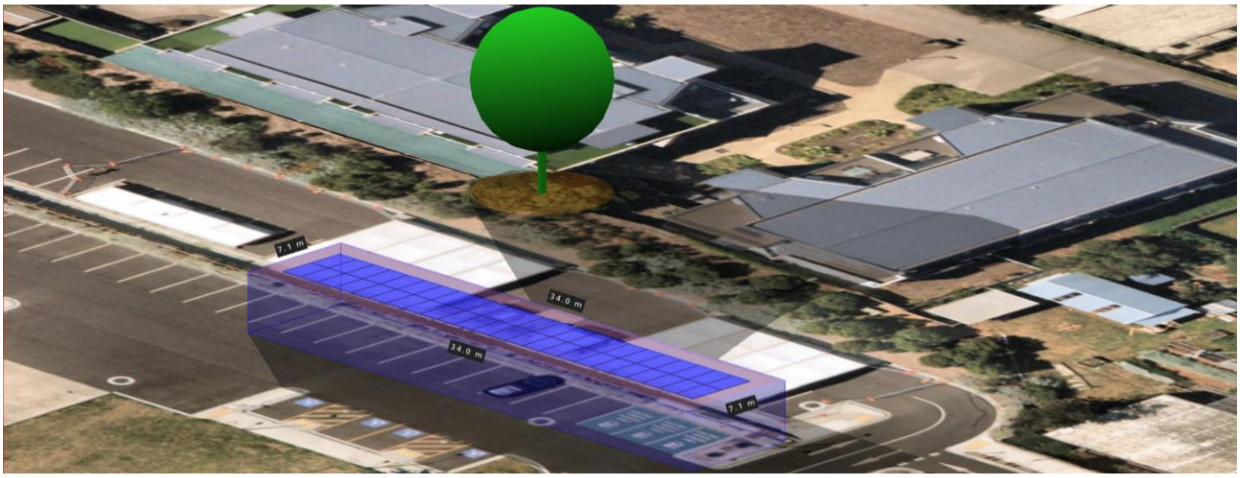


Figure 24: Solar carpark model

The solar carpark would need to have a new canopy installed which includes a water management rail and front gutter. A new, pre-engineered, and professionally installed canopy could cost around $800 per kW, depending on the size and site conditions[27].

[27] All About Solar Car Parks | SCP

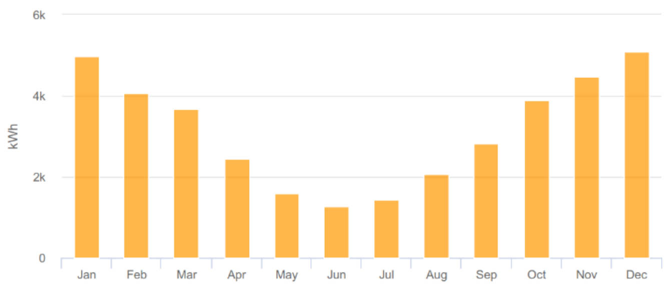
5.1.1 Modelling outputs

Table 13 outlines the key outputs for a 29kW solar carpark:

Table 13: 29kW solar carpark system metrics

System metrics	Value
Module DC nameplate	28.8 kW (48x 600W panels)
Inverter AC nameplate	25 kW
DC/AC ratio	1.15
Annual production	37.88 MWh
Performance ratio	84.1%
kWh/kWp	1,315.4

Figure 25 shows the monthly solar generation for the solar carpark:



Month	GHI (kWh/m^2)	POA (kWh/m^2)	Shaded (kWh/m^2)	Nameplate (kWh)	Grid (kWh)
January	205.2	205.2	205.1	5,591.3	4,976.0
February	168.3	168.3	168.2	4,567.7	4,085.9
March	150.8	150.8	150.6	4,075.5	3,671.4
April	100.2	100.2	100.0	2,679.9	2,447.8
May	65.8	65.8	65.6	1,736.1	1,594.7
June	53.1	53.1	52.8	1,385.7	1,282.0
July	59.6	59.6	59.3	1,561.3	1,447.8
August	84.2	84.2	84.0	2,243.0	2,074.6
September	114.4	114.4	114.3	3,074.9	2,828.6
October	157.3	157.3	157.2	4,268.6	3,899.5
November	182.8	182.8	182.7	4,969.0	4,472.5
December	209.0	209.0	208.9	5,690.9	5,101.9

Figure 25: Helioscope solar generation forecast for 24kW DC / 18kW AC

Figure 26 shows the shading report for the solar carpark design:

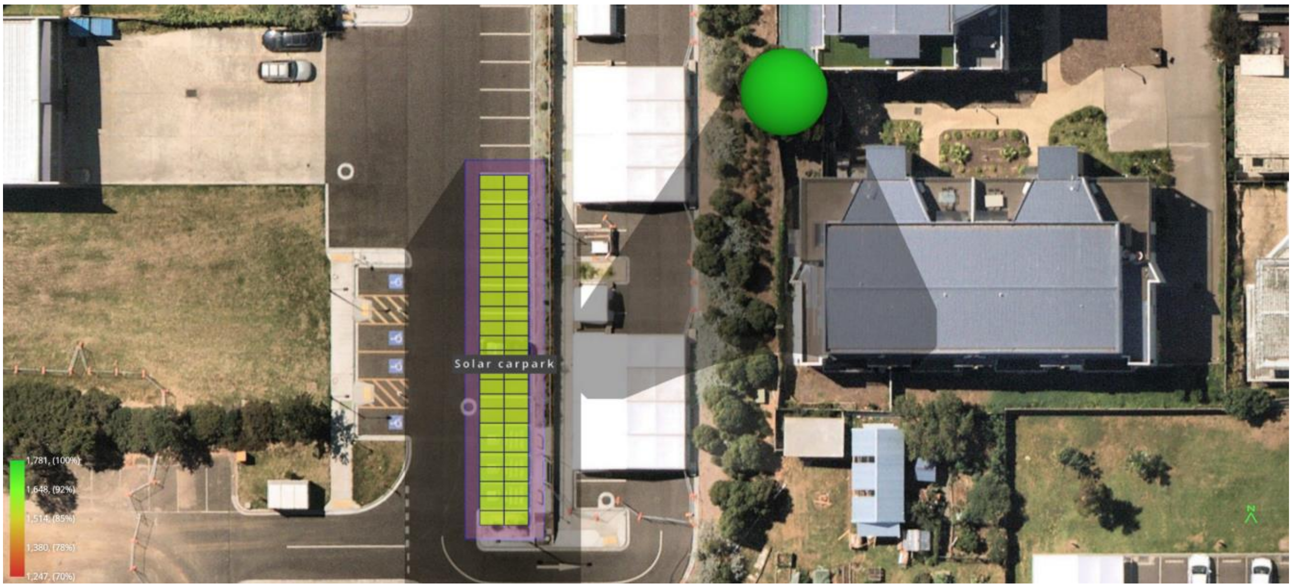


Figure 26: 24kW solar carpark shading report

For more details, see Appendix H: which shows the annual production report for the 29kW carpark system.

A solar model for both levels of the carpark was also modelled with the total capacity estimated to be around 125kW using 600W panels. Please see Appendix G: which provides the solar model report for the 125kW carpark system.

5.2 Financial estimate summary

Table 14 provides a high-level financial estimate summary for the 29kW solar carpark:

Table 14: Solar carpark financial summary

	29kW solar carpark
Output (MWh)	37.88
Capital Cost	$60,000
NPV (25yrs)	-$73,000
IRR (25yrs)	-4%
Estimated payback (years)	34

The capital costs provided are based on industry typical $/W figures and depend on the site conditions and specific solar system selection. A detailed feasibility study is required to calculate more accurate cost estimates and would be strongly influenced by the type and size of the car park canopy, equipment, and export limits.

The following **qualifications** were assumed for the high-level financial summary:

- For DEVEX and CAPEX costs, a **$1.75M** per MW has been assumed which covers the cost of an installed (incl. relocation and installation cost) and other construction costs.
- The capital costs include STCs and **roughly $20k for a professionally installed canopy**.
- The OPEX costs were based on $21/MWh over the lifetime of the project.[28]
- No land rates were assumed.
- The depreciation was assumed to be 10%.
- The AusNet monthly charges are based on AusNet's Embedded Generation Guide.
- The standard solar feed-in tariff price of 5.2c/kWh has been assumed.
- The CPI was assumed at 2.5% based on an average of the last 25 years.
- Loan duration of 10 years with a 5% interest rate.
- A discount rate of 5% has been assumed for the NPV calculation.

The **additional costs** may include:

- Switchboard upgrades (could be significant if changing from single phase to three phase)

The annual production is generated from the solar modelling – see Appendix H: for more details.

[28] Solar Insights - Australian Renewable Energy Agency (arena.gov.au)

Revenue model

The main benefit is expected to be the electricity price offset from the on-site eV charging usage, in addition to exporting excess solar at the 5.2c/kWh solar feed-in tariff rate.

This financial model only assumes all energy is sold at the current solar feed-in tariff price. The electricity price offset would significantly impact the financial outcome of the project. A discussion with council would be required to understand the eV charger load profile.

5.3 Recommendation

The high-level financial summary for the 29kW solar carpark suggests that it may not be financially feasible. This is primarily due to the high additional capital costs associated with installing a new canopy structure to support the solar system. The non-financial benefits of the canopy would need to be included in the project evaluation to make it viable.

The recommended next steps are:

- Consult with the local council to see if there are any plans to install a solar canopy, or if there are any existing, suitable locations nearby which could be utilised.
- Consult with council to better understand the eV charger connection limitations.
- Procure quotes from carport manufacturers to gauge the additional support structure costs.

6 Conclusion

Totally Renewable Phillip Island (TRPI) and Energy Innovation Cooperative (EICo-op) have a vision to develop a solar project to provide sufficient energy to the increasing population and electric vehicles, and to supplement existing renewable resources such as the PICESS battery, with the goal of making the Phillip Island more energy self-sufficient.

The report begins by addressing the current Phillip Island landscape which includes an overview of the Ausnet Services network, the population and growth of existing solar installations in the community.

There are currently over 12,500 private dwellings with roughly 23.5% of them having existing solar installations. There is over 17MW of solar capacity installed which has been growing by 29% on average, year on year for since 2010. In late 2022, the community will also have access to the 5MW/10MWh Li-ion battery known as PICESS which will provide short-term performance improvements to the local electricity supply.

The solar project feasibility is discussed from section 3 which provides two solar opportunities to increase Phillip Island's renewable energy usage – a solar farm and solar carpark. An outlook of the PV power potential in Phillip Island is shown with the annual PV power potential expected to be 1759.4 kWh/m^2, which presents reasonably good basis for solar projects at the nominal location.

It continues to describe the benefits of various solar system sizes and covers the Ausnet Services connection process for systems sized between 30 to 1.5MW, 1.5 to <5MW and 5MW or greater. This includes the high-level timeline, connection fees, requirements (i.e., network studies and potential connection upgrades) and associated costs.

The nominal solar farm location is the farmland near Gap Rd and Ventnor Beach Rd in Cowes with has enough land for a large-scale solar system sized up to 5MW. The primary benefit of this location is the proximity to the Phillip Island zone substation and new PICESS battery. This mean less costs for potential connection upgrades as the site is only located 300m from the zone substation. The other benefit is that many of the required planning studies for development in the area have already been completed and published as part of the PICESS development.

The proposed site for the solar carpark is the nearby the eV charging station at the council-owned parking lot by the Cowes Transit Centre. The advantage of this location is that this provides additional renewable energy to the transit centre and eV charging station and shelter for EV drivers accessing the chargers.

In section 4, the solar farm system design is discussed. A summary of potential revenue streams and economic considerations are provided with a focus on the recent volatility in spot prices to provide some perspective on expected variability in generation prices when considering annual revenue. The report continues to provide some information and examples on potential developer partnerships who may be able to assist with funding solar farm projects.

The report considers solar farm sizes for the technical and financial modelling – 100kW, 1MW and 5MW systems have been considered. The 100kW system is the largest system size eligible for STC benefits from the small-scale renewable energy scheme. The 1MW system was considered given the annual generation, physical size and cost can be linearly scaled to larger systems. The 1MW sized farm is more aligned with the PICESS battery capacity and all of its output could potentially feed into the battery during the peak summer holiday period. The modelling completed for a 1MW system can be extrapolated and scaled to a larger system to determine the solar output and high-level costs.

The 100kW system consumes a total area of 0.36Ha and has an annual generation of 176MWh. The system costs roughly $140k (after STC incentive) and has a payback period of 20 years. The 1MW system consumes a total area of 2.3Ha and has an annual generation of 1.654GWh. The system costs roughly $1.75M and has a payback period of 13 years. The 5MW system consumes a total area of 10.5Ha and has an annual generation of 8.25GWh. The system costs roughly $8.75M and has a payback period of 13 years. Note, these costs do not include any network upgrade costs or connection study fees etc.

Section 5 looks at a solar carpark located above the eV charging station at Cowes Transit Centre. The preferred location only considers 12 parking spaces and is based on the reduced number of trees and vegetation which can have a significant impact of the solar performance, due to shading losses. Given this is an open parking space, a professionally installed canopy would be required to support the solar system. These pre-engineered canopies generally cost around $800 per installed kW.

The total area of 242m^2 above 12 parking spaces can support a 29kW solar system that generates 38 MWh per annum. The 29kW solar system itself could cost around $40k, however the solar canopy is expected to cost around $20k. Due to this increased capital investment, the financial return is expected to be significantly longer. This indicates a commercial solar system of this size may not be feasible unless there is an existing carpark canopy structure or funding consideration for its non-financial benefits. Otherwise, the most feasible option would be to explore a similarly sized system on an available rooftop.