Solar my School is pleased to present a feasibility study showing the benefits of installing a 9kW solar system, or a smaller 3kW system, at Balmain Public School.

Large electricity savings

Electricity is a major cost for your school. By investing in solar, your school can save close to **$1,863** a year with the 9kW system, up to 12% of the school's current total energy bill. A smaller 3kW system could save the school $495 pa. Because of the generous 50% co-contribution from the Department of Education the energy savings would cover the cost of installing solar for the school in around 5.2 years.

The capital cost to the school is estimated at $7,5000 for the 9kW system and $3,900 for the 3kW system[1].

A 9kW system will:

Save on your annual energy bill 12%

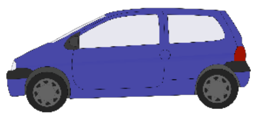
$$

Produce clean green electricity each year equal to powering: 59 school computers 2 homes

Help to avoid 10 tonnes annual carbon emissions

CO2

Equivalent to taking 4 cars off the road each year



A good time to go solar

There has never been a better time to install solar. Costs of solar power have fallen 80 per cent in the last 10 years and your school is also eligible for a significant upfront discount through the Federal Government's Small Scale Renewable Energy Scheme.

Next steps

We can help you with advice on accessing funds and grants and discuss next steps for installation.

Please feel free to contact me on 02 9392 5932 or sonya.williams@innerwest.nsw.gov.au if you have any questions or queries.

Yours sincerely,

Sonya Williams

Sonya Williams
Renewable Energy Innovation Officer

[1] Alongside the 50% contribution from the NSW Department of Education

SOLAR my SCHOOL

Solar Feasibility Report

Balmain Public School

INNER WEST

Balmain Public School

Solar PV Scoping and Feasibility Assessment

P19053_P003_S07
April, 2020

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Date	Version	Status for Purpose	Authors	Reviewer/s	Authoriser
04/04/2020	1.0	Report	Heath Shakespeare	Trevor Ackland	Heath Shakespeare

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Table of Contents

1 Executive Summary

Enhar is pleased to provide this solar feasibility assessment for Balmain Public School as part of the Solar my School program located in the Inner West.

The feasibility assessment included:

- a site inspection of the site, in consultation with a school representative, to assess solar PV suitability of roof areas and electricity infrastructure
- review and assessment of electricity bills and electrical smart meter data
- solar PV recommendations and analysis including recommended solar sizing, solar PV layouts and locations, inverter locations and electrical connection points
- hourly analysis of solar PV generation and electrical consumption data, determining avoided tariffs and feed in tariffs
- financial analysis including budget based on Department of Education estimates, payback and financial metrics

Where practical two design options are presented, as Balmain Public School has a number of heritage buildings to be avoided:

- Option 1: A PV system installation to one AC connection point, installation on a single roof area without the removal of existing panels
- Option 2: A larger PV system to offset a higher amount of electricity usage at the site which includes the removal of the existing PV systems that are approximately 8+ years old.

1.1 Option 1:

Parameter	Detail
System Size (kWp DC)	3.0
Location	Block G
Yield (kWhr/yr)	3,904
% load met by solar	6%
% solar export	1%
Cost to school ($)	$3,900
Annual ($) Income/Savings	$495
Payback (years)	7.6
Annual electricity cost before solar ($)	$15,828
Annual electricity cost after solar ($)	$15,333
Main risks and barriers	• No major barriers • Very small system viable

1.2 Option 2 (recommended):

Parameter	Detail
System Size (kWp DC)	9.0
Location	Block G
Yield (kWhr/yr)	11,712
% load met by solar	15%
% solar export	10%
Cost to school ($)	$7,500
Annual ($) Income/Savings	$1,863
Payback (years)	5.2
Annual Electricity Cost before solar ($)	$15,828
Annual Electricity Cost after solar ($)	$13,966
Main risks and barriers	• Removal of existing solar PV system (income loss from existing solar PV included in system option)

2 Site Details

Facility	Site Address	Metering and electricals
Balmain Public School	1 Eaton St, Balmain NSW 2041	**Meter:** 005778 **NMI:** 4102015845 **MSB:** Unknown supply **DB-G:** 160A main switch **DB-6:** 160A main switch

N	Roof Identification	Electrical meter	Main Switchboard	Distribution Board	Suneye Shade %	Approx. roof angle
	R#	kWh				

Figure 2-1: Labelled roof area of suitable roof areas assessed for solar PV suitability (not to scale, all location and tilt angles are approximate).

3 Site Infrastructure

3.1 Roof Assessment

Table 3-1: Roof areas

No.	Roof Suitability		
R1: Block G	**Details** • 20^0 pitch north orientation • Corrugated tin (or similar) • Existing anchors • Single storey building **Recommendation** • Considered a suitable roof space within the school for solar PV installation. This roof area has an existing PV system.	 	
No.	**Roof Suitability**		
R2: Block C	**Details** • 30^0 pitch north orientation • Corrugated tin (or similar) • No safe roof hardware • 6+ metre heritage building **Recommendation** • Heritage building therefore no PV panels are to be installed		
No.	**Roof Suitability**		
R4 Block B	• Heritage(excluded)		
	Highly suited roof area for solar PV installation		
	Moderately suited roof area for installation: may have moderate issues with shading, roof condition, limited open area for solar installation, roof safety or similar		
	Roof area not suitable for solar installation		

3.2 Electrical constraints

Table 3-2: Electrical Constraints

Detail	Details and Suitability		
MSB	**Details:** • MSB located in Block A • Switchboard inaccessible **Recommendation** • Not suited to solar connection due to location		
DB-6	**Details:** • Good condition switchboard • 160A Main Switch **Recommendation** • Suitable connection for a small solar PV system	 	
DB-G	**Details:** • Good condition switchboard • 160A Main Switch • Existing solar PV connected to this board. **Recommendation** • Suitable connection for a small solar PV system, however only if existing solar system is removed.		
	Highly suited switchboard for solar connection		
	Moderate switchboard for installation: will require switchboard modifications for solar connection or a difficult cable run form rooftop solar location.		
	Switchboard not suited for solar PV connection, due to physical location, age, inadequate electrical capacity and/or voltage drop due to low electrical capacity.		

3.3 Existing solar PV system

Table 3-2: Existing solar PV system

System Configuration	**System Capacity**	1 x 1500W AC – SMA Sunnyboy; 1 x 1100W AC – SMA Sunnyboy
	Panels	19 x 72 Cell panels (1.65mx1.0m)
	Inverters and location	In storeroom near DB-G
	AC connection	DB-G
	Installed	2012+, potentially installed in two separate vintages.

4 Electricity Usage

Table 4-1: Electrical usage and load profile

Total Annual Consumption (kWh)	Peak (kWh)	Shoulder (kWh)	Off peak (kWh)	Peak Demand (kW)
69,388	14,282	38,559	16,547	39
$ Annual cost	**$ Peak**	**$ Shoulder**	**$ Off peak**	**$ Demand**
$15,828	$2,845	$6,084	$1,867	$5,031

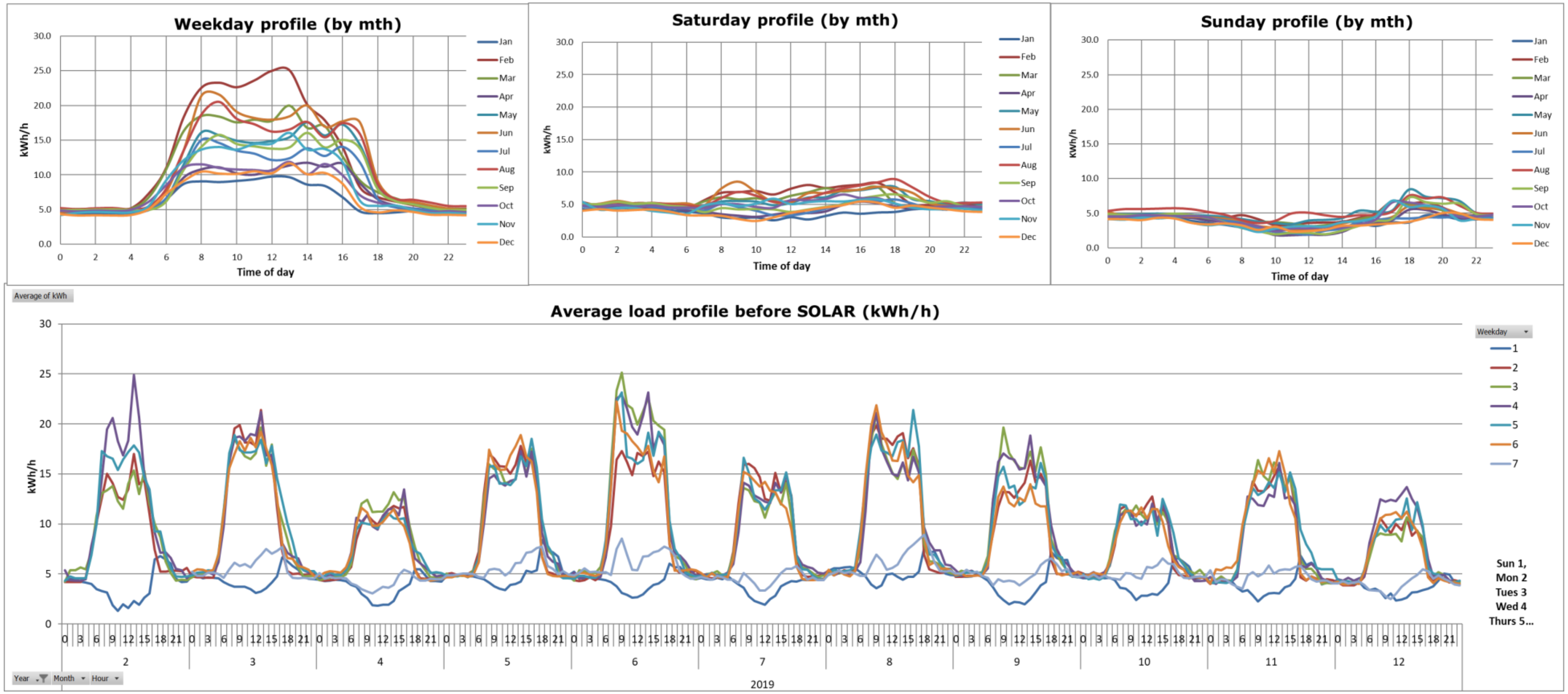


Figure 4-1: Average load profile data for available data

5 Solar Recommendations

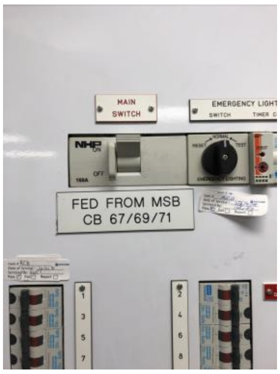
5.1 General

Table 5-1: General recommendations based on assessment and electricity details.

General solar suitability	Balmain Public School has a number of heritage listed buildings and therefore PV panels are not able to be installed on these buildings, as per DOE requirements. In addition these roof areas are very steep and have inaccessible roof areas. The only option is on Block G where two small existing solar PV systems are located, taking up most of the usable roof area. The site's electrical network is in generally good condition however the main switchboard was inaccessible to be viewed. Only a small capacity is possible at this site and therefore electrical constraints are not expected to be a limiting factor to solar viability.
Load profile assessment	An optimum solar PV system size of up to $30kW_{AC}$ is recommended based on load profile, with exports less than 30% total solar generation, however not viable at this site due to roof constraints.
Recommended system designs	**Option 1: $3.0kW_{DC}$** • Install on Roof 1: Block G • Install PV panels on Block G in landscape under existing PV system. **Option 2: 9.0kW system (maximised)** • Install on Roof 1: Block G • Remove existing PV system, and optimise roof area
Major, Risks and Barriers or solar installation	**Option 1** • No major issues **Option 2:** • Removal of existing PV systems on Block G, resulting in some lost income from the existing system (included in financials).

5.2 Option 1:

Table 5-2: Solar PV system sizing yields and details

Solar	**Total System capacity (kWp DC)**	**Estimated Annual yield (kWh/yr) Year 1**	
	3	3,904	
	Annual solar yield % of total elect consumption	**% of site load met by solar**	
	6%	6%	
Tarif analysis	**Peak/Shoulder Times % of solar generation**	**Off-peak Times % of solar generation**	**Exported Energy % of solar generation**
	72%	27%	1%
	Peak kWh	**Off Peak kWh**	**Exported energy kW**
	2,792	1,064	48
Design and Installation	**Roof areas for installation**		
	Roof Area 1 Block G		
	Recommended Orientation and framing		
	Landscape panels to maximise capacity under existing PV system		
	Solar DC design requirements		
	No specific requirements		
	Inverter location		
	On wall next to DB6		
	Recommended AC connection		
	DB6		
	Grid connection		
	Based on transformer size and electrical capacity, we expect no issues with grid connection approval. Total system capacity (including any existing systems) is below 30kW$_{AC}$ (inverter capacity), therefore secondary grid protection is not required, and grid connection approval timeframes reduced, compared to a >30kW$_{AC}$ system.		

5.2.1 Option 1: Solar Layout and Yield Graphs

Symbols	
N	North Arrow
R#	Roof Identification Number
kWh	Electrical meter
	AC Solar Connection
	String inverter station
	Concept solar PV layout adopting 335W panels, dimensions 0.99x1.65m

Figure 5-1: Concept solar PV roof top design layout

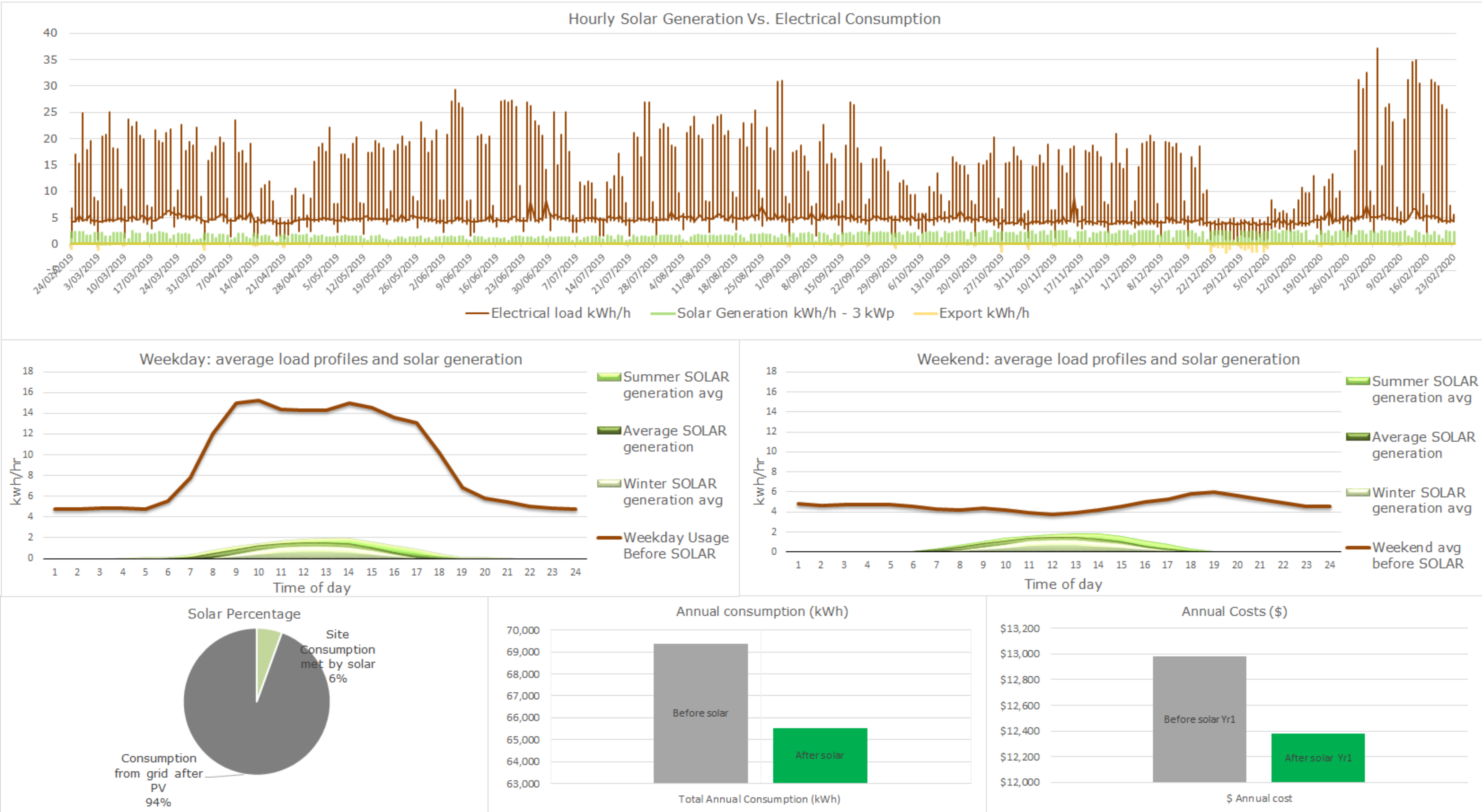
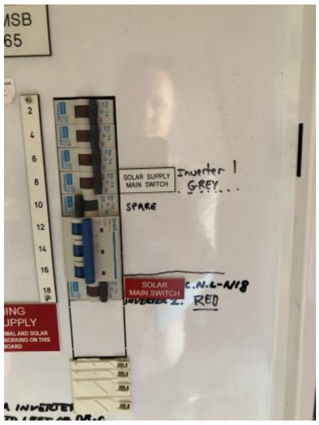


Figure 5-2: Load profile and solar generation

5.3 Option 2: Maximised System

Table 5-3: Solar PV system sizing yields and details

<table>
<tr><th rowspan="4">Solar</th><th colspan="2">Total System capacity (kWp DC)</th><th>Estimated Annual yield (kWh/yr) Year 1</th></tr>
<tr><td colspan="2">9</td><td>11,712</td></tr>
<tr><th colspan="2">Annual solar yield % of total elect consumption</th><th>% of site load met by solar</th></tr>
<tr><td colspan="2">17%</td><td>15%</td></tr>
<tr><th rowspan="4">Tarif analysis</th><th>Peak/Shoulder Times
% of solar generation</th><th>Off-peak Times
% of solar generation</th><th>Exported Energy % of solar generation</th></tr>
<tr><td>69%</td><td>21%</td><td>10%</td></tr>
<tr><th>Peak kWh</th><th>Off Peak kWh</th><th>Exported energy kW</th></tr>
<tr><td>8,105</td><td>2,485</td><td>1,123</td></tr>
<tr><th rowspan="12">Design and Installation</th><th colspan="3">Roof areas for installation</th></tr>
<tr><td colspan="3">Roof Area Block G</td></tr>
<tr><th colspan="3">Recommended Orientation and framing</th></tr>
<tr><td colspan="3">Landscape panels to maximise capacity with removal of existing PV systems</td></tr>
<tr><th colspan="3">Solar DC design requirements</th></tr>
<tr><td colspan="3">No specific requirements</td></tr>
<tr><th colspan="3">Inverter location</th></tr>
<tr><td>In storeroom next to DB G (remove existing inverters)</td><td colspan="2"></td></tr>
<tr><th colspan="3">Recommended AC connection</th></tr>
<tr><td>DBG or DB6</td><td colspan="2">
</td></tr>
<tr><th colspan="3">Grid connection</th></tr>
<tr><td colspan="3">Based on transformer size and electrical capacity, we expect no issues with grid connection approval.
Total system capacity (including any existing systems) is below 30kW$_{AC}$ (inverter capacity), therefore secondary grid protection is not required, and grid connection approval timeframes reduced, compared to a >30kW$_{AC}$ system.</td></tr>
</table>

5.3.1 Option 2: Solar Layout and Yield Graphs

Figure 5-3: Concept solar PV roof top design layout

Symbols	
N	North Arrow
R#	Roof Identification Number
kWh	Electrical meter
	AC Solar Connection
	String inverter station
	Concept solar PV layout adopting 335W panels, dimensions 0.99x1.65m

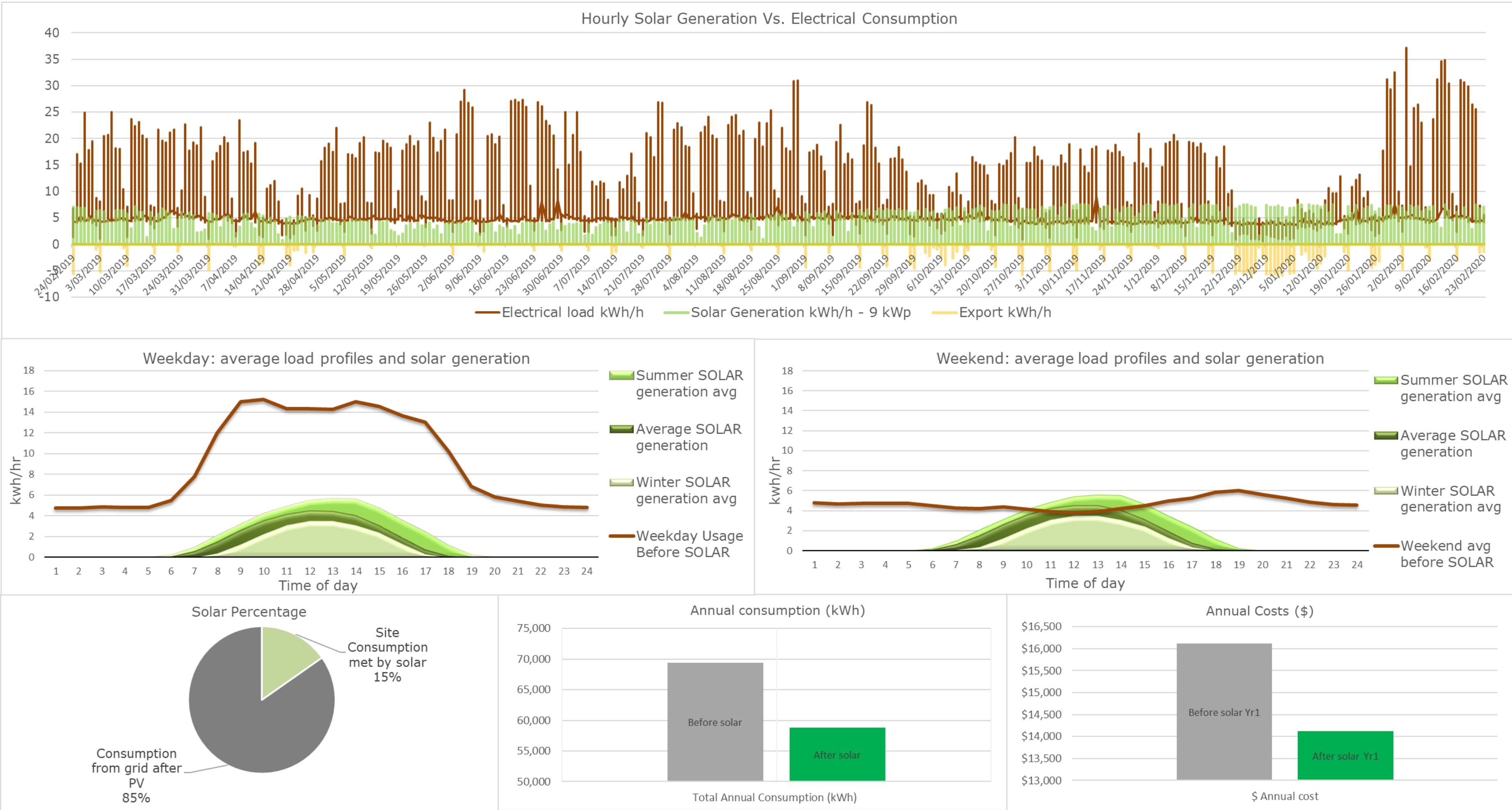


Figure 5-4: Solar yield and load profile.

6 Summary

Table 6-1: Summary of system options

Category	Parameter	Option 1:	Option 2:
Solar system	System Size (kWp DC)	3	9
	Yield (kWhr/yr)	3,904	11,712
	% load met by solar	6%	15%
	% export	1%	10%
Costs	DoE Capital cost Estimate	$7,800	$15,000
	DoE Contribution	$3,900	$7,500
	Capital cost to school (Ex GST)	**$3,900**	**$7,500**
	Annual Maintenance Yr1	$0.00	$0.00
Income/ savings	Annual tariff savings Yr 1	$460	$1,676
	Annual Feed In tariff Payments	$4	$93
	Demand Charge Savings	$31	$93
	TOTAL	$495	$1,863
Metrics	Simple Payback (yrs.)	**7.6**	**5.2**
	NPV (6.5% discount rate)	$2,459	$14,326
	IRR (25 years)	12.66%	20.77%
Elect. Bill	Before Solar ($) ex. fixed costs	$15,828	$15,828
	After solar ($) ex. fixed costs	$15,333	$13,966
Issues and discussion		• No major issues	• Removal of existing PV system on Block G. • Income loss included the financial analysis ($469 per year)

7 Current Electrical Tariffs

Table 7-1: Tariff times

Shoulder times	Peak times	Off peak times
Mon - Fri: 8pm to 10pm Mon – Fri: 7am to 2pm	Mon-Fri: 2pm-8pm	All other times

Table 7-2: Electrical usage and tariffs for NMIs

$/kWh	CHARGES	PEAK	SHOULDER	OFF-PEAK
ENERGY (Contract Rates)	Energy usage	$0.1050	$0.1050	$0.0725
ENVIRONMENTAL	Green power	$0.0029	$0.0029	$0.0029
	NESC	$0.0029	$0.0029	$0.0029
	SRES Charge	$0.0019	$0.0019	$0.0019
	LRET Charge	$0.0029	$0.0029	$0.0029
NETWORK CHARGES	Network	$0.0649	$0.0235	$0.0111
Market Operator Charges	AEMO ancillary	$0.0060	$0.0060	$0.0060
	AEMO market	$0.0038	$0.0038	$0.0038
TOTAL TARIFFS		**$0.1992**	**$0.157**	**$0.1011**
Feed in tariff adopted for solar export		**$0.1050**	**$0.1050**	**$0.0725**

7.1 Electrical Tariff Projections

Table 7-3: Tariff projections adopted 2020-2032

Year	1 to 2	3 to 5	6 to 10	11 to 15	16-25
% change adopted for total tariff	0.00%	1.00%	2.00%	2.00%	2.00%
Annual inflation	2.00%	2.00%	2.00%	2.00%	2.00%

7.2 Peak Demand Charges

Table 7-4: Peak Demand

$/kVa/Month	$10.80
Current Maximum Peak Demand (kVa)	38.82
Date and Time of current peak	8:00 03 Feb 20
Current Annual cost	$5,031

8 Methodology and Assumptions

8.1 Solar PV Panel specification

The PV arrays presented in the concept drawings are based on readily available conventional solar panels. For feasibility assessment sizing and modelling, a 335Wp 60-cell solar module with physical dimensions of 1.65mx1.00m were adopted. This is a common solar PV module configuration and approximate footprint on the market at the time of this report's preparation.

8.2 Solar PV layout and sizing

All layouts have adopted 335Wp conventional panels with physical dimensions of 1.00mx1.65m. General solar PV roof design follows design are as below:

- **Panel design for pitched roof areas:**
  - **Option 1 & 2, flush-mounted -** shading shall be avoided between 10am and 2pm at any time of year.
- **Panel Maintenance access:** must be provided to ensure that the Solar PV system can be easily and safely maintained and cleaned, inclusive of:
  - Ensuring that every panel can easily reached by removing only one other panel
  - Providing min. 600mm maintenance access rows between groups of panels a maximum of 4 deep.
- **General roof maintenance and access:** Ensure adequate and safe access to roof for general roof maintenance of plant and guttering, inclusive of
  - A minimum 600mm clearance between the edges of the solar arrays to the edges of any roof sheets/gutters
  - A minimum of 600mm clearance between the edge of the panel and at least 2 sides of fixed plant such as fixed fans etc.
  - A minimum of 1200mm clearance to larger HVAC plant and items that need routine maintenance
  - A minimum of 600mm clearance between any skylight and the edge of the nearest panel.
- **Safe roof Hardware access and accessibility:**
  - Ensure suitable access and usability of all existing safe roof hardware. Any future safe roof hardware installations (if specified) and offsets from the edge of roof. Where a practical 2m offset from the roof edge/unprotected edge is preferred.

The location, sizing and orientation of recommended PV systems considers:

- Available roof area and building/roof/structural electrical constraints.
- Measured shading profiles and quantitative shading measurements (if required), ensuring that panels are not subject to excessive shade.
- Purlin orientation, spacing and roof type to ensure ease and adequacy of solar framing roof connection.
- Electrical load profile at the site/ to optimise system orientation and sizing.
- Ease of grid connection.
- Ease of construction and maintenance during system life.
- AC electrical connection points and appropriately sized distribution boards for the recommended system size.

8.3 Solar Yield model

8.3.1 Calculated yields

Simulations of each system option were conducted using a Helioscope™ – a robust modelling software tool to get results on the system yields, shade and other losses; or an alternative recognised solar software. The simulations from our analysis have been included for reference and are based on an industry accepted bankable solar power simulation engine.

Typical Meteorological Year (TMY) hourly yield calculation results from each site were used in our load profile modelling. Simulation summaries are included in this report and consider the following parameters:

- the solar resource information specific to the site and proposed PV orientation,
- technical data from current market standard solar PV mono or poly crystalline solar PV panels – Trina Solar 300Wp modules were used in these simulations
- technical data from solar inverters – the SMA Tripower, Fronius or Solaredge inverters were simulated (common well regarded 3-phase commercial inverter).
- system loss due to panel temperature based on the power temperature co-efficient of the panel, local BoM temperature data and roof type at the site,
- Estimated percentage system losses such as AC/DC wiring losses, panel soiling and panel mismatch factor, etc.

8.3.2 Annual Degradation

Natural reduction in performance/yield of the PV system is included due to minor deterioration of PV cell efficiency. The decrease in efficiency is linear between 0% at commencement and 18% at the completion of 25-year warranty.

All solar panel have a performance warranty at least 80% of the initial level at 25 years.
Inverter locations and AC connections

8.3.3 Inverter locations

When selecting a location to install inverters, several considerations were considered.

- **Weather protection:** Most inverters are rated to be installed indoors or outdoors (IP56 or IP65 rated for example), however, if locating outdoors, they require protection from direct sunlight and rain. For instance, locating inverters on a south facing wall with a small canopy installed to provide protection from directly overhead is generally suitable. If North Facing a suitable shade structure is required.
- **Maintenance**: It is important to consider how the system will be maintained when selecting a location for the inverters. Installing the inverters at a single location will make maintenance and troubleshooting more straight-forward. If inverters are installed across 2 or more locations, then consideration of their location relative to the PV modules they are connected to should be taken so that it is obvious to any maintenance personal how to isolate different parts of the PV system.
- **Minimise Cable Runs**: Locating the inverters such that the cable runs are minimized will control costs and simplify installation. The longer the AC cable run, the higher the AC voltage the inverters will operate at, due to the resistance that needs to be overcome to "push" power to loads.
- **Access:** According to Australian Standards AS5033, inverters shall be located in a "restricted access" area if the PV array voltage is greater than 600VDC. It is a major technical advantage for larger scale PV arrays to operate above 600V.

In all cases where a recommended string inverter location is provided, most inverter locations are recommended on internal masonry/concrete walls if available. Other considerations include:

- **Car accident/vandalism protection:** as the proposed inverter locations are publicly accessible in a car park, adequate vandalism protection and car exclusion will be necessary via cages, bollards or similar. This is included in budget price estimates.
- **Inverter type:** where practical string inverters have been included in budget costs. However, if there is differential shading or multiple PV orientations, a micro inverter systems or panel DC optimiser solution is recommended, and additional costs assumed in the capital costs provided in this document.

The exact inverter location may be subject to the inverter make and models chosen and the final design of the PV system.

8.3.4 Inverter sizing and type

Solar PV panels are rated in kWp DC (kilowatt peak DC) and inverters are rated in kW nominal AC (kilowatt nominal AC).

Maximum AC inverter rating: Some inverters can provide power above their nominal capacity for a period, for example 10% over-rating. Hence final inverter selection should consider the maximum power capable of being produced by the inverter, rather than nominal capacity, when designing AC connection points and circuit breakers.

DC capacity of the PV array can be oversized compared with the inverter's kW AC capacity, with minimal loss in performance. This is due to real-world losses during operation such as temperature, incident solar angle, cable losses etc. PV module's ratings are at Standard Test Condition which very rarely (if ever) occurs in the field, and therefore will not achieve peak capacity.

For projects in Sydney, a solar PV DC capacity of 10-15% higher than inverter AC inverter capacity is expected to result in an annual energy yield loss of less than 0.3%.

Therefore, for string inverters connected to a 100kWpDC solar system, the AC inverter capacity could be designed with 85kWac to 88kWac inverters. Final design AC inverter capacity is subject to final electrical string design and available inverter sizes.

Inverter Type: Fronius, SMA andSolarEdge string inverters have been included in budget costs and performance simulations, as these systems are commonly the most used and cost-effective inverter systems.

https://www.solaredge.com/, provide some added benefits including panel level performance and monitoring, ease of DC string design on multi-orientated arrays and 'rapid shutdown' of the system. The SolarEdge design is marginally more expensive and as an overall system cost is expected to be 3-4% more expensive.

8.3.5 AC connection

All relevant Main Distribution Boards (MSBs) and Distribution Boards (DB) were inspected during site inspections to identify electrical constraints, suitable locations for AC connection of the solar system and a maximum potential PV system size for each DB.

8.4 Grid Connection

- **Solar Systems Below 30kW AC (Inverter capacity, including any existing PV systems):** For Solar PV systems installed on 3 phase electrical infrastructure that are below 30kW AC (Inverter capacity), Ausgrid and Australian Standards do not require secondary grid protection devices. The grid connection application process for Ausgrid is relatively straight forward and approval is received in a quick timeframe. The 30kW AC threshold includes any solar PV inverter systems currently on site.
- **Solar Systems above 30kW AC (Inverter capacity, including any existing PV systems):** For Solar PV systems above 30kW AC (Inverter capacity), Ausgrid and Australian standards require additional secondary protection controls and devices over and above internal grid protections in the inverter systems. Where multiple electrical AC connection points are required, Ausgrid require a master grid protection device/board, and slave boards to ensure that all systems are shut down if there is a grid outage. This requires communications between inverter/grid protection boards, which is conducted ideally via ethernet cable or similar; wireless comms is also a viable but less reliable option. The grid protection controls are also required on existing solar PV inverter systems currently on site.

8.5 Financial savings, parameters and assumptions

8.5.1 Avoided Tariffs

When the solar system is generating it will avoid consumption of electricity from the grid. The value of this avoided electrical consumption is dependent on the tariff structure and rates at the site. The following tariffs are applicable:

- **Avoided PEAK tariff:** this is the rate of ¢/kWh saved by consumption of solar generated electricity on site during peak hours. Peak times are 2pm to 8pm Monday to Friday.
- **Avoided SHOULDER tariff:** this is the rate of ¢/kWh saved by consumption of solar generated electricity on site during Shoulder hours. Shoulder times are 7am to 2pm, and 8pm to 10pm Monday to Friday.
- **Avoided OFF-PEAK tariff:** rate of ¢/kWh saved by consumption of solar generated electricity on site during off-peak hours. Off Peak times are all times outside the peak and shoulder times.

8.5.2 Feed In Tariffs

The Feed in Tariff for Large market customers is negotiated with the energy retailer. Most commercial electricity retailers will provide a Feed in tariff rate equivalent to the 'Energy Charge' electricity tariff, which is what we have used in our modelling.

Feed In tariff adopted for exported power are provided in Section 7**Error! Reference source not found.**, and are based known FIT rates from the retailer.

8.5.3 Tariff Increases adopted

Estimated increases in tariff rates adopted are provided in Table 7-3**Error! Reference source not found.**, and are based on known publicly available modelling data.

8.5.4 Company tax depreciation

Company tax offsets for the solar asset have **NOT** been included in the financial model.

If applicable tax offsets and depreciation benefits for the renewable energy asset installation assuming a company tax rate of 28% and adopting the diminishing value as per ATO tax rulings with a 20-year project life

8.6 Renewable Certificate System

All solar PV systems are eligible for renewable energy certificates. There are currently two renewable energy certificate schemes; the Small-scale Renewable Energy Scheme and the Large-scale renewable energy scheme.

The Large-scale Renewable Energy Target is designed to deliver the majority of the Australia's 2020 large renewable energy target, while the Small-scale Renewable Energy Scheme supports the installation of small-scale renewables, such as household solar rooftop panels and solar hot water systems.

8.6.1 Small-scale Technology Certificates (STCs) <100kWp:

The STC system provides an upfront capital subsidy for small renewable energy systems under 100kW and for eligible solar hot water systems. For Solar PV Systems, the subsidy equates to approximately 25-30% upfront discount at the point of sale.

The number of upfront STCs available is based on an estimated annual MWh energy production of the PV system over a 11-year period, for different climatic zones. One STC equates to 1MWh of renewable energy generation.

STC value has been upwards of $36 for a four-year period.

Enhar's analysis estimates the STC price at **$32** per certificate for installation in 2018 for the financial analysis of the solar PV systems. Current legislation indicates that STC eligibility is for system sizes up to 100kWp connected to a single NMI meter.

The Department of Education capital cost estimates are post STC price.

8.6.2 Large Generator Certificates LGC >100kWp:

Systems over 100kWp will be eligible for large generator certificates (LGCs), if the system is commissioned prior to 2020, and if the renewable energy target has not been met (a situation unlikely to occur before mid-2019).

LGCs are an annual subsidy provided under Australia's Renewable Energy Target (RET) and is based on the metered annual generation of the solar system. One LGC is equivalent to 1MWh of electrical generation.

To access LGCs, the installed solar PV system will be required to become a Clean Energy Regulator accredited power station. There are additional metering infrastructure works required to meet the requirements of the Clean Energy Regulator, which includes a utility grade meter. In addition, annual paperwork requirements are mandated in order to create eligible LGCs and claim the annual payment, this paperwork can be completed by a consultant, internally or through a renewable energy trader.

LGCs are a market-based system and vary in price depending on the market, demand for certificates at the time of sale, and government legislation at the time. LGCs for the renewable energy generated electricity will be available until 2030 under current legislation, and the renewable plant must be registered with the Clean Energy Regulator prior to 2020 (or prior to the renewable target being met). Due to a large number of large-scale solar farm developments in 2018, our understanding is that the renewable energy industry is on track to meet the target ahead of 2020 and we will attempt to quantify this risk over the coming period.

The following table presents the adopted LGC rates adopted in the financial analysis, adopting:

- Known hedged market rates for the first 4 years from Green Energy Traders for a 4 year contract to sell LGCs to the trader, Green Energy traders is a well- regarded Renewable Energy Certificate trader in the industry.
- Review a range of modelled forecasts for LGC prices and some of our partners involved in the Melbourne renewable energy buying group. From the Projected market rates of the LGC's from the year 2022 to 2030 we have chosen a conservative scenario condition as below
- Recent federal government policy has introduced some extra risks in the LGC pricing forecast, however, our current understanding is that this does not affect the current LGC system which is legislated to 2030.

8.7 Costs

8.7.1 Capital costs (CAPEX)

Capital cost estimations have been provided based on pricing from **The Department of Education.**

Based on the complexity of some of the recommended options in this report, we expect that these prices may be exceeded in some instances, particularly where a complex system is recommended. Estimated system pricing has been provided for the recommended solar PV systems. The system variation pricing may vary depending on:

- Complexity/ease of installation, with consideration of available access/crane hire, AC/DC cabling runs, safety issues.
- DC electrical design considerations such as cable runs and complexities.
- Grid connection costs specific to the site and system size.
- Excluding any safe roof hardware requirements.
- Tier 1 moderate quality solar PV panels, that have Australian warranty and technical support
- Good quality well known inverter brands and systems, that have Australian warranty and technical support (SolarEdge, Fronius Eco and Symo)
- Industry norms

8.7.2 Operating costs (OPEX)

The Department of Education is responsible for any maintenance costs for Public schools and this is not an ongoing cost for the school

The following operating costs have been included:

- Estimated annual maintenance cost of AUD$10/kWp installed.
- Inverter replacement 10 years after the installation date at a cost of 7% of the initial capital cost of the installation

8.7.3 Payback, NPV and IRR

The payback time, return on investment, net present value and internal rate of return calculations involve the following assumptions

- All PV generated electricity will produce electricity bill savings and income at the rates and amounts detailed in this report, refer to section 7.1**Error! Reference source not found.**.
- Feed-In Tariff (FiT) adopted for exported power are provided in **Error! Reference source not found.** For further information on Feed-in-tariffs please refer to: https://www.ipart.nsw.gov.au/Home/Industries/Energy/Reviews/Electricity/Solar-feed-in-tariffs-201920.
- Estimated increases in tariff rates adopted are provided in section 7.**Error! Reference source not found.**
- Company tax depreciation offsets not adopted. If applicable tax offsets and depreciation benefits for the renewable energy asset installation assuming a company tax rate of 28% and adopting the diminishing value as per ATO tax rulings with a 20-year project life. Including tax depreciation will improve the financial case.
- Government subsidies either:

- sub-100kWp: Upfront STC (small technology certificates) rebate available at the time of report preparation (12 year deeming period $32 per MWh)
- >100kWp: Annual LGC payments until 2030 at a variable rate

- Estimated annual maintenance cost of as stated above.
- Financial payback assumes a 25-year system lifetime (manufacturer performance warranty on PV yield is 25 years for all the proposed PV panels),
- Natural reduction in performance/yield of the PV system due to minor deterioration of PV cell efficiency. The decrease in efficiency is linear between 0% at commencement and 20% at the completion of 25-year warranty (product warranty is for performance at least 80% of the initial level)
- Inverter replacement 10 years after the installation date at a cost of 7% of the initial capital cost of the installation
- Does not include unexpected failure of equipment

Net Present Value (NPV): is determined by calculating the costs (negative cash flows) and benefits (positive cash flows) for each period of an investment. After the cash flow for each period is calculated, the present value (PV) of each one is achieved by discounting its future value at a periodic rate of return. NPV is a useful tool to determine whether a project or investment will result in a net profit or a loss. A positive NPV results in profit, while a negative NPV results in a loss. The NPV measures the excess or shortfall of cash flows, in present value terms, above the set discount rate.

Internal Rate of Return (IRR): The internal rate of return (IRR) is a rate of return used in capital budgeting to measure and compare the profitability of investments. The IRR is also called the effective interest rate. The higher a project's IRR, the more desirable it is to undertake the project. An investment is considered acceptable if its internal rate of return is greater than an established minimum acceptable rate of return or cost of capital.

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