QUEENSTOWN ELECTRIFICATION ACCELERATOR

# Off Grid System: Solar Feasibility Study

## Introduction

This report assesses the performance of different solar array sizes for an off-grid business that operates primarily during winter and currently relies on a diesel generator for power. The aim of installing a solar and battery system is to reduce operating costs, lower emissions, and decrease dependence on the generator.

## Solar and Battery Analysis

The tables below show the economics behind various sized solar arrays. Under all scenarios, a 40kW battery has been considered.

Table 1: Economics of various sized solar arrays, assuming solar is not able to be exported back to the grid.

| Solar Size (kW) | ROI (after tax) | NPV (after tax) | Annual Savings |
|---|---|---|---|
| **15** | 20% | $12,037 | $7,136 |
| **20** | 13% | $8,652 | $7,552 |
| **25** | 4% | $2,929 | $7,757 |
| **30** | -4% | -$3,002 | $7,944 |

The table below assesses the performance of each size solar array and battery system, for each season of the year. See Appendix A for detailed consumption profiles for each size and season.

| Solar Size (kW) | Winter | Spring | Summer | Autumn |
|---|---|---|---|---|
| **15** | Heavy reliance on diesel generators for the majority of power during the winter.<br>No excess solar is available to go into the battery. The battery would serve more to manage system volatility and transition | Solar profile covers the majority of the consumption profile. The battery would be able to charge with the excess solar to cover the electricity required outside of solar producing hours (assuming minimal night time loads are required). Generators should not be required during these months. | | |

| | | |
|---|---|---|
| **20** | from generator to solar during winter months. | Similar to the 15kW system, however more excess solar would be available for export earnings (If connected). |
| **25** | Similar to the 15kW and 20kW system, however there would be a small amount of excess solar to go into the battery and offset generator costs. | The amount of excess solar would enable the battery to become charged and have a high amount of kW left over for export. This system would be oversized during summer if excess solar is not able to be sold as export (based on current electricity demand). |
| **30** | Similar to the 25kW system, however with more excess solar to charge the battery and offset generator costs. | |

# Conclusion

The business operates primarily during winter, which presents a unique challenge for solar feasibility. The peak energy demand coincides with the lowest solar generation period, while summer, when solar output is highest, sees ~50% of the energy use of winter. This seasonal mismatch significantly impacts the economic viability of larger solar systems.

Currently, the business is not connected to the grid and cannot export excess solar generation. As a result, larger solar arrays lead to substantial energy waste during summer, reducing return on investment (ROI). For example:

- A 30 kW solar system with no export capability yields a -4% ROI due to unused summer generation.
- The same system with export capability could achieve a 11–18% ROI, making it far more viable.

## Key Considerations

- **Export Potential**: Connecting to the grid or establishing a private line to the neighboring business could unlock export revenue (during the summer) and improve system economics (depending on the cost to connect).
- **System Sizing**: Without export, a 15–20 kW system is recommended to maximise ROI, minimise energy wastage in the summer and maintain flexibility for future expansion.
- **Winter Reliability**: Regardless of system size, diesel generation will remain essential in winter due to low solar production and high demand (see consumption profile examples in Appendix A). A fully solar-reliant winter setup would require an impractically large array.

## Solar and Battery Analysis Assumptions

- Solar price is assumed to be $1750 /kW installed. Battery price assumed to be $830.15/kW installed.
- It is assumed that the Battery and inverter will need to be replaced in 15 years, solar panels have a 30 year warranty, and the battery has a 15 year warranty.
- Annual degradation of solar panels is assumed to be 0.5%.
- Diesel price (supply and delivered) assumed to be $1.45. Generator assumed to be 35% efficient.
- Battery effective range is assumed to be 80%.
- Useful life of the battery for tax purposes is considered to be 5 years, as defined by IRD. The warranty of the battery is considered separately to this as 15 years.
- Useful life of the Solar system for tax purposes is considered to be 12.5 years, as defined by IRD. The warranty is considered separately to this as 30 years.

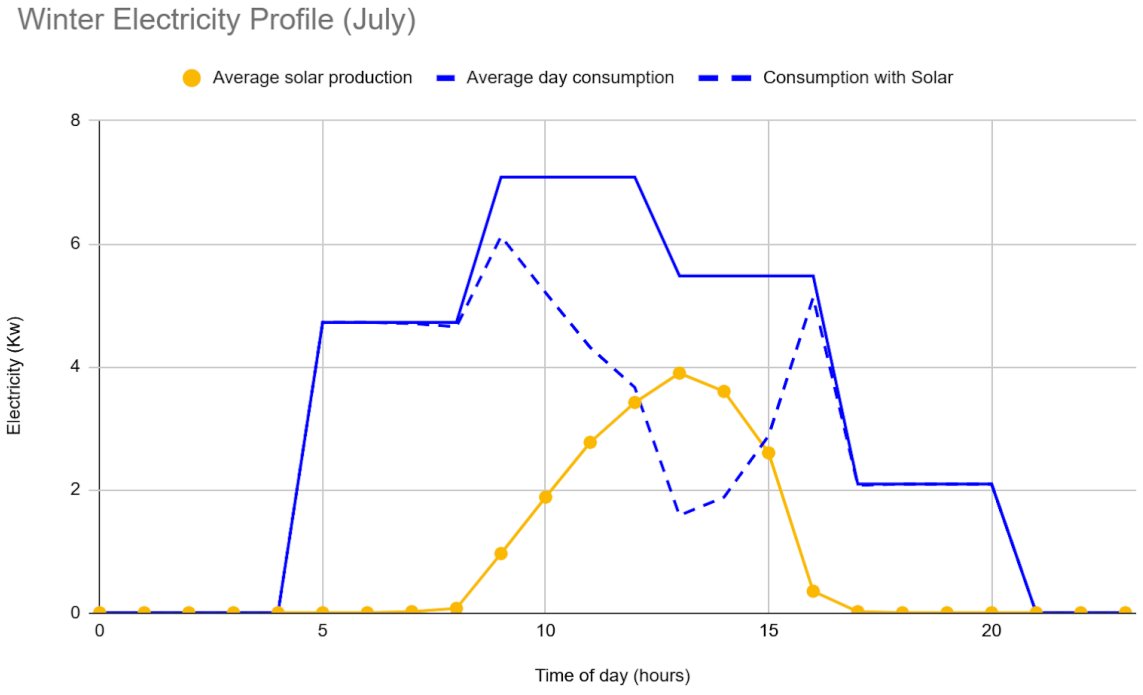
## Disclaimer

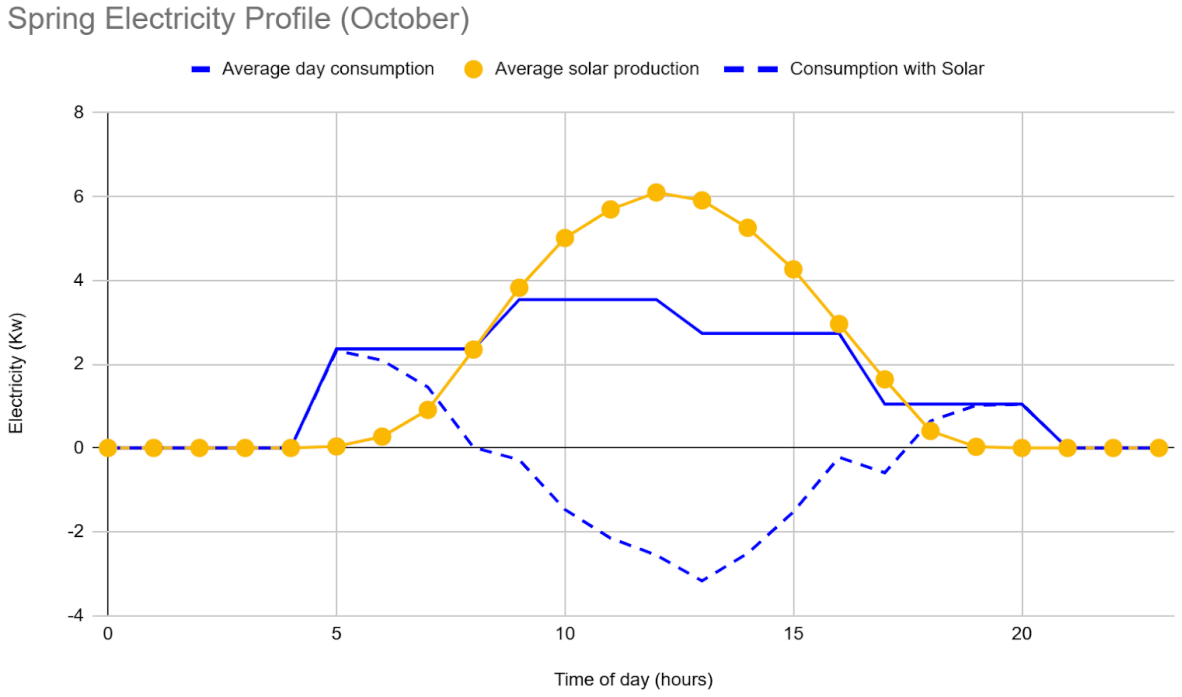
Please note:

- Is of a general nature, and may contain ‘typical’ values in order to provide a reasonable simulation;
- Is based on information provided by you and subject to our best interpretation of that information;
- Is not provided as a guarantee of the exact level of output of the system as variations may occur;
- Can not reflect variability in actual energy use which may have a significant impact on savings potential;
- Should not be considered as financial advice and does not substitute professional financial advice in terms of an investment decision.

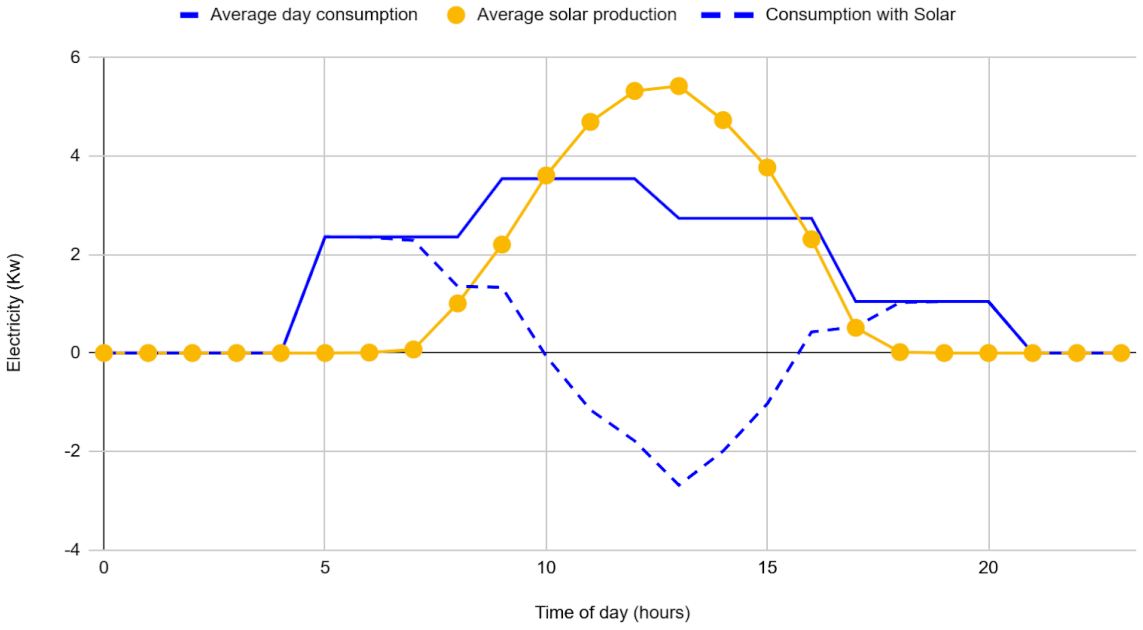
# Appendix A: Estimated Solar Array and Consumption Profiles

## 15kW Solar Array

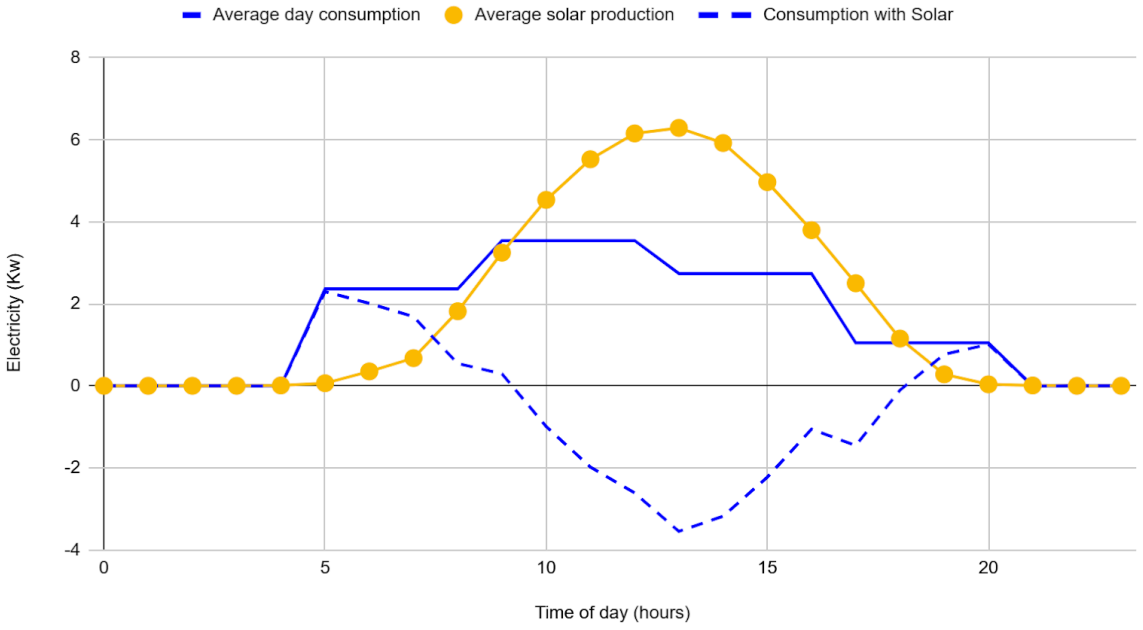


## Autumn Electricity Profile (April)

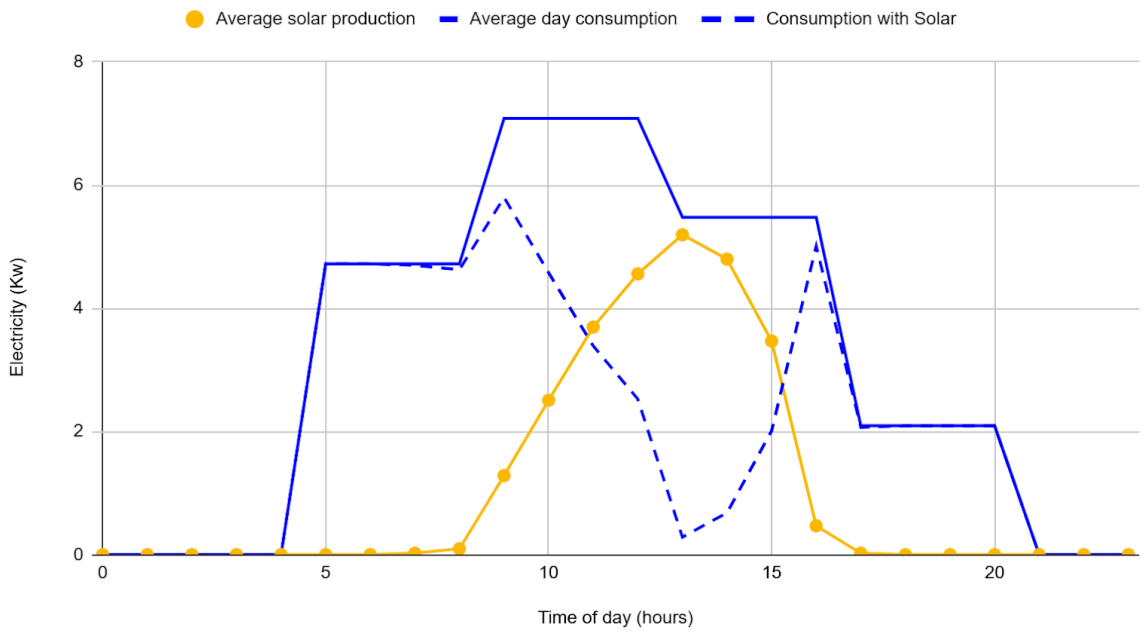



## Summer Electricity Profile (January)

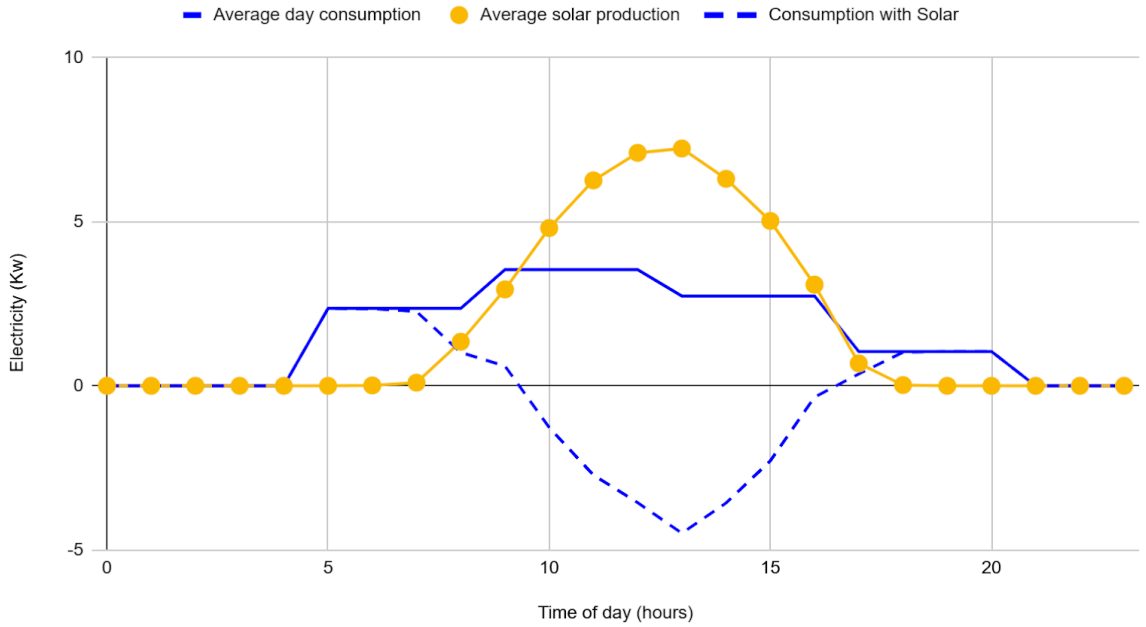


# 20kW Solar Array

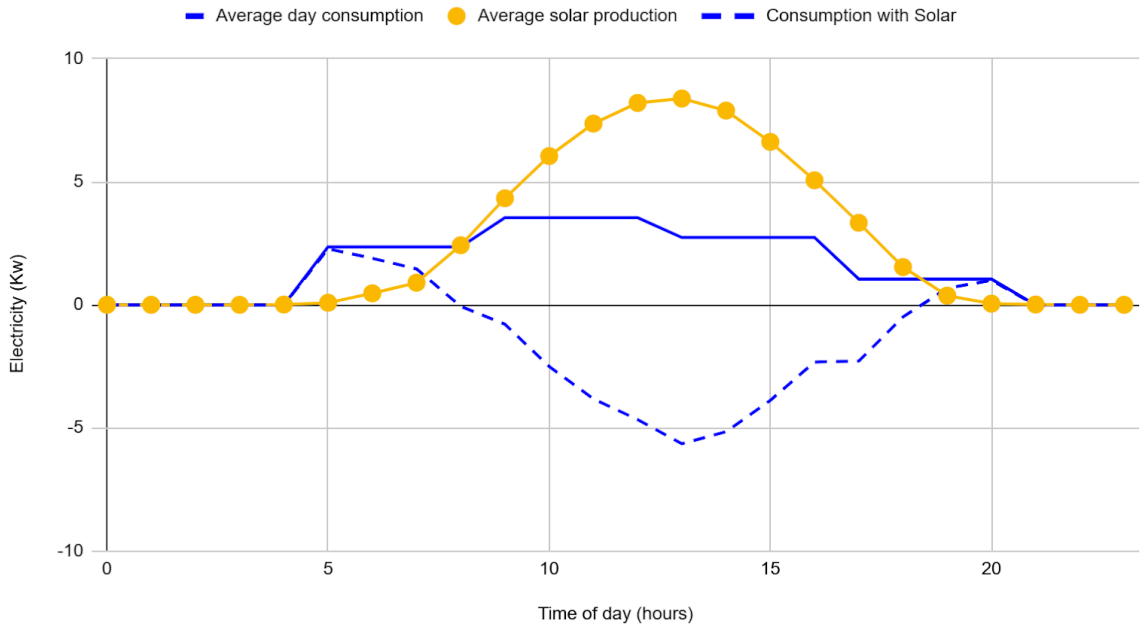
Winter Electricity Profile (July)



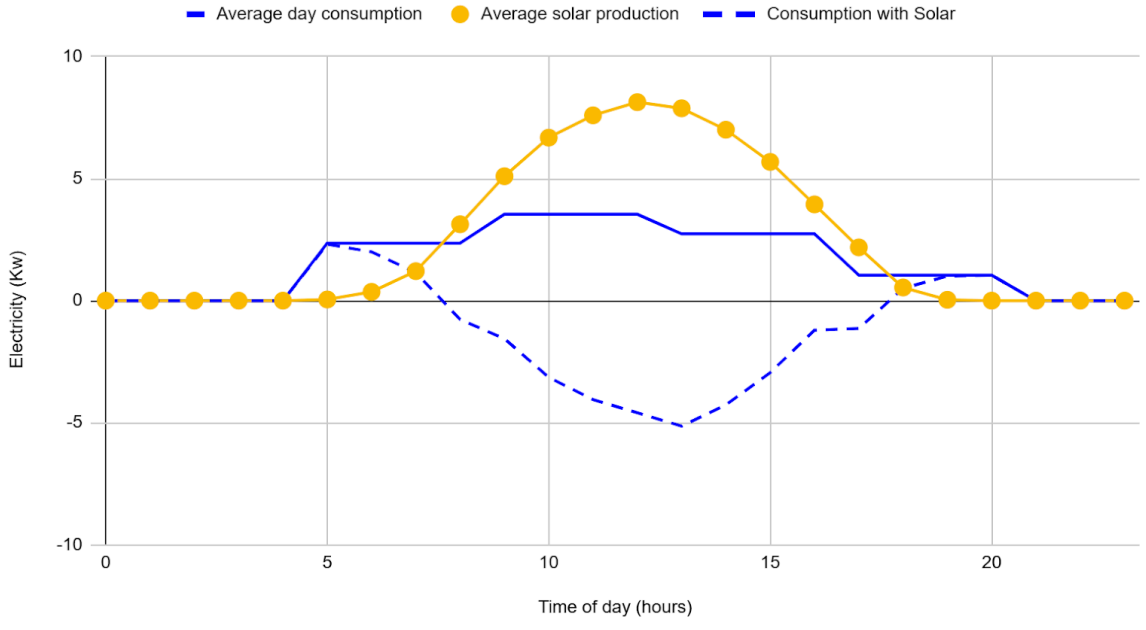

Autumn Electricity Profile (April)



## Summer Electricity Profile (January)

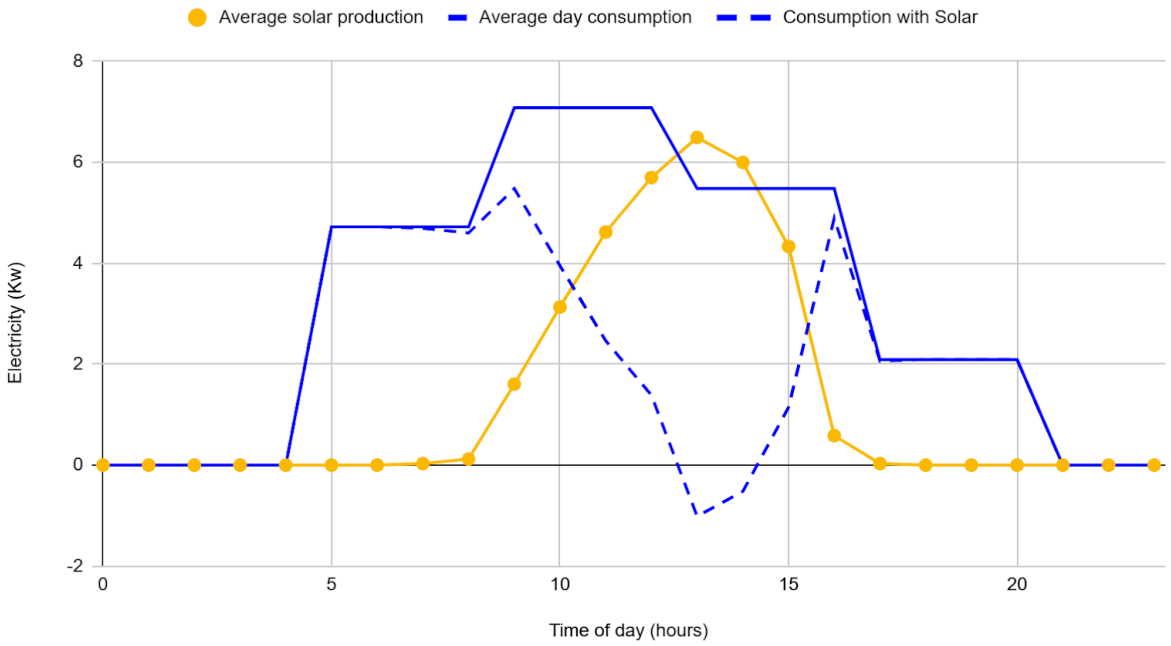



## Spring Electricity Profile (October)

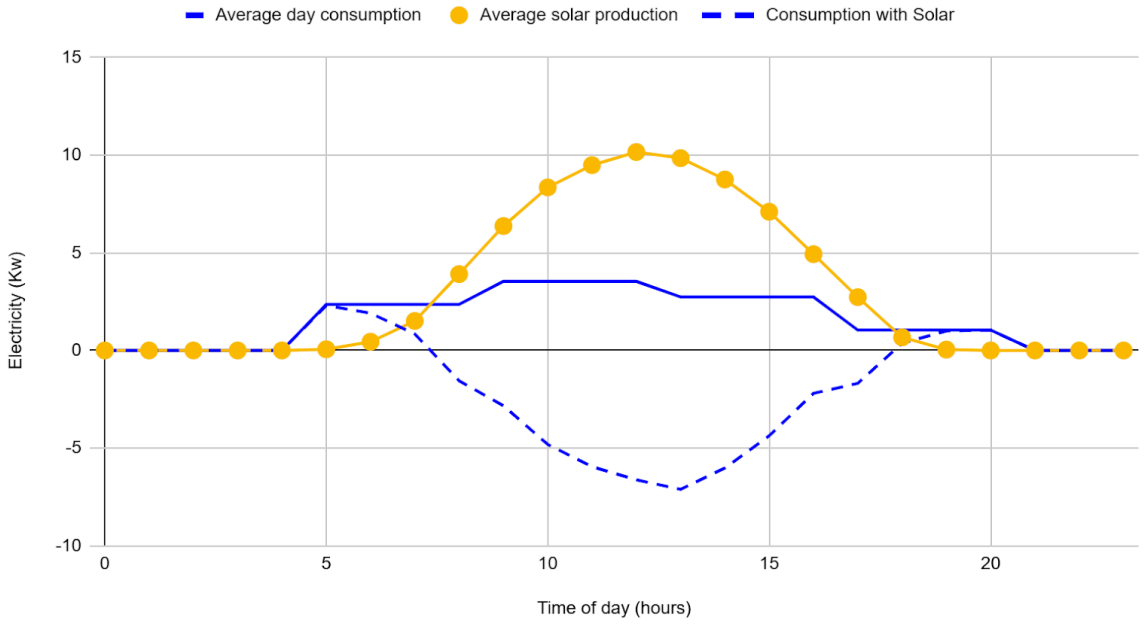


# 25kW Solar Array

Winter Electricity Profile (July)




Spring Electricity Profile (October)



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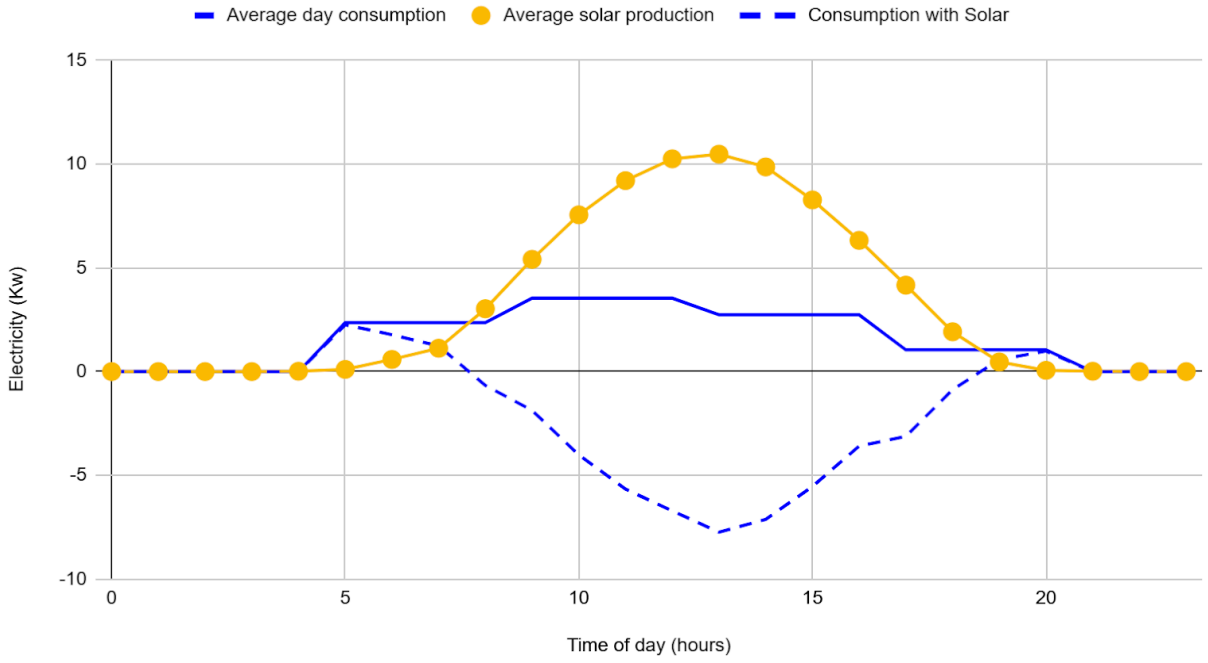
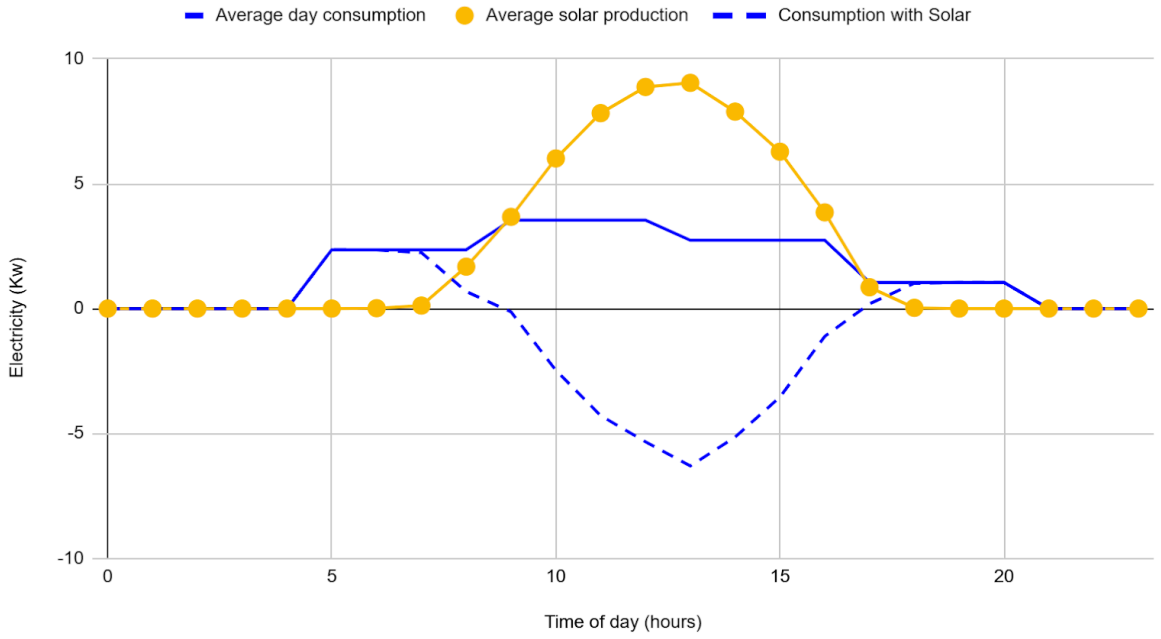
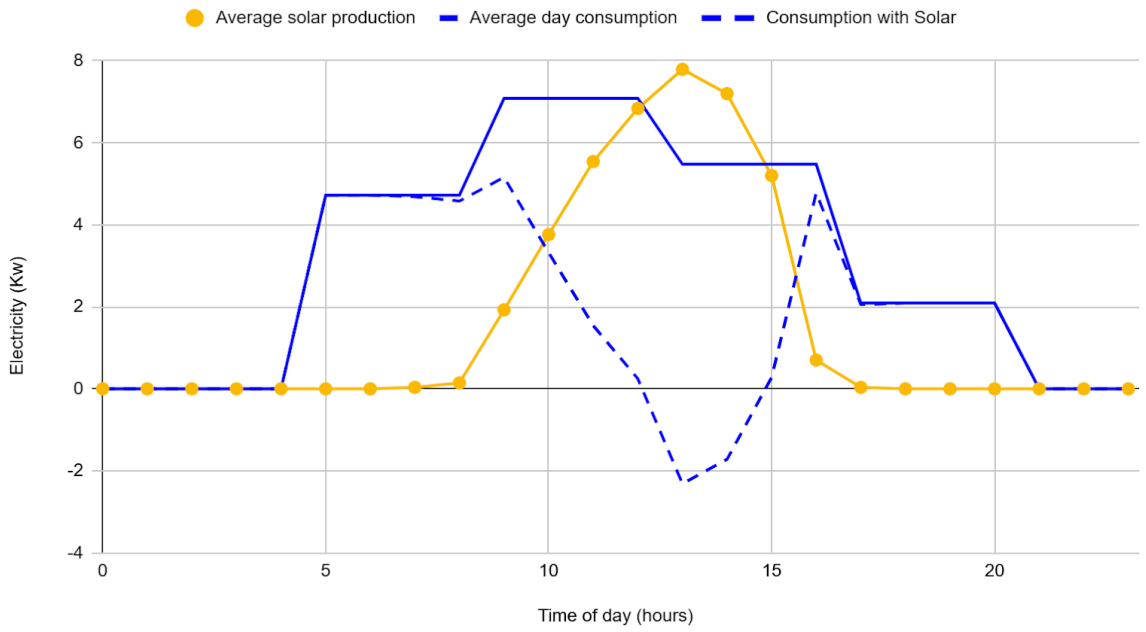



## Autumn Electricity Profile (April)

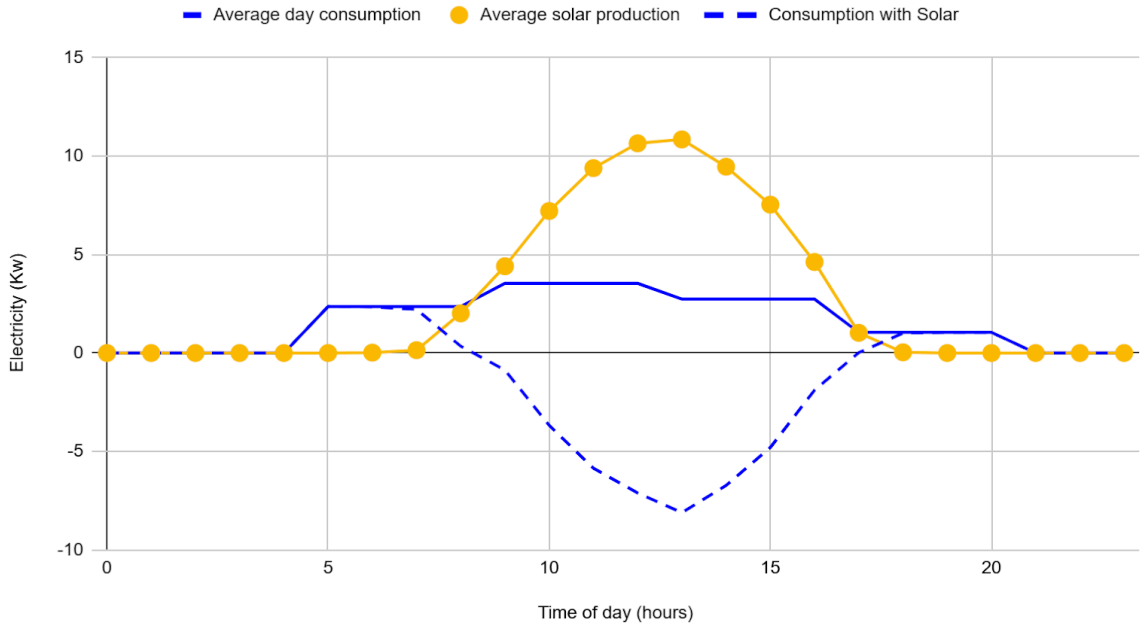


# 30kW Solar Array: Estimated Profiles

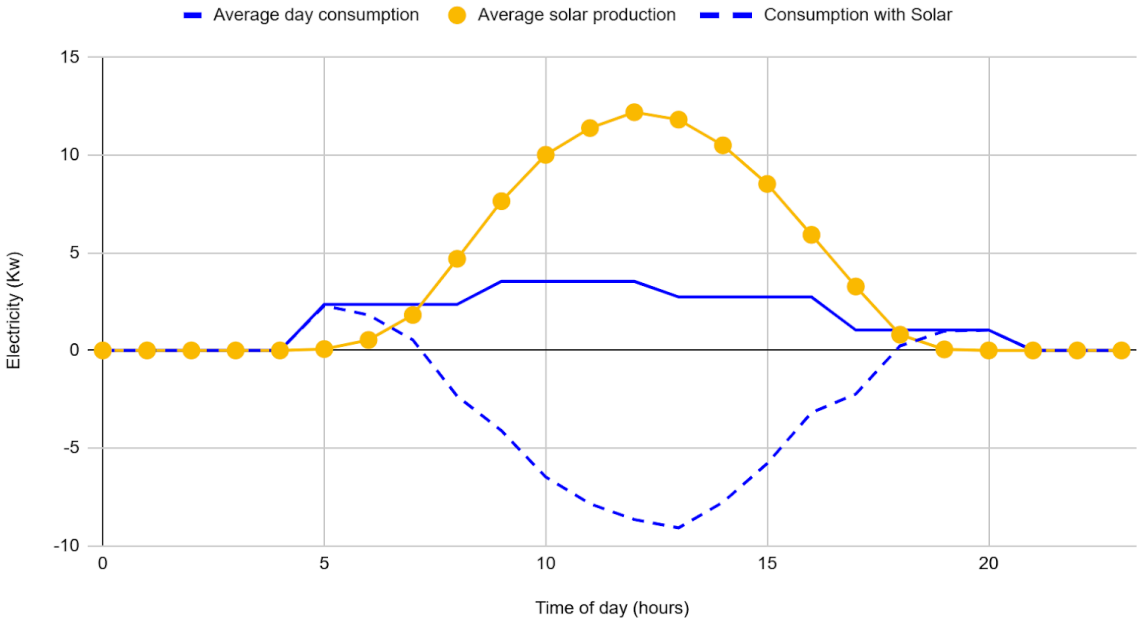
Winter Electricity Profile (July)




Autumn Electricity Profile (April)



## Spring Electricity Profile (October)




## Summer Electricity Profile (January)