WATTBLOCK

Solar, Solar Thermal and Heat Pump on Strata Case Study

Acknowledgements

We would like to thank the following people who contributed to this case study for Strata Plan SPXXXXX at XXXXXXXXXXXXX, Glebe:

- XXXXXXX XXXXXXXXX (Chairperson)
- XXXXXXX XXXXXXXXX (Executive Committee Member)
- XXXXXXX XXXXXXXXX (Owner)
- XXXXXXX XXXXXXXXX (Strata Manager)
- Brent Clark
- Ross McIntyre
- Scott Witheridge
- Jacky Zhong
- Alexander Prideaux
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- Stuart McGregor
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- Megan Chatterton

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Background

Details	Data
Strata Plan Number	SPXXXXX
Residential Lots	46
Commercial Lots	1
Floors	5+2 Parking
Age of Block	0-10 years
Common Area Electricity Consumption	$12,148
Apartment Electricity Consumption	Est. $68,000
Projects Completed	LED lighting upgrade, Waterproofing roof, Cover over hot water plant & equipment

[redacted]

Strata Energy Efficiency Challenge

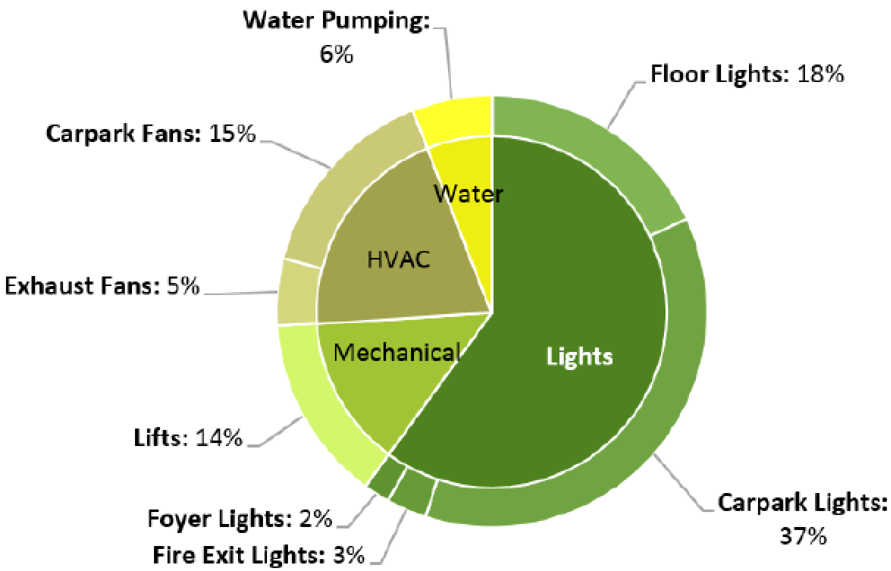
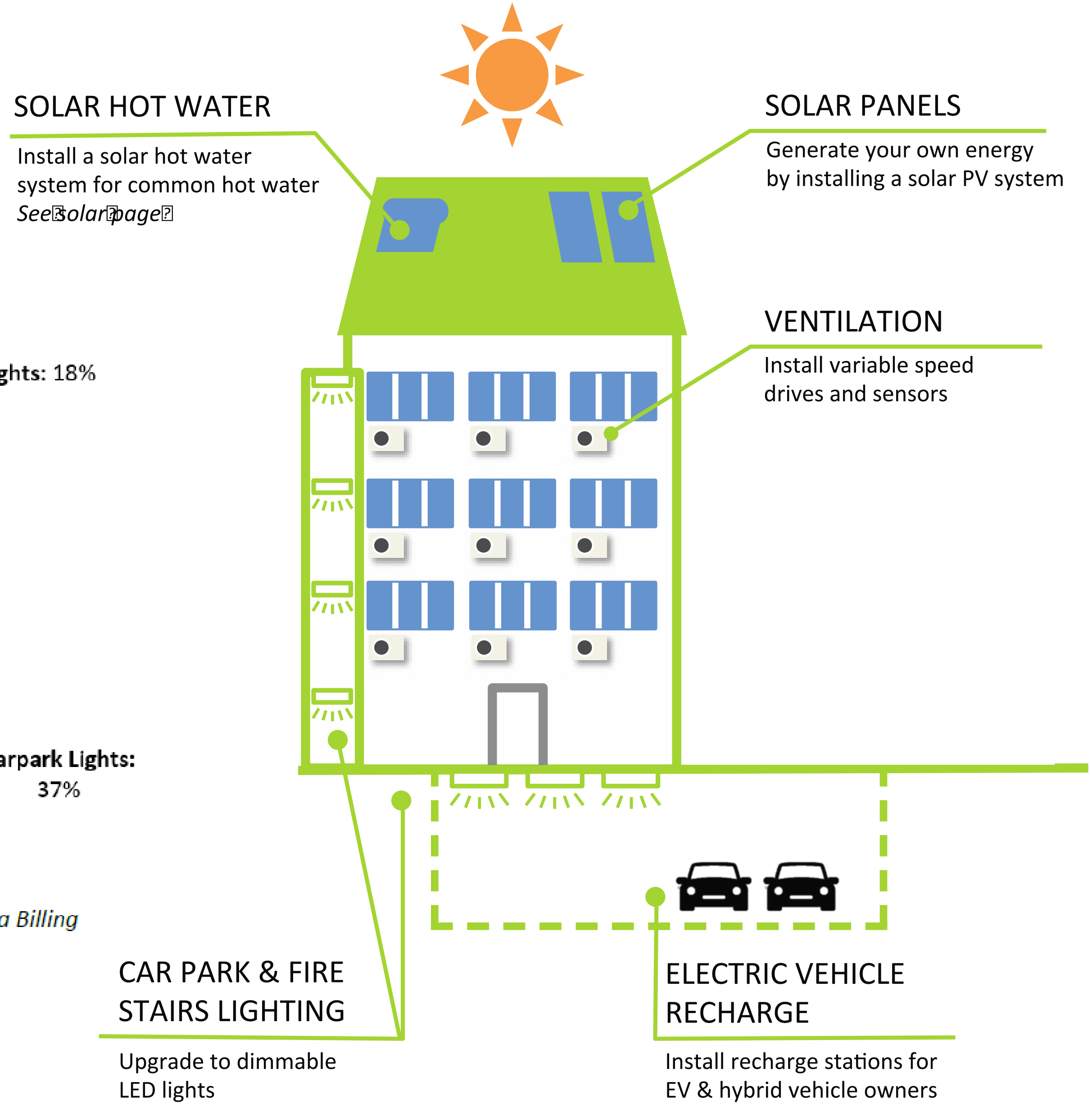


Figure 3: Energy Cost Distribution for Common Area Billing



Wattblock Energy Assessment

The strata block at XXXXXXXXXXXX previously participated in the City of Sydney Virtual Energy Assessments project run by Wattblock in 2015. As a participant the committee received an energy assessment report for their building covering energy efficiency benchmarks and a solar assessment.

Lighting represented the greatest opportunity for energy savings by switching to LED with sensors and timers. XXXXXXXXXX completed an LED upgrade for common area lighting in the basement carparks and fire escapes at the beginning of 2015. The annual energy usage has been reduced by 13%, saving 7MWh of energy per annum. Since then the common area energy usage has remained at a consistent level.

Lowering the energy footprint of the building is generally advisable prior to investigating solar energy opportunities to avoid over sizing.

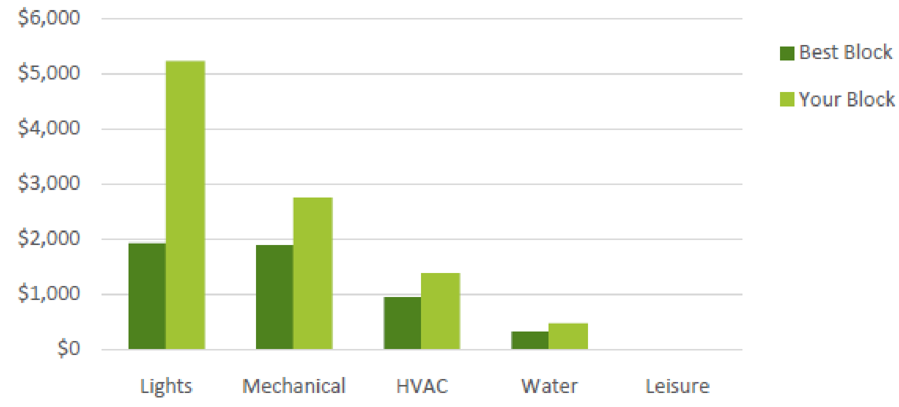


Figure 4: Annual Energy Cost Benchmarking for Common Areas

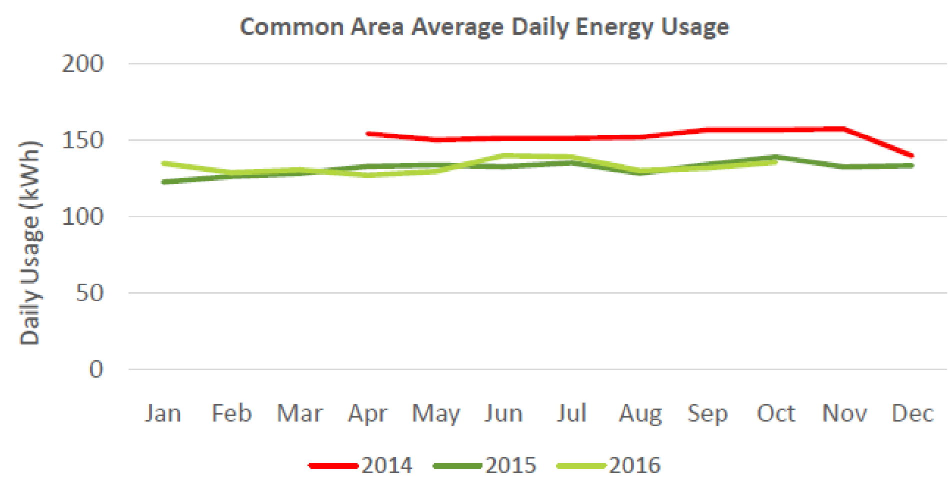
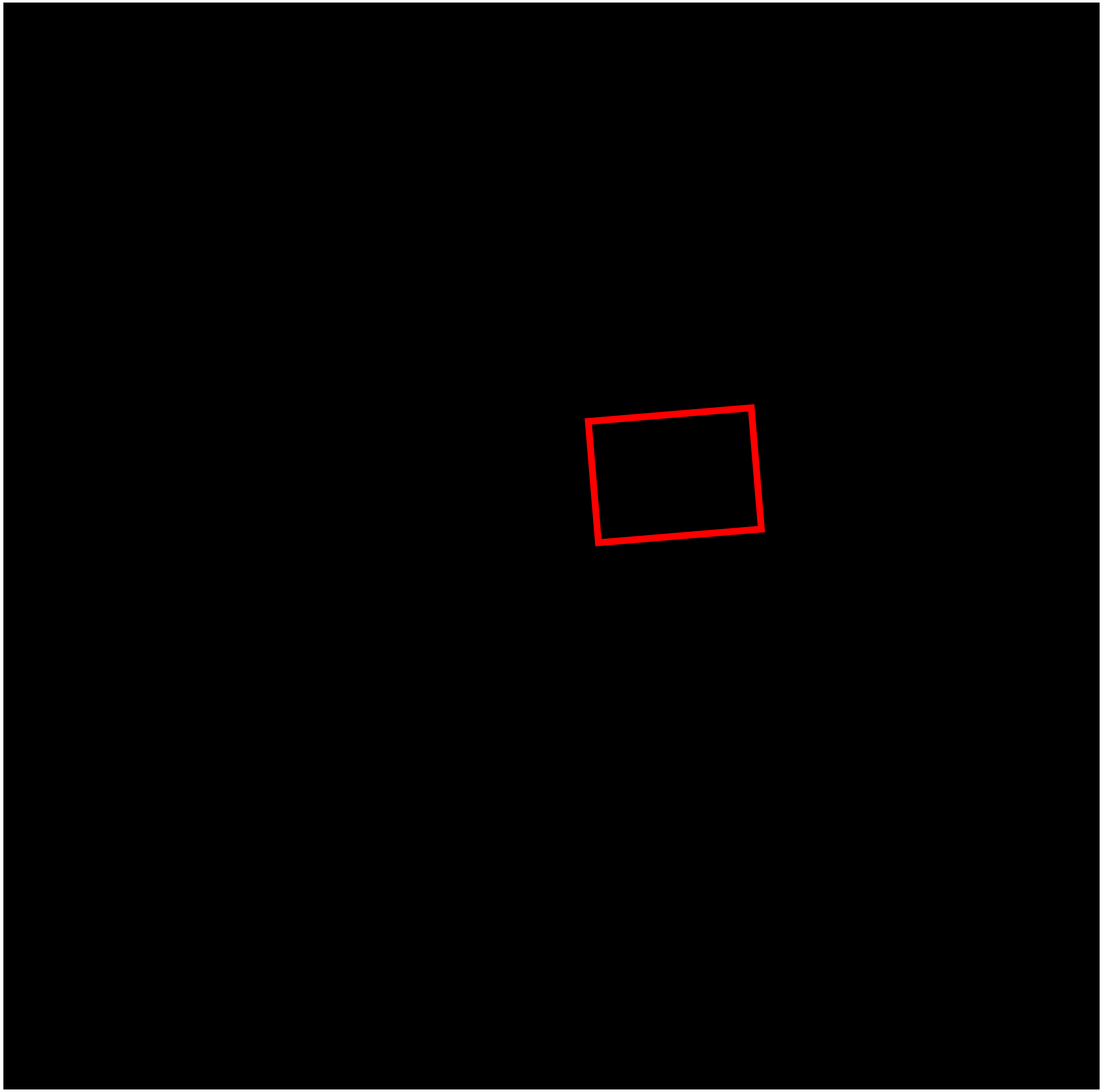


Figure 5: Common area energy reduced 13% in 2015

Objective – Optimise this strata roof space for energy



Strata Committee completed waterproofing project

It is prudent to first waterproof any roofspace which may be used for solar equipment. Solar panel lifespan is 25 years which is longer than the lifespan of typical rooftop waterproofing. Below is an example of a three layer waterproofing solution.

Before

After

Strata Committee completed hot water roofing project

Common hot water plant & equipment is some of the most expensive equipment to maintain within a strata building. Investing in protecting this plant and equipment should increase lifespan of the equipment and also reduce the chances of a water tank bursting and creating water damage.

Before

After

The combined project cost for the Owners Corporation to waterproof the roof and construct the cover over the hot water plant and equipment was approximately $130,000.

Energy Options Considered

The key challenge behind this case study was to work out the optimal solution for a strata building which has available roof space for solar and/or hot water solutions. The following options were considered:

1) Install a solar photovoltaic system (10kW) to power common areas, with any excess solar energy feeding into the grid

2) Install a larger solar photovoltaic system (20kW) to power common areas first, then power individual apartments which are consuming electricity in the building, before feeding any left over electricity into the grid. Requires a digital metering and billing solution.

3) Install a solar thermal hot water system to be boosted by existing gas hot water equipment

4) Install an electric heat pump system to be boosted by existing gas hot water equipment

5) Install a solar photovoltaic system for common areas AND electric heat pump to be boosted by existing gas hot water equipment

Solar Analysis for Common Area Electricity Only

A 10kW solar system typically consists of about 30-40 solar panels. A strata plan such as XXXXXXXXXXX would typically crane solar equipment up to the roof.

In order to get the best performance, racking is also required to tilt the panels towards the sun.

The cost of craning up the equipment is large in comparison with the actual cost of the solar system (panels, racking, ballast, inverter, cabling and solar meter which allows excess solar power to feed back into the grid).

Most solar companies would not offer solar finance (e.g. Power Purchase Agreement) for a building such as XXXXXXXXXXXX due to the craning costs. Solar companies will typically offer a capital expenditure model to pay for the solar system.

The strata scheme could take out an energy leasing option such as an 'operating lease'.

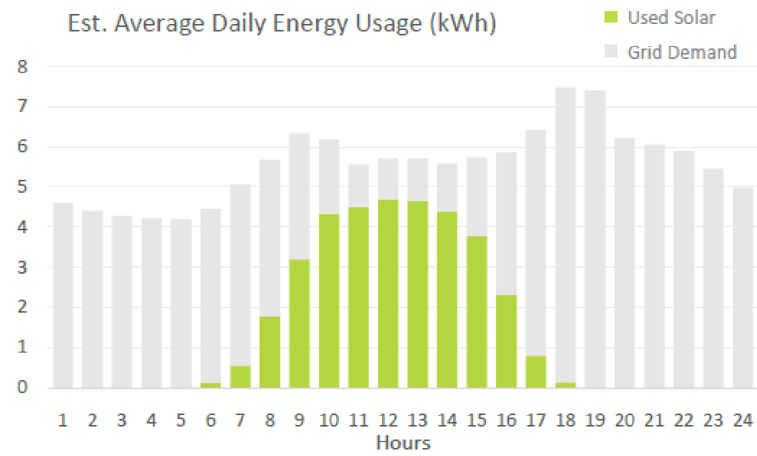


Figure 11: Energy Usage of Common Area with 10kW Solar

Figure 12: Conceptual layout of 10kW solar energy system for common areas

Solar Analysis for Common Area + Apartments

The maximum size solar photovoltaic system which could fit in the available space on the roof of XXXXX XXXXXXXX is 20kW. (Pictured to the right)

If this size system were installed, it would provide too much electricity for the common areas on their own to consume and excess electricity would feed into the grid. This is not a good situation as the Owners Corporation would only be offered 5-6c per kWh for electricity it feeds into the grid. Meanwhile, individual apartments within the building might be consuming electricity which costs them up to 48c per kWh.

A better solution for a strata building like this would be to use excess solar power generated from the solar system for powering individual apartments first and only feed-in to the grid as a last resort option. The Owners Corporation could then charge say, 20c per kWh to the individual apartment, creating a win-win scenario for both the Owners Corporation and the individual apartment.

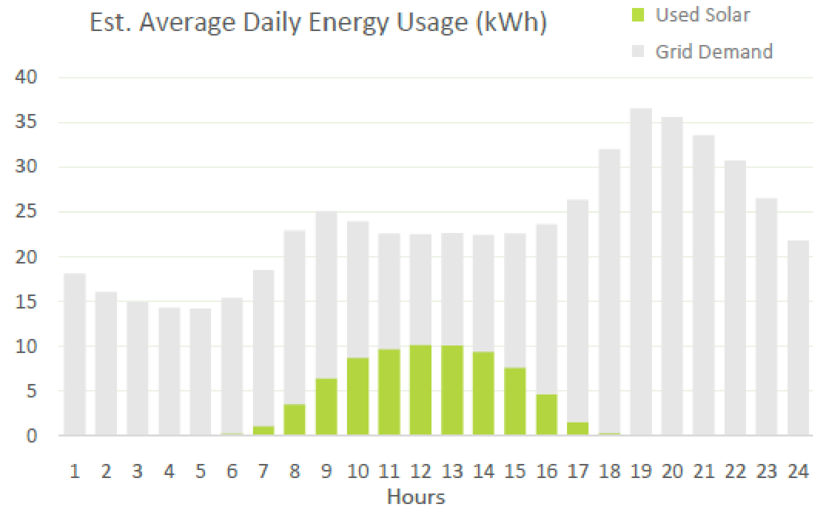


Figure 23: Combined apartment and common area daily load profile

Figure 24: Conceptual layout of a 20kW solar energy system

Ballast-mounting of solar equipment

A key concern for strata buildings is maintaining the integrity of the roofing slab, in order to minimize water intrusion into apartments below.

For this reason, a solar racking solution which uses ballast, is preferable to drilling anchor points into the slab, which necessarily compromises the waterproofing membrane.

A structural engineer needs to sign off on the ballast system, given the wind speeds in the local area.

Modern solar racking systems use a combination of ballast and “wind-deflectors” to ensure that the solar system remains in place.

The picture to the right shows the “wind deflectors” which are designed to stop gusts of wind getting under the solar panels and creating upward thrust.

Solar Thermal boosting of gas hot water

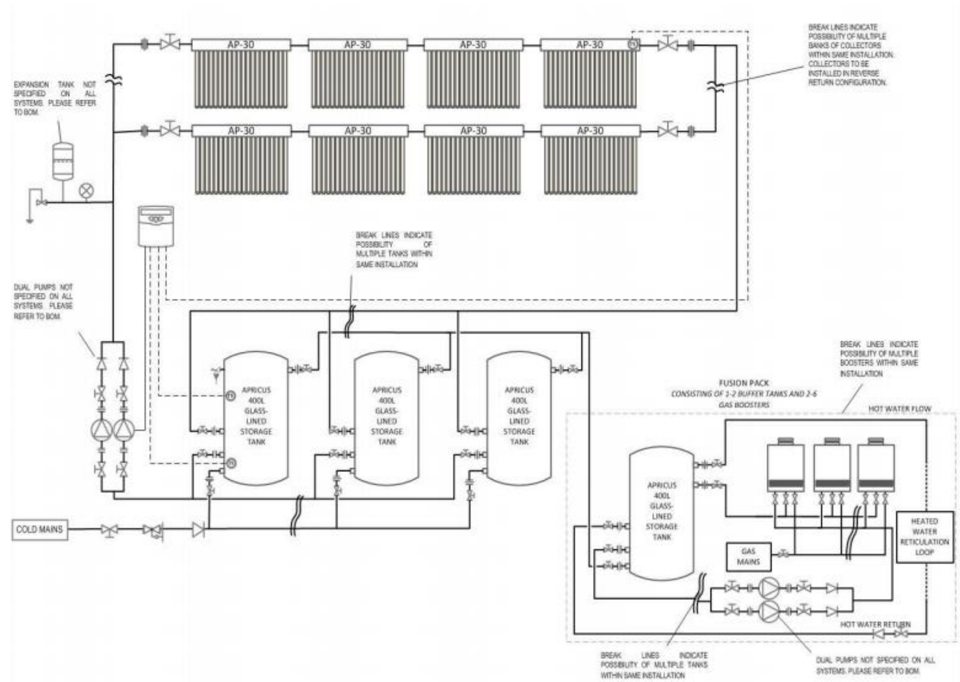
Using solar energy to heat up water can actually be twice as effective as using solar energy for electricity.

Solar Thermal hot water systems pump water through evacuated tube systems in order to pre-heat the water, prior to pumping the water into tanks where gas is used to further boost the water heat.

XXXXXXXXXXX is fortunate to have its hot water plant and equipment located on the roof. This minimizes the piping and pumping costs required to transfer the pre-heated water from the solar thermal water heating equipment into the existing gas hot water boiler plant & equipment.

Solar Thermal systems are expensive and typically have longer payback periods.

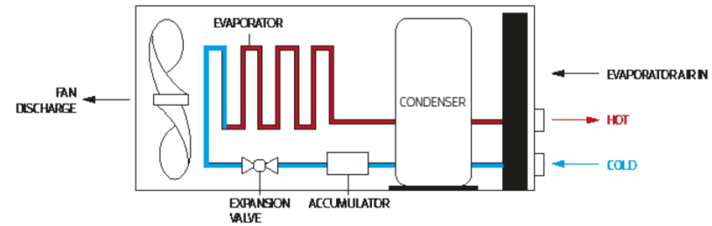
However, the lifespans of solar thermal systems may be longer than the lifespans of electric heat pump systems.



Electric Heat Pump boosting of gas hot water

An electric heat pump is like a **reverse refrigerator**. Heat from the air is captured and then stored into an **energy bank** which is really just a hot water storage tank. For every 1kWh of energy input into the heat pump, up to 4kWh of thermal energy can be generated by extracting heat from the air.

Heat Pump



Electricity prices in Australia are high but gas prices in Australia have risen sharply. Gas heats water quickly, but after it is heated to 65 degrees and stored, it loses heat quickly. Hot water in a gas system often has to be re-heated after being circulated through the building, leading to energy waste.

Hot water storage tank
'energy bank'

Electric heat pumps heat water slowly and to lower temperatures than gas e.g. 50 degrees. Off-peak electricity can be used to power a heat pump at times when demand is low, for example in the middle of the day when fewer people are at home.

Water heated by off-peak electricity can be stored more efficiently at 50 degrees and is not circulated through the building. When the hot water is required, it can be pumped from the storage tank into the gas hot water tank, 'topped up' with additional heat, before being consumed in apartments.

How best to use this roof space for maximum benefit?

Relative Payback Periods

The following tables compares the benefits of different solar/hot water solutions for XXXXXXXXXXX.

Technology	Cost	Savings	Area Occupied (m^2)	Savings/ m^2	Payback
Solar Photovoltaic Energy Systems					
10 kW Common Area Solar System	$16,080	$2,763	95	$29	5.6 Years
20kW Community Solar System (Limited Roofspace)	$42,542	$726	190	$4	>25 Years
35kW Community Solar System (Assumed Unlimited Roof)	$62,277	$5,466	330	$17	9.8 Years
Hot Water Systems					
Gas Boosted Solar Hot Water	$53,585	$5,896	51	$116	9.1 Years
Gas Boosted Heat Pump Hot Water	$74,377	$11,336	17	$667	6.6 Years
Optimised Solution for [redacted]					
Common Area Solar and Heat pump hot water	$90,457	$14,099	112	$126	6.4 Years

Benefits of the preferred solution

For XXXXXXXXXXXX, the best solution is to consider installing an electric heat pump system and a 10kW solar system to power the common areas.

Technology	Cost	Savings	Payback	Energy Savings	Reduction
Solar Energy for Common Area	$16,080	$2,763 p.a.	5.6 years	12.9 MWh p.a.	26%
Heat Pump Hot Water System	$74,377	$11,336 p.a.	6.6 years	263.7 GJ p.a.	70%
Total	$90,457	$14,099 p.a.	6.4 years		

Note: Total project costs may be reduced if implemented at the same time due to lower craning costs.

A combined solution will result in a 26% reduction in electricity costs and a net 70% reduction for the common area gas hot water system.

Savings of over $14,000 p.a can be achieved with a payback of 6.4 years.

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