strata community australia
NSW member

2017 Winner ANN SHEVILL ESSAY AWARD
2016 Winner INNOVATION OF THE YEAR
2015 Finalist COMMUNITY SUPPORT CeBIT
2014 Finalist ENERGY & SUSTAINABILITY CHALLENGE CUP 1776

WATTBLOCK

Electric Vehicle Report

Observatory Tower

168 Kent St, Sydney, NSW 2000

Date: 11th September 2017

Wattblock NSW

Michael Crouch Innovation Centre
Gate 2, High St, UNSW, 2052

Phone: (02) 9977 1801

Email: support@wattblock.com.au

www.wattblock.com

Wattblock Queensland

32 Saul St Brighton
Queensland, QLD, 4017

Wattblock Victoria

Gurrowa Lab
242 Exhibition St
Melbourne Vic 3000

Observatory Tower

Electric Vehicle Report

Prepared for:

Strata Plan 53158

168 Kent St

Sydney, NSW 2000

Prepared by:

Wattblock NSW

Michael Crouch Innovation Centre

Gate 2, High St, UNSW, 2052

Document Control Log

Revision No.	Date	Prepared By	Checked By	Approved By
Revision A	11/09/17	JZ	RM	BC

Contents

Executive Summary

The main objective of the report is to provide background information on Electric Vehicle (EV) charging for residents and the benefits of having your building ready for Electric Vehicles. It allows the Owners Corporation to come to a conclusion on basic questions such as how to bill owners for charging their Electric Vehicles, which location is the best to put the charger, how to set it up, what type of charging equipment should be used and what to do once the building gets near to the maximum number of Electric Vehicles before overloading the common area power supply.

This report also provides information on the location of nearby public charging stations as well as the carbon impact with the deployment of Electric Vehicles. If the Owners Corporation is interested in preparing for Electric Vehicle charging for a large number of residents, a licensed electrical contractor should be engaged for a capacity assessment report and to obtain firm pricing on the infrastructure upgrade. However, this may not be needed for the setup of a small number of Electric Vehicle chargers. The report also includes a review on the electrical infrastructure of the building such as the location and spare capacity of the switchboards.

The key findings in the report are summarised as below:

- Using the Electric Vehicle survey results and research projections, your building has **2 Electric Vehicles** today and the number will grow to **106 by 2027**.
- Based on the estimated energy usage of common area facilities (such as lifts and lighting), the building's main distribution board could **currently support charging for 33 Electric Vehicles at 32 Amps** before risking the disruption of common area power supply. Risk of overloading of common power supply could become a problem **by 2019**.
- Improved energy efficiency of common area facilities (such as LED lighting) can lower the projected energy usage of the building and free up capacity for Electric Vehicle charging without additional spending for switch board upgrades. Your building has already completed a large number of energy efficiency upgrades.
- There are a total of **199 apartments** in your building and infrastructure upgrade of electrical boards to prepare all residents for Electric Vehicle charging is estimated to cost **$323,000**, which is approximately $1,600 per apartment.
- "EV Ready" buildings may attract a premium property valuation on market. There is some case study evidence from San Francisco, such as the Lumina building, which shows there is a strong demand for EV charging facilities in apartments.

1.0 Introduction

Wattblock has been commissioned by the Owners Corporation of Observatory Tower to undertake an electric vehicle study at 168 Kent St, Sydney. Observatory Tower is a premium residential complex with 199 units. The complex is approximately 11 years old with 5 levels of carparking.

A physical site audit was conducted on 19th June 2017 to inspect the energy consuming assets and electrical switchboards at the site. To assist Wattblock in the study, Glen the building manager, provided electricity bill, energy & water management strategies, strata plan map and single line diagrams of the building.

Figure 1: Observatory Tower Foyer

2.0 Background on Electric Vehicles

The Electric Vehicle (EV) revolution has arrived. Within the next 10 years, EVs are expected to reach 25% of new vehicle sales. This will translate to an additional **250,000 vehicles** on Australian roads each year. With more people moving into apartments, many of these EV owners will live in strata. Charging an EV at home is convenient, but for many apartment residents, this is a challenge due to the concern in regards to the **overloading** of common area power supply, how to pay for the use of electricity and expensive installation costs.

2.1 Benefits of Driving Electric Vehicles

Research has found that people choose to drive electric mainly for the reasons below:

1. **Cost Savings**
   - Electricity cost for charging EVs is about $400 p.a., typically 2-3 times lower than gas.
   - Conventional cars use an internal combustion engine which has more than 2,000 moving parts, while EVs use less than 20 which drives significantly lower maintenance costs.
   - Driving electric can save $13,000 over the life of an EV. (Union of Concerned Scientists, 2015)
2. **Environmental Benefits**
   - Better air quality can result in health benefits.
   - Potential to cut greenhouse gas emissions in half or more, depending on how electricity is generated where drivers live.
3. **Techie**
   - EVs have cutting-edge software and the latest features.
   - Completely quiet and fun to drive.
   - Quick acceleration with instant torque .
   - Have the ability to park themselves in the future.

2.2 Popular Electric Cars

Table 1: Popular Electric Cars in Australia and Around the World

	Battery Range	EV Type	Upfront Cost	Seats	Body Type
Tesla Model S	407km	Pure Electric	$120,000	5	Sedan
Tesla Model 3	345km	Pure Electric	$60,000	5	Sedan
BMWi3	300km	Pure Electric	$64,000	5	Hatch Back
Nissan Leaf	175km	Pure Electric	$40,000	5	Hatch Back
Chevrolet Volt	65km	Pure Electric	$60,000	4	Sedan
Mitsubishi Outlander	53km	Hybrid	$50,000	5	Wagon

2.3 Owners Benefit From Preparing for Electric Vehicle Charging

Not all apartment owners are interested in driving an EV in the future. However, everyone can benefit from preparing for EV recharge:

- Increase in property valuation of all apartments in a block which is EV charging ready.
- Increase in rental income and more attractive for green minded residents (see case study in appendix 7.4).

3.0 How to Set Up Electric Vehicle Charging for Strata Buildings?

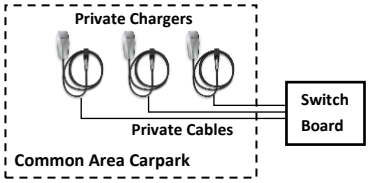
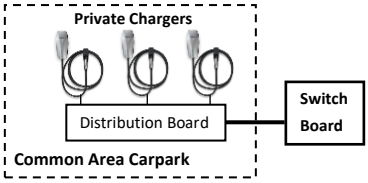
3.1 Location of Charging Equipment

EV charging stations can be installed near visitor carparking spaces for shared use or at resident's individual car parking bays for private use. A different by-law should be set up for the Owners Corporation, depending on the decision on where to locate the charging stations. For some apartments, visitor carparking is not available. In addition, the use of shared charging is less convenient for residents. Wattblock has conducted resident surveys in established residential apartment blocks and there is an overwhelming preference for individual charging facilities.

3.2 Electric Vehicle Charging Solutions And Set Up Arrangements

EV owners can charge their vehicle using common power sockets or set up a private charger ontheir carspace. There are different types of set up arrangements and the benefits and drawbacks of each are summarised below.

Table 2: EV Charging Solutions and Set Up Arrangements

	Common Area Power Socket	Private Charger With Private Cable Connection	Private Charger With Shared Cable Connection
Conceptual Diagram			
What is it?	• Use existing power socket with extension cables or, • Install new power socket and connect to either residential or common area electricity boards based on the lowest set up cost option	• Install EV charger in private carspaces and connect to existing electricity boards via private cables • Use either the residential or common area electricity boards based on the lowest set up cost option	• Owners Corporation set up new common electricity boards and shared cabling throughout all carpark levels, making the building EV ready • Residents can connect the 'last mile' of cabling into their individual car space
How to bill for charging Electric Vehicles?	• Install a new electricity sub-meter behind power sockets. Requires administration (reading & billing) or, • Flat-rate annual fee based on driving distances (see appendix 7.1). • Billing not required if the charger is connected to residential metering	• Install a new electricity sub-meter behind the private cable. Requires administration (reading & billing) or, • Flat-rate annual fee based on driving distances (see appendix 7.1). • Billing not required if the charger is connected to residential metering	• Install EV charger with smart meters and engage a third party billing service ($30/month) to reimburse electricity costs to the Owners Corporation. No additional administration for strata management. • DIY billing off individual meters by building manager
Who pays for set up costs?	• EV Owners • Est. Set Up Cost Per Socket: $0 - $1,000	• EV Owners • Est. Set Up Cost Per Charger: $1000 - $8,000	• EV Owners & Owners Corporation • Est. Set Up Cost Per Charger: $800 - $2,000
Who should use this solution?	• Small apartments and inter-mediate solution for larger buildings • Proven to be successful in Canada	• Small apartments and inter-mediate solution for larger buildings • Provides faster charging speeds in comparison to using power sockets	• Long term solution for large apartment buildings • Owners benefit from increased rental return and property valuation uplift • Increased adoption rate for EV as its easy for residents to set up a charger at home
Drawback	• Additional administration cost for billing to Owners Corporation • Difficult to manage a large number of meter readings • Slow charging speed	• Capacity in existing electricity boards can only accommodate a limited number of EV chargers • Difficult to manage a large number of meter readings	• Capital spending for Owners Corporation

3.3 Risks of Overloading Common Power

Unchecked and unmanaged, the installation of EV charging equipment in the building may be limited and the maximum threshold depends on two factors:

- Capacity of main switchboards and sub-boards in the carparking levels
- The speed used for charging the EV, which is related to the amperage used for charging. Common power sockets have the slowest charging speed of 10 Amps, while private EV chargers range from 16 Amps to 100 Amps. EV owners often prefer the use of 32 Amp charging as it ispractical and convenient.

Based on our on-site assessment for the common area switchboards (see appendix 7.3.2 for detail) and the EV survey results:

- Your building has **2 Electric Vehicles** today and the number will grow to **106 by 2027.**
- Your building could **currently support charging for 33* Electric Vehicles at 32 Amps** before disrupting common area power supply. Overloading of common power supply could become a problem by 2019.

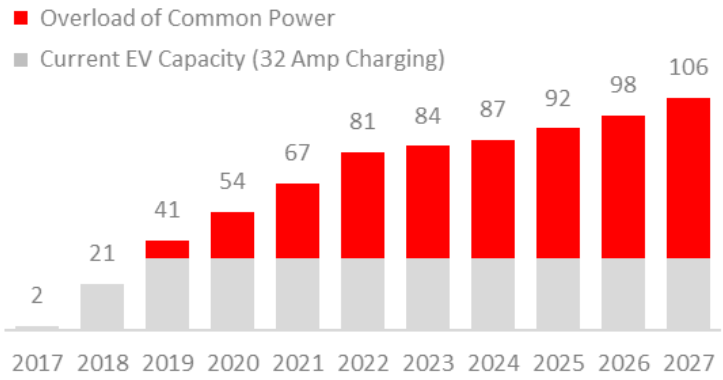


Figure 2: Electric Vehicle projection

*Prior to installation of EV charging for a large number of residents, an onsite capacity analysis conducted by a qualified electrician is recommended. Please contact Wattblock for further information.

3.4 Increasing Capacity for Electric Vehicle Charging

There are several ways to increase the capacity for EV charging in your building. Careful consideration for the options below can help to identify the most cost effective way to implement EV charging solutions for residents.

1) Limit charging speed to 16 Amps or lower.
2) Run energy efficiency projects within the building (e.g. LED lighting) to reduce the baseload in the building and free up more capacity for Electric Vehicles.
3) Install a solar system for charging Electric Vehicles.
4) Install a third party networked Electric Vehicle charging system with power management. This can allow you to simultaneously charge up to 10 times as many EVs as your maximum number, without upgrading your main switchboard.
5) Upgrade your main switchboard, which is a costly exercise.

3.4.1 Restricting Electric Vehicle Charging At 16 Amps Or Lower

With 32 Amp charging it will typically take an EV owner 1.5 hours to charge an average driving distance of 50km per day. The Owners Corporation may consider drafting a by-law to restrict the charging speed to 16 Amps to double the EV charging capacity from 10 to 20 before costly upgrades are needed (see part 2 of the attached sample electric vehicle by-laws for guidance). However, this can extend the time required to charge up for a typical daily driving distance from 1.5 to 3 hours.

Consideration should also be given to providing more standard 10 Amp power outlets in the car park. These can allow slow charging for EV owners if the by-laws permit this. If the existing power outlets are far away from the desired carparking location, new connection points can be set up at a low cost if the plan allows for nearby circuit access. Nevertheless, despite 10 Amp charging accommodating the most EV chargers for the cheapest set up cost, it can take 7 hours to charge up for the typical driving distance. Furthermore, while a simple user pays schedule can be put in place (see Appendix 7.1) this would require some administration by the Owners Corporation.

3.4.2 Improving Energy Efficiency of Other Services

Energy efficiency is describing the state of using less energy to deliver the same work. A reduction in common area energy use can free up capacity for EV charging without additional spending for infrastructure upgrades. Based on the energy and water management strategies provided for Observatory Tower, a large number of cost effective energy efficiency upgrades have already been implemented. However, there is still a small opportunity with replacing the T5 fluoros in the fire stairs with motion sensored LED lighting. Following the site visit, Wattblock has identified the major energy loads in your building to be ventilation systems (HVAC) as shown in the graph below (see your Wattblock Energy Report for detail).

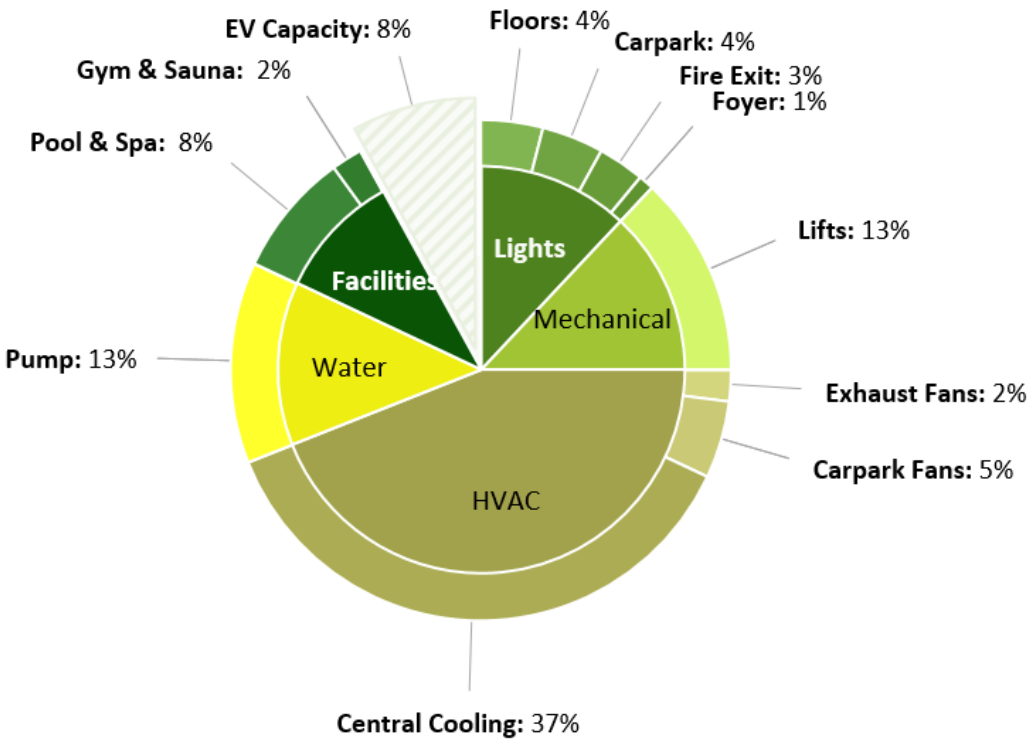


Figure 3: Common area energy wheel

3.4.3 Installation of a Solar System

The Owners Corporation may want to investigate the use of a solar system for charging EVs, which removes the power demand from common area power supply. However, this solution is only recommended for EV owners who often leave their cars at home during the day. EV owners who drive to work will not be able to utilize the solar power unless a battery storage system is integrated, which is still an expensive project today. Nevertheless, there are significant environmental benefits with the use of solar and batteries as discussed later in section 5.0 of the report.

3.4.4 Power Management Solutions

Power management is concerned with avoiding the risks of larger numbers of EVs charging at the same time so that the main switchboard will not be overloaded. As mentioned in earlier sections, the typical daily driving distance in a city environment is about 50km and 32 Amps standard charging takes about 1.5 hours to complete charging your EV. With power management this can be facilitated without restricting chargers to 16 Amps. Such solutions allow EV owners to connect their vehicle whenever they want.

Staggered Charging

One simplistic approach is to separate EV chargers into two or more circuits set up to charge on different time intervals. In-line timers can be used to stagger the charging cycles. For example one group of EVs might charge for 30 minutes at a time overnight with 30 minute breaks, while a second group of chargers kick in. This effectively doubles the maximum number of EV chargers with relatively minimal infrastructure cost. This can be achieved without a costly billing system if the Owners Corporation or Building Management is happy to administer a simple access charge fee as suggested in appendix 7.1.

Power Management Systems

A more advanced solution is to set up a third party managed service with built-in power management functions. A smart power management system is capable of identifying the vehicles which have the highest priority of charging and supply power to those vehicles first. The use of power management charging stations can support up to **10 times** more vehicles charging simultaneously than a traditional solution by intelligently allocating power. The importance of using power management to smooth out the power demand from all residents to use their EV charging facilities is shown in appendix 7.3.2. The upfront cost of a charger with built-in power management functions is typically around $1,800 per charger. An on-going monthly service fee of approximately $30 will also be charged to EV owners to reimburse electricity costs to the Owners Corporation with no additional administration for strata management.

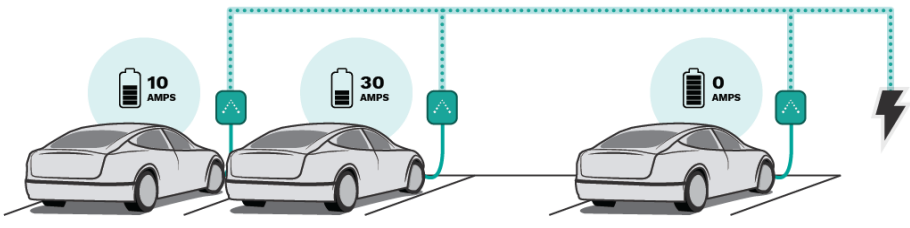


Figure 4: Power management of EV Charging (EverCharge, 2017)

Embedded Power Network

A third party power management solution can effectively reduce the risk of overloading the common area power supply. However, EV owners need to pay an expensive billing service fee of $30 per month. If all residents are using the service in the future, this is equivalent to an additional cost of $71,640 per annum. The setup of an embedded power network has the potential to reduce these billing costs significantly.

What is an Embedded Power Network?

In most strata buildings, individual residents negotiate their own electricity contract directly and receive retail energy rates. In an embedded power network, the Owners Corporation acts as an intermediary in the supply of electricity to all residents and receives discounted wholesale rates. A billing service provider would act on behalf of the Owners Corporation to charge residents for their usage with a typical billing cost of $10 per month. The service provider could potentially integrate residential electricity supply and EV charging into a single bill to lower the overall billing costs for residents.

Other Benefits of an Embedded Power Network

In July 2017, Australia has been ranked as number one for the highest electricity pricing in the world. Consumers living in houses can find a refugee with the use of solar and battery systems. However, consumers living in residential apartments remain a struggle to the rising energy costs. In addition, despite consumers have the choice to shop around for the best retail electricity pricing, an individual has a lack of bargaining power and the products offered by retailers are often confusing and misleading. Eventually consumers feel stuck and give up trying to find the best deal. These challenges can be addressed with the setup of an embedded power network.

Typically an embedded power network can generate savings of 20% - 40% on the total combined energy usage of the building. Depending on the Owners Corporations preferences, savings can be passed on to residents or used to offset common area energy costs. The latter treatment means the Owners Corporation can achieve direct payback on the investment. This also allows for more equitable distribution of the benefits via reduced strata levies in the medium term. The benefits of setting up an embedded power network is summarized below:

- 20% - 40% savings on energy costs by getting wholesale electricity rates
- Lower strata levies and ability to offer tenants lower energy rates
- Increased property yields and valuations
- Enables future opportunities like community solar, batteries, and billing for electric vehicle recharge

3.4.5 Electricity Switchboard Upgrade

3.4.5.1 Extension of Electricity Sub-boards

There are mainly two types of upgrades to electrical switchboards to accommodate increasing EV charging demand. The first type of upgrade is where the existing main switchboard has sufficient capacity and new sub-boards are extended from the main board to each carparking level. This is the most cost effective solution for an Owners Corporation to set up EV charging facilities after 3 to 4 years, as the uptake of EVs starts to ramp up. However, sub-boards could be funded by the Owners Corporation today, enabling the building to be marketed as EV ready to achieve an immediate uplift in property valuation. Wattblock estimates the infrastructure upgrade to prepare everyone for EV charging to be **$323,000**, which is approximately $1,600 per apartment.

3.4.5.2 Main Switchboard Upgrade

The second type is where the main switchboard has insufficient capacity and requires an upgrade such as installing a new link from the grid. This is the most expensive solution in comparison with the other approaches. The implementation of energy efficiency projects as well as the use of power management solutions are often sufficient to avoid this worst case scenario. Wattblock has summarized the top recommended projects for your block in the section below with estimated costs and paybacks. A detail quote on each project is available upon request.

3.4.6 Top Recommended Projects

Table 3: Top recommended projects

	Projects	Description	Est. Savings	Est. Cost	Est. Payback
1	Common Area Lighting	Replace fluoro fittings in the fire stairs with motion sensored LED lighting.	$5,976	$22,117	3.7 Years
2	Embedded Power Network	Owners Corporation bulk buys energy for all residents and obtains cheaper energy rates.	$106,847	$125,520	1.2 Years
3	Residential Air Conditioning	Improve cooling performance of AC units with the injectiion of thermal additives.	$18,470	$98,505	5.3 Years
4	Lift Upgrade	Investigate the use of regenerative drives for lifts.	$11,349	$90,792	8 Years
	TOTAL		**$142,642**	**$336,934**	**2.4 Years**

One of the simplest upgrades for increasing EV charging capacity in your building is to retrofit LED lighting in the fire stairs. Additional benefits for the implementation of all recommended projects are estimated to save **your building $336,934 p.a.** in energy costs with a combined **payback of 2.4 years**.

From the Owners Corporations perspective, a building with lower operating costs, and “EV ready” charging capacity, can be marketed as a premium development. There is evidence to support significant **improvements to property valuation** and rental income in years to come, especially as NABERS is introduced into strata.
See: www.wattblock.com/valuations-surge-for-green-strata

Pay by Savings

Due to the attractive economics, such projects can be financed through a ‘Pay by Savings’ model where the Owners Corporation pays $0 upfront for the upgrades. Financing for all recommended projects in **Table 3** over a 5 years term generate a **net gain of $4,610 per month** from day one. The Owners Corporation may want to explore further project financing options for one or more of the identified projects.

Figure 5: Pay By Savings Analysis

3.5 Summary On How to Set Up EV Charging Equipment

EV owners who live in apartment buildings need to work with building management or Owners Corporation to get approval and to find the best solution for installation of the charging equipment.

- Evaluate installation options
  - Location of the charger (visitor parking vs private car parking)
  - Type of charging system (power sockets vs EV charger vs EV charger with power management)
  - Maximum charging speed of the EV charger (16 Amps vs 40 Amps or other)
  - Method to set up cabling (user pays vs strata pays for all residents)
- Evaluate payment options
  - Common power (strata pays)
  - Common power with a “flat rate annual fee” (owners pay, minimum administration)
  - Private sub-meter off common power (owners pay, requires administration for billing)
  - Residential meter (owners pay)
  - Third party billing system (owners pay, minimum administration)
- Engage a licensed electrical contractor
  - Obtain quotes for the electrical job
  - Validate the agreed solution of the Owners Corporation through a capacity assessment report. This is only recommended for setting up a large number of EV chargers. The capacity assessment report will depend on the size of the building and cost from $1,000 to $12,000.
- Include Electric Vehicle charging in the following strata documents
  - 10 Year Capital Works Plan
  - Strata By-laws

4.0 Public EV Charging Stations

Private chargers are convenient for residents. However, public charging stations are also important for the increase of EV uptake in the future. Public charging stations have the following benefits for residents:

- Top up your vehicle, but not necessarily fully charging it
- Emergency back up and relieving range anxiety of EV drivers

The public charging stations available near Sydney are summarized in the map below. Additional information on the charging stations such as how many are available, detailed location inside the building and whether its free charging or user pays can be found on: www.plugshare.com.

Most of the public charging stations within the City of Sydney are located inside private carparks with payable parking fees. To avoid the expensive parking fees, Wattblock has identified the most cost effective charging location to be Bondi Junction Westfield carpark, with free parking for 3 hours. There are also two solar powered charging stations operated by City of Sydney as shown below.

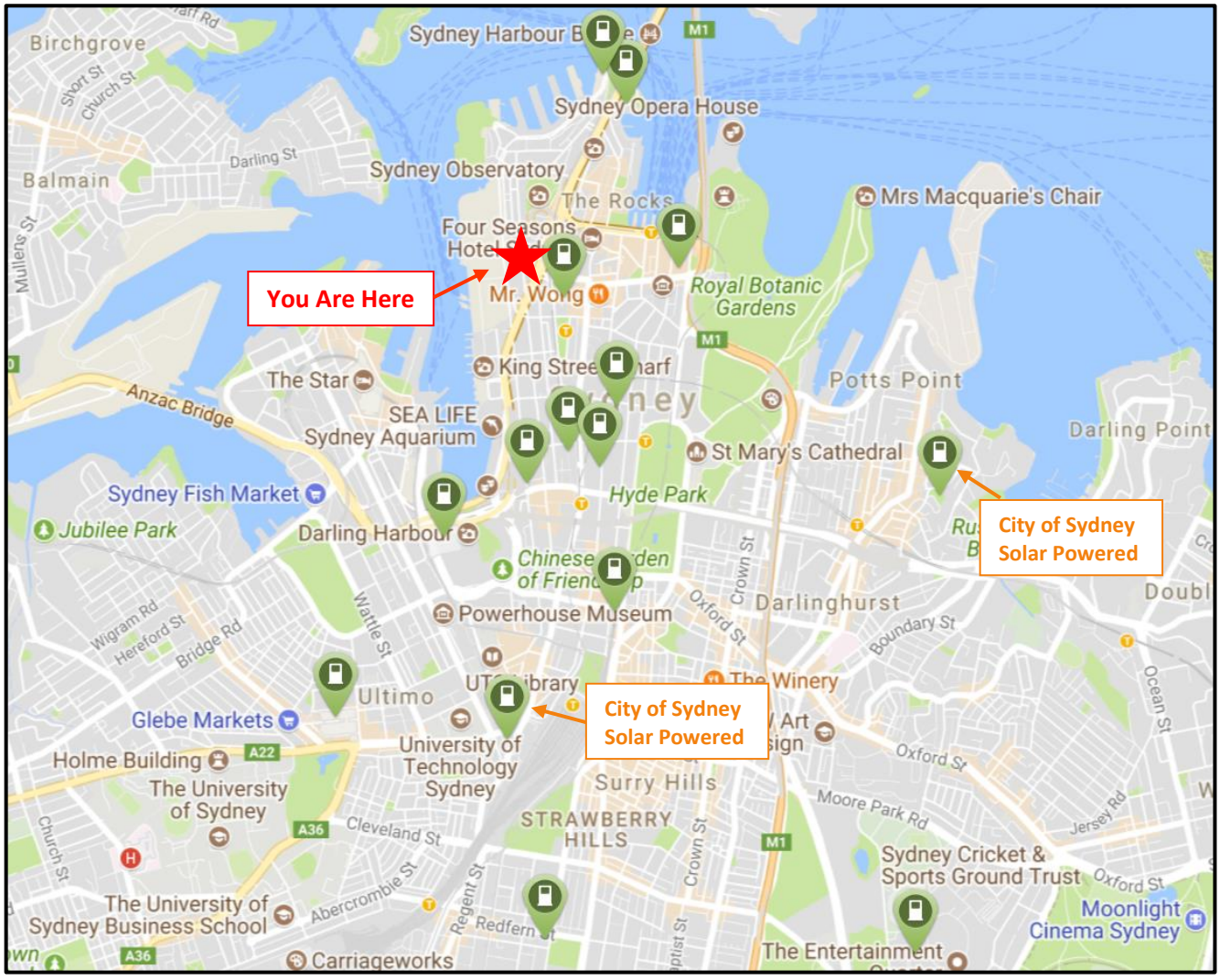


Figure 6: Public Charging Stations near Sydney (PlugShare, 2017)

5.0 Impact of Carbon Emissions with the deployment of EVs

5.1 Carbon Emissions with the deployment of EVs in Australia

The carbon footprint of electric driving is dependent on the emissions from vehicle manufacturing, power station combustion, upstream fuel production and grid losses. Shrink That Footprint, an independent research group devoted to helping people concerned about climate change understand, calculate and reduce their carbon footprints, released a study in 2013 around carbon emissions of electric cars around the globe.

The study surprisingly shows that driving Electric Vehicles in Australia is more carbon intensive in comparison with a gasoline vehicle (Shrink That Footptint, 2013). This is because the energy generation sector in Australia is heavily dominated by coal. Despite air quality in local suburbs being improved through driving EV, more pollution will be emitted in rural areas where coal plants are based. In contrast, the study shows that European countries such as Iceland and Norway with high penetration of renewable power, the carbon intensity of driving EV is about 3 times lower in comparison with a gasoline vehicle.

5.2 Australia's 2020 Emission Reduction Target

The Australian Government has a 5% target to reduce emissions by 2020. However, the deployment of EVs can have a negative impact on carbon emissions in the transport sector.

In order to align with the government's emission reduction target, the strata scheme may want to investigate solar and batteries. This means the Electric Vehicles can be charged from a renewable energy supply bringing down the carbon emissions of the building, potentially achieving fossil fuel neutrality.

However, some apartment buildings do not have sufficient roof space for the installation of a solar system and using a battery for charging of EVs might be an expensive option. The building may want to investigate switching to "greenpower" on the common area meter to achieve carbon neutral. Greenpower is electricity sourced from the grid which is certified to come from renewable sources such as hydropower, wind or solar. Greenpower can be used to offset the increasing carbon emissions of the building, which otherwise would result as the number of Electric Vehicle owners who are charging increases.

In addition, the more Electric Vehicles that are in a basement car park, the less carbon monoxide emissions will be emitted. Over a period of time as the number of Electric Vehicles increases, this will reduce the carbon monoxide levels in the basement car park. If your strata plan has carbon monoxide extraction fans triggered by carbon monoxide sensors, this will reduce the operating costs of the carbon monoxide extraction fan.

6.0 Conclusions

According to the research, EV adoption is set to increase rapidly in the coming years and this will place strain on the buildings existing electrical services. Unchecked, most EV recharging will tend to occur in the 'after work' hours when energy usage in the building is already at its peak. It is sometimes the case that people with EVs will utilize existing common area power sockets without a user pays agreement. In this case the power would be paid for by the Owners Corporation, which is not an ideal long term solution.

Managed EV charging is the best long term solution for apartment buildings as discussed in section 3.4.4 Power Management Solutions. This can dramatically increase the number of vehicles that can charge and usually provides for a means of user pays based implementation. However, the market for service providers is still in the early stages and is expected to become more competitive over time. Early adopters can pay a premium to be the first, but may also benefit from valuation impacts. Case studies such as the Lumina building in California have demonstrated that early adoption of electric vehicle chargers subsequently attracted more EV owners to buy at a premium. There are also examples of buildings in Canada where the building manager administers resident billing based on readings from EV charging sub-meters.

Whether or not Observatory Tower wants to be an early adopter is a matter for the Owners Corporation to discuss. However, our analysis highlights further mitigating actions that can take the pressure off making an immediate decision. In particular, putting a by-law in force can limit the impact of individual charger installations. It is even possible to set up a simple interim user pays solution with or without individual sub-metering of EV chargers.

It has also been identified that the energy efficiency of other services in the building can be improved. These can be implemented to reduce overall power demands of the building. This would allow for more EV chargers to be installed before risking other critical services, effectively prolonging a more expensive investment in managed EV charging.

According to our analysis and secondary research on EV adoption rates, Observatory Tower would probably not experience any power disruption until 2019. With power management, by-law restriction and energy efficiency initiatives this can be extended beyond 2027.

7.0 Appendix

7.1 Flat Rate Fee

Example of a flat rate fee that could be applied to users of electric vehicle recharging facilities.

Table 4: Recommended annual flat rate fee

Weekly Driving Distances	Up to 50km	Up to 100km	Up to 200km	Up to 400km	> 400km
Annual Fee	$98	$177	$333	$646	$959

Recommended fix charges are calculated based on average driving distances of a standard Electric Vehicle and the electricity rates of the common area. A small administration fee for strata management is also included.

Owners charging with control equipment during off-peak hours can receive a 50% discount to the standard annual fee. Hybrid Electric Vehicle owners may also be able to negotiate for a discount.

7.2 Capital Works Plan

In a medium-large size strata it is likely that you already have one or more Plug-in Hybrid Electric Vehicles in the building. Electric Vehicles are predicted to reach 25% of new Electric Vehicle sales within the next 10 years. This means your 10 year Capital Works Plan (formerly Sinking Fund plan) should be updated now to cater for Electric Vehicle charging upgrades to common areas.

The key items to be added to the Capital Works plan are:

- Upgrade of common area meter to a smart meter (if required)
- Higher amp cabling of all basement carpark areas
- Upgrade of capacity for existing electrical switchboards or to connect a new grid link into the building

7.3 Electrical Infrastructure of the Building

7.3.1 Electrical Layout Options

Wattblock has examined the electrical switchboards to assist in our capacity analysis. There is one main switchroom located in the basement carpark.

Generally speaking residential apartment building energy supply is split between resident energy meters and common area services. Common area services are usually further split between Essential and Non-essential services, both of which sit behind a single (sometimes multiple) common area energy meters. Services are connected off busbars with circuit breakers that limit the Amperage load within Australian Standards.

In planning for electric vehicle charging facilities it is possible to set-up dedicated distribution boards running off either the apartment busbar or the common area essential or non-essential services busbars. We recommend connection to the non-essential services busbar. Firstly, this limits any potential disruption to essential services in the building such as the lifts. However, secondarily the common area supply is recommended because there is no

need to set up a new power supply contract and capacity can be directly impacted by improving energy efficiency of other common area services.

Figure 7: Main Switchroom

If the Owners Corporation wants to investigate setting up electric vehicle charging distribution off the apartment busbar, keep in mind that a new meter would need to be installed, similar to adding a new apartment meter. Furthermore a new energy supply contract would need to be established and paid for by the Owners Corporation for that meter. The electricity rate for supply to the new meter will be higher than the existing common area meter due to the bulk rate discounts available. On the plus side, this may make overall energy cost more transparent for electric vehicles and assist in cost recovery. However, keep in mind that the apartment busbar and circuit breakers have been sized for apartment energy usage. The growing demands from electric vehicle charging may risk disruption of energy supply to apartments over time.

For the purpose of cost recovery there are multiple solutions available. Generally speaking the solutions, costs and administrative effort will be the same regardless of whether the EV chargers run from the apartment busbar or common area busbars.

In the case of some smaller buildings it may be practical to connect an EV charger directly to the apartments existing individual energy supply. In this case the problem of installing a distribution board and administering a user pays system is eliminated. However, it is recommended that the building continue to monitor energy demands on the overall apartment busbar and potentially upgrade capacity over time to avoid disruption to apartment power supply.

7.3.2 Switchboard Analysis

The main electricity supply of the building is three phase 3,200 Amp, which is split between separately metered apartments and common area services. The distribution boards for common area services are then split between essential and non-essential services. There are a number of spare circuits which could be used to set up electric vehicle charging services on the non-essential circuits as shown in the single line diagram below.

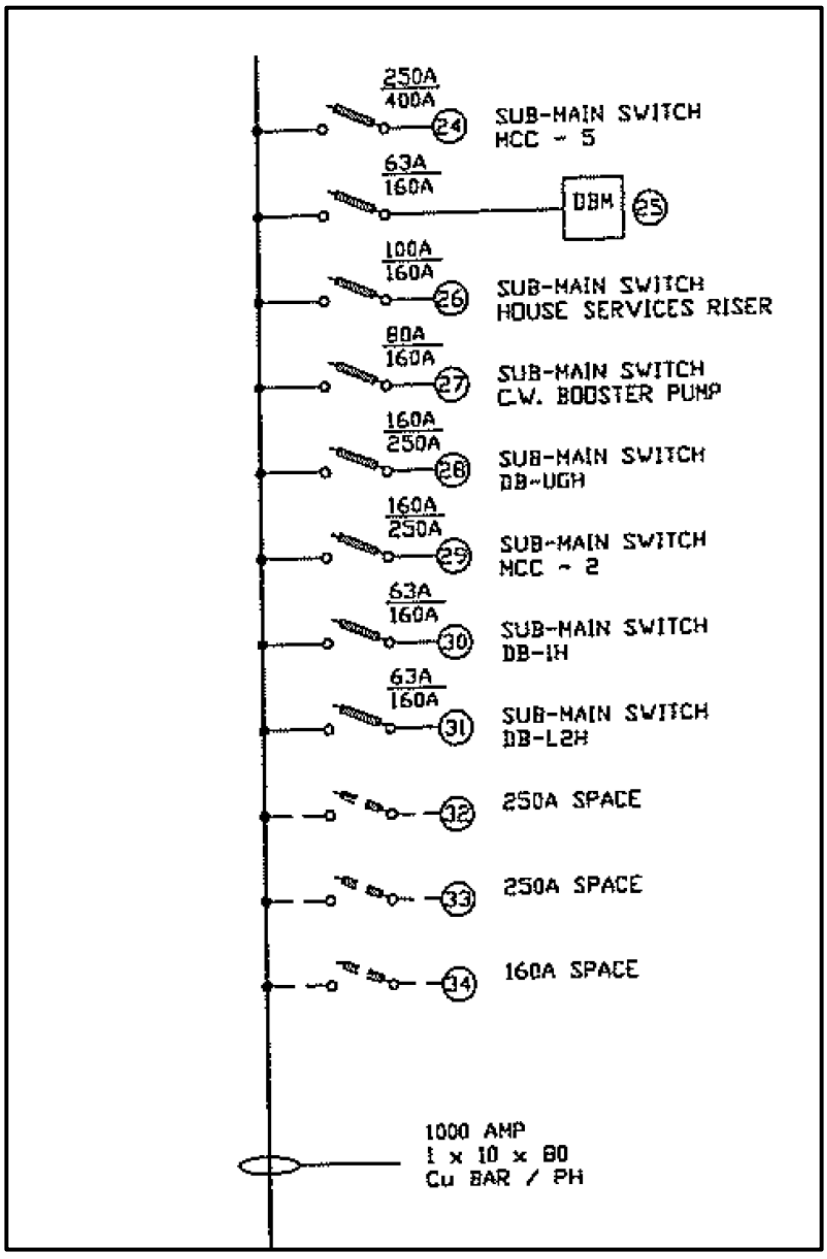


Figure 8: Circuit Schedule of the Non-Essential Services for Common Area

A capacity assessment would be advised for the extension of a new electrical sub-board (e.g. 400 Amps) as it draws a large amount of power and could potentially overload the distribution board. However, the assessment might not be necessary for the connection of a small number of 16 Amp or 32 Amp circuits.

In addition, your building has already completed a large number of energy efficiency upgrades, which will relieve the power demand on the distribution board and free up additional capacity for EV charging.

For the installation of individual chargers, a major factor that can impact the cost is the distance between the resident's carspace and the closest electrical board with sufficient capacity to accommodate the EV charging equipment. This should be considered in determining the best location for electric vehicle charging circuits.
In the absence of any EV charging consideration or governance, we examine the risks of unchecked behaviour of EV owners. From a risk perspective, we must consider probabilities with respect to types of charging installed and usage frequency and timing. Most EV owners are going to prefer higher 32-40 Amp charging installations, so we must consider this a likely choice. It has further been proven that EV owners have successfully negotiated with building management and Owners Corporations to install their high amp chargers on available spare poles on existing distribution boards. The physical set-up of the distribution board itself provides a limit both in terms of the number of free poles as well as the rated amperage of the given distribution board.

Our analysis considers the probability of all vehicles being plugged in and charging at the same time. Given behavioural consideration that EV owners are more likely to plug in during 'after work' hours, it is almost certain that all EV chargers will operate concurrently at some point over the course of a year. Based on this analysis it is estimated that 34 high amperage electric vehicle chargers represent a risk to other building services.

As covered in the body of the report, this limit can be mitigated dramatically via suggested low cost measures, including simply putting in place a by-law to limit individual charger amperage. The analysis that follows further examines capacity demand impacts where basic measures have already been put in place.

7.3.3 Future Proofing Switch Board for EV Charging

Assuming a "future proofing" scenario with 100% uptake of EV charging, Wattblock has modelled the potential impact on electrical demand. The following graphs illustrate the impact with and without the use of a power management solution. The analysis shows that without power management the average load on the switch board could reach 739kW, where the main switchboard can handle a maximum of 1,262kW. This suggests the existing capacity of the main switchboard is sufficient to cater for the scenario with 100% uptake of EV charging.

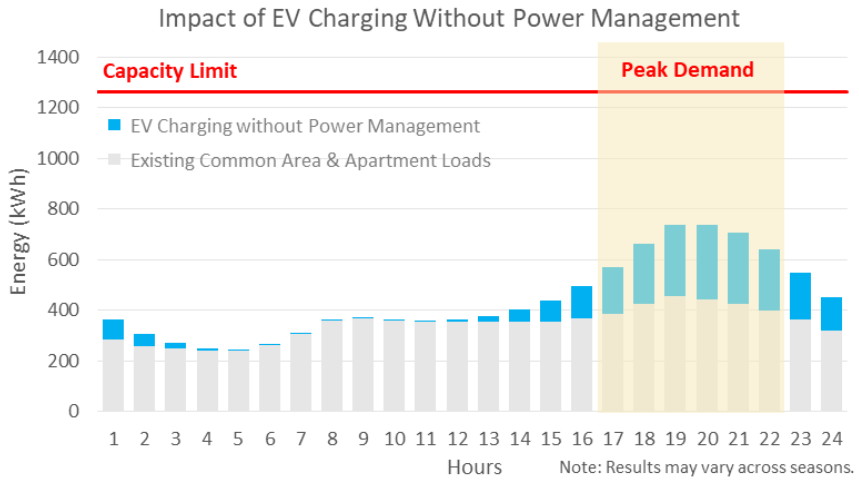


Figure 9: The impact of EV charging to the power supply of your building without power management

Nevertheless, the use of power management is expected to lower the peak load to 600kW, which can reduce the set up costs of EV charging facilities for residents as electrical sub-boards with a lower capacity would be sufficient.

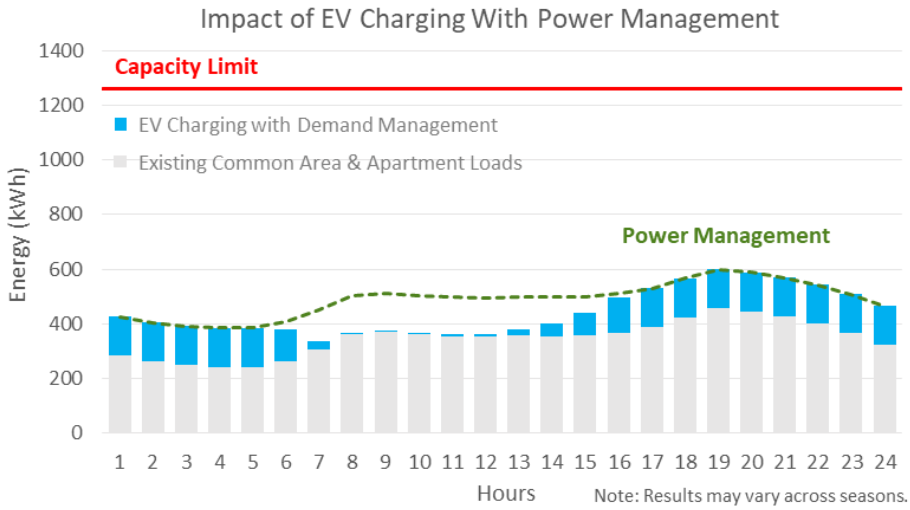


Figure 10: The impact of EV charging to the power supply of your building with power management

The demand analysis covers both residential and common area power demands. Assumptions have been made with respect to typical energy demands of apartments. To improve the accuracy of the analysis a capacity assessment on the building's main power supply is needed. For electric vehicle charging without power management, the modelling includes assumptions around average driving frequency and distances, 16 Amp charging, and a normal distribution around typical "end of day" plug in time. It is important to highlight that the electric vehicle load profile is an average load. There may be scenarios as discussed in section 7.3.2 where all EV chargers will operate concurrently at some point over the course of a year, resulting in a higher than average peak demand for the building

7.4 Lumina Case Study, San Francisco

LUMINA
201 Folsom Street,
San Francisco, CA 94105
Website: luminasf.com
Reference: Evercharge

Scenario

As the newest landmark condominiums in San Francisco, this property desired to be the forefront of EV adoption. While still completing construction of the 600 luxury units, the developer decided to install 25 EV stations for resident use within the garage. In **just 4 months** and 25% occupancy thirteen EV owners have moved in and are leveraging charge stations today. At this rate **over 40 EV owners** are expected to move into this building by the end of 2016.

Solution

With EverCharge the building will not be capped at 25 chargers like it would with traditional EVSE. Leveraging SmartPower **over 125 charge stations can be installed** in the garage scaling to serve the growing needs of San Francisco residents without any additional electrical capacity. With this scalability the building becomes a true enabler of EV adoption for years to come. The building expects significant increases in EV demand with the release of the Tesla Model 3 and other mid range EV options.

8.0 References

Union of Concerned Scientists, 2015. Electric cars produce lower global warming emissions than the average compact gasoline-powered vehicle.
http://www.ucsusa.org/clean-vehicles/electric-vehicles/emissions-and-charging-costs-electric-cars#.WRphoYiGNdg

AEMO, 2016. AEMO INSIGHTS Electric Vehicles.
https://www.aemo.com.au/-/media/Files/Electricity/NEM/Planning_and_Forecasting/NEFR/2016/AEMO-insights_EV_24-Aug.pdf

EverCharge, 2017. Dedicated Home Charging.
http://evercharge.net/smartpower

Shrink That Footptint, 2013. The 'electric cars aren't green' myth debunked.
http://shrinkthatfootprint.com/electric-cars-green#iuQ9LpOtgPJfttIh.99

Tesla, 2017. Wall Connector.
https://www.tesla.com/sites/default/files/pdfs/wall-connector-eu/wall_connector_installation_manual_80A_en_US.pdf?201612081439

ING, 2017. Breakthrough of electric vehicle threatens European car industry.
https://www.ing.nl/media/ING_EBZ_breakthrough-of-electric-vehicle-threatens-European-car-industry_tcm162-128687.pdf

IEA, 2017. Global EV Outlook 2017.
https://www.iea.org/publications/freepublications/publication/GlobalEVOutlook2017.pdf

IRENA, 2017. Electric Vehicles Technology Brief.
http://www.irena.org/DocumentDownloads/Publications/IRENA_Electric_Vehicles_2017.pdf

Dave Southgate, 2017. Using Solar Power to Charge an EV.
https://sway.com/CpaWPJYHRNUDMRAG

Kulima Panapa (Wattblock), 2017. Impacts of EV Charging on Strata Building Distribution Infrastructure
http://www.wattblock.com/uploads/4/4/9/8/44984189/ses_finalreport_-_panapa_kulima.pdf

Thomas Crossman (Wattblock), 2016. Developing Tools for Modelling Electric Vehicle Charging in High-Rise Buildings
http://www.wattblock.com/uploads/4/4/9/8/44984189/iap_thesis_crossman_thomas_final.pdf

Who is Wattblock?

Wattblock was started by Brent Clark, chair of a strata building which reduced common area energy costs by 77%. He is joined by Ross McIntyre specializing in data analytics, Scott Witheridge environmental engineer and Jacky Zhong, data analyst plus a team of solar and low energy buildings specialists. Visit wattblock.com

What is Wattblock's mission?

The energy wasted in Australia's strata buildings has a bigger impact on carbon emissions than the cars driving on the roads. Wattblock aims to **crowdsource** the achievement of Australia's national carbon emission reduction target.

How many strata buildings has Wattblock assisted?

Wattblock has assisted approximately 1,000 strata buildings across Australia to mobilize on energy saving initiatives. Wattblock has also directly project managed the upgrade of 36 buildings in Sydney and Brisbane with LED Lighting, solar, hot water and ventilation. To date it has identified over $25m of annual energy waste across townhouses to high-rise residential skyscrapers.

Who is partnering with Wattblock?

City of Sydney, NSW Innovate, Advance Queensland, Microsoft CityNext, Telstra's muru-D, UNSW, Griffith Uni, Queensland University of Technology, University of Queensland & the Michael Crouch Innovation Centre.

Who is covering Wattblock in the media?

SBS, North Shore Times, Foxtel, BRW, The Australian, Business Insider, Computerworld, Startup Smart, Startup Daily, Lookup Strata, SmartStrata, SSKB, Technode, Fifth Estate, One Step Off the Grid and Renew Economy.

Wattblock Awards

Best Social Change Entrepreneur 2015 (Start-up Smart), Energy Winner at 1776 Challenge Cup Sydney, CeBIT Community Support Finalist, Innovation of the Year 2016 (Strata Community Australia – NSW)

Are Wattblock's electrician's licensed?

All electricians engaged by Wattblock have been licensed in the states in which they operate.

Is Wattblock insured?

Wattblock has professional indemnity insurance as a renewable and energy efficiency consultant ($1m), public liability insurance ($20m) and complies with workers compensation requirements in all states in which it operates.

Who is backing Wattblock?

Wattblock has received investment from muru-D as part of Telstra's startup accelerator program, Eastern Hill Investments, an Asian-based environmental engineer, a UK-based energy company consultant, a U.S.-based hi-tech investor, a NZ sustainability funds manager, a Sydney-based environmental impact investor, a Sydney-based clean tech consultant and a Sydney-based clean technology finance consultant.

Where is Wattblock located?

Wattblock is based at Michael Crouch Innovation Centre at UNSW in Sydney and at River City Labs in Brisbane.