Residential Energy Supply Handbook (Updated June 2023)

SUSTAINABLE SETTLEMENTS PTY LTD

T: (08) 9757 6688
E: info@ecovillage.net.au
W: ecovillage.net.au

WITCHCLIFFE ECOVILLAGE

Acknowledgement of Country

The Witchcliffe Ecovillage is located on the traditional lands of the Wadandi people.

We acknowledge the Wadandi people as the Traditional Custodians of the land, we respect their continuing connection to land, spirit and community, and we honour their unique cultural and spiritual relationship to the land.

We pay our respects to Wadandi ancestors and Elders past, present and emerging.

Table of Contents

Introduction

The Ecovillage

The Witchcliffe Ecovillage is a unique sustainable housing development in Western Australia which aims to be 100% self-sufficient in renewable energy, water and organic fresh food produce in a community setting. We are leading the way to cheaper, reliable and abundant renewable energy at a village scale, which is good for our residents and great for the environment. Our energy microgrids will not just be the flagship for energy management in the South-West, but will be the guiding star for all other similar projects, not just across Australia but around the world.

This guideline provides advice and sets out requirements to ensure that all new dwellings in the Ecovillage are reliably provided with 100% supply of renewable energy generated by rooftop solar panels.

Please note: All information is correct at time of publication in June 2023 but may be subject to change.

Renewable Energy at the Witchcliffe Ecovillage

Overview

Renewable energy generated by solar panels is by far the most sustainable source of energy for all appliances within Ecovillage homes. The following alternative energy sources were investigated but not found suitable:

WIND POWER: The infrastructure required for a village scale wind power energy plant is not a viable or practical option for energy generation in the ecovillage due to per kW costs and mandatory turbine setbacks to homes.
GAS: While many people will be accustomed to using gas for cooking and heating, fossil fuel extraction and consumption contribute to both atmospheric carbon emissions and unhealthy particulate pollution within the home. As the only household gas available in the Margaret River area is bottled LPG, it is also an expensive and inconvenient form of energy for everyday heating and cooking.
BIOMASS (i.e., wood): Using a conventional wood fuelled heater is a very inefficient way to heat your home, cook food, or heat hot water, and produces greenhouse gases and hazardous particulate pollution.

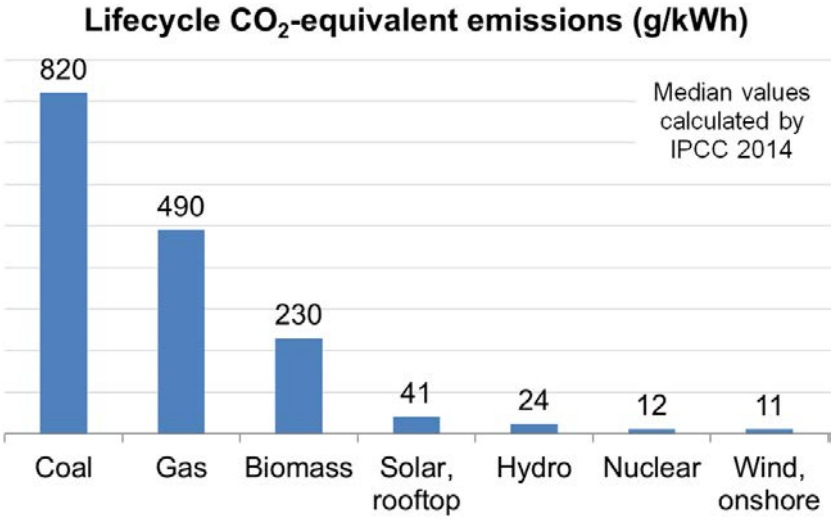


Figure 1. IPCC comparison of energy sources by carbon footprint (https://www.solar.com/learn/what-is-the-carbon-footprint-of-solar-panels/)

Ecovillage houses are therefore designed to be self-sufficient in renewable energy through energy generated during the day by roof top solar PVs on every roof and stored for night-time use in either centralised storage batteries or individual household batteries, depending on the location of the cluster (see Table 1).

The residential clusters in stages 1 to 3 of the Ecovillage include a 232 kWh Tesla Powerpack community battery storage in their strata common property to enable communal storage of clean, renewable rooftop solar energy (see page 12). When Tesla discontinued the production of their Powerpack in 2022 and replaced this with their Megapack product (which is far too large for the energy production and storage requirements of the individual clusters) our electrical engineer recommended that cluster 3C and stage 4 and 5 clusters use individual household batteries to meet their energy storage needs. This solution provides just as much storage, but leads to individual battery ownership, see p 22.

Cluster	Battery type
1A, 1B, 1C 2A, 2B 3A, 3B	Shared strata battery 232 kWh (Tesla Powerpack)
3C, 4A, 4B, 4C, 4D 5A, 5B, 5C, 5D	Individual household batteries

Table 1. Ecovillage battery type by cluster

Throughout this document, residential stages 1-3, and stages 3C, 4 and 5 will be referred to separately in regard to their battery provision.

A Western Power connection is provided to each cluster to enable export of excess renewable power back to the grid, and provide supply of renewable energy during the construction phase. The total renewable energy produced within the Ecovillage over a whole year has been designed (using 30-year worst case cloud cover weather data) to be significantly greater than the total energy that residents consume. This excess energy is a result of smart solar passive house design and energy efficient appliances (ensured by the requirements of the Witchcliffe Ecovillage Sustainable Building Design Guidelines: https://www.ecovillage.net.au/library/document-library/) coupled with extensive rooftop solar. The total generation of power by the Ecovillage when all homes are built will be around 3MW, and this should produce on average around 15MWh/day or 5,450MWh/year – the equivalent of a small solar farm!

Each strata cluster scheme within the Ecovillage will own a private microgrid, located in strata common property, and have a large single low voltage (LV) connection to the Western Power high voltage (HV) grid. The microgrid will connect all homes within the strata cluster to each other, the central battery (if applicable—see Table 1), the cluster's Electric Vehicle (EV) charger, and the Western Power grid, to enable each household to export their excess renewable energy for sale to other households, the EV charger, or the grid. The 300A connection will allow for a very large amount of solar power generation and export within each cluster. The grid connection will also provide power for lots during the construction of homes, and the Developer has negotiated supply of renewable power (offset through Large-scale Generation Certificates) from a private energy retailer, currently Amanda Energy (see p.11).

The average household in a standard green title subdivision in WA to provide a connection to the Western Power grid. As each Ecovillage strata cluster has a single point connection to the Western Power grid and is large enough to be considered "contestable," we have been able to negotiate with a range of energy retailers and service providers other than Synergy.

While residents will be able to charge their future electric vehicles at home, each cluster microgrid network will also include a 75kW EV electrical vehicle charging station on common land to potentially provide significant income to the strata companies from the sale of excess renewable energy to tourists staying in/visiting the ecovillage as EV ownership expands in years to come.

A Model for the Future

One of the very important goals of the Witchcliffe Ecovillage is to provide a model of best practice sustainable development for the future, and wherever practical we aim to contribute what we have learnt and what we are achieving to researchers, local and state governments, and industry bodies. For Ecovillage residents this means that generalised information about Ecovillage energy consumption and production may be gathered for the purpose of research and education.

Race for 2030 is an industry-led, federally-funded cooperative research centre aimed at decarbonising Australia by 2030. We are proud to have been invited to participate in two RACE for 2030 projects: the Australian Strategic EV Integration Project (SEVI), and Pathways to Net Zero Precincts. The Witchcliffe Ecovillage is an industry partner in these projects and our state-of-the-art renewable energy system is headlining the case studies in Australia.

For more information on Race for 2030 projects, please see:
https://racefor2030.com.au/wp-content/uploads/2022/11/Priority-Projects-1-pager-Everyone-Pathways-to-Net-Zero-Precincts.pdf
https://racefor2030.com.au/wp-content/uploads/2022/11/Strategic-EV-Integration-Project-Final-1.11.22.pdf

Figure 2. Launch of SEVI at Witchcliffe Ecovillage, March 2023

Strata Power

Microgrid

Each strata cluster has its own private microgrid, which is located underground and runs inside the strata Common Property, at the strata lot rear garden interfaces, not inside the road verge. It is designed and installed to Australian Electrical Standards and satisfies Western Power Technical and safety requirements for embedded generation. The location of the microgrid cabling is identified in each cluster's infrastructure plan, which is held by the strata companies to ensure that Common Property activities do not compromise electrical or irrigation infrastructure.

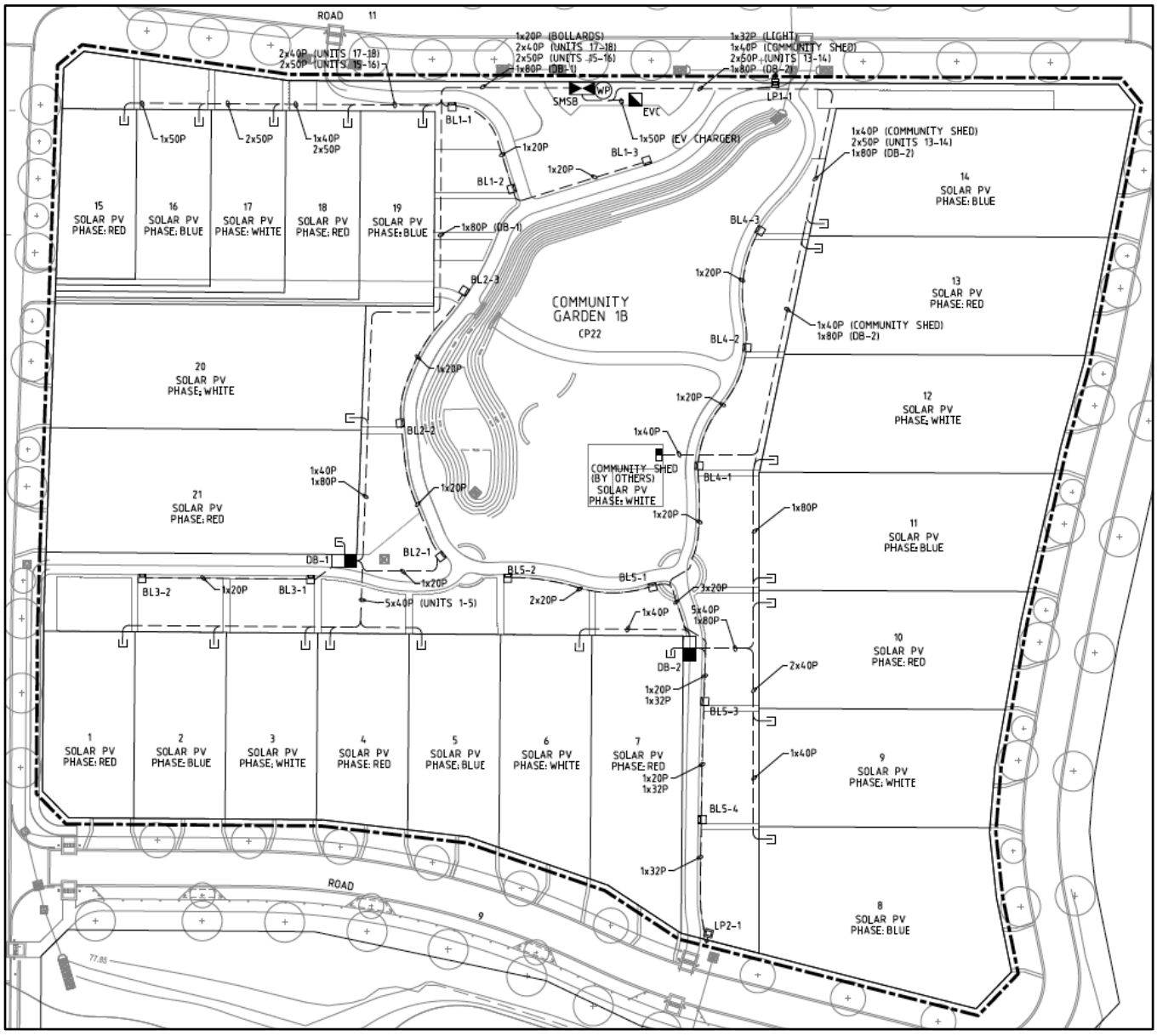


Figure 3. Example microgrid location, 3E Consulting Engineers Pty Ltd

Western Power

The microgrid for each cluster is connected to the Western Power low voltage cabling at a single point located at the interface of the strata's Common Property and the public road reserve. A typical green Western Power pillar or switchboard cabinet sits above ground at this point and provides access for Western Power service and maintenance. This connects each cluster to the Western Power managed South West Interconnected System (SWIS) https://www.wa.gov.au/organisation/energy-policy-wa/electricity-industry , the energy infrastructure grid which services the south west of WA.

The average household in a standard green title subdivision in WA pays approximately $1.05 per day in service charges to Synergy to provide a connection to the Western Power grid. As each Ecovillage strata cluster has a single point connection to the Western Power grid and is large enough to be considered "contestable," we have been able to negotiate with energy retailers and service providers other than Synergy. Ecovillage residents currently pay between 19c to 26c per lot per day (depending on cluster size) in supply charge fees to private energy retailer, Amanda Energy, see Retail Energy Supply, p.11.

Ecovillage residents are required to install NMI meters and SwitchDin Droplets which will provide for real time peer to peer energy trading within each cluster, sale of excess energy to the grid and EV users, equitable night-time shared battery allocation (where applicable, see Table 1), potential for Western Power Distributed Energy Resources opportunities, and supply of 100% renewable energy from the grid when needed (e.g., during construction of houses).

Connection to the SWIS grid does come with the requirement to meet the statutory regulations of Western Power.

Energy Production and Sales

The Ecovillage's energy production system is unique, and is based on the best available technology, Western Australian energy policies and the Ecovillage strata ownership structure (see Figure.4, Ecovillage microgrid flowchart).

Each separate strata company within the Ecovillage owns and is responsible for managing its internal microgrid. The strata microgrid allows residents within each cluster to generate 100% of their household power, store energy for night-time power in batteries, trade power between households within the same cluster, sell excess power to an energy retailer, and sell energy to visitors' and tourists' electric vehicles via an EV charger located in each cluster's carpark area.

The strata companies' responsibilities include:

- receiving data from household's NMI smart meters;
- receiving invoices and payments from the energy retailer; and
- invoicing/refunding each lot according to how much energy their household has generated and consumed (this can be outsourced to an external service provider or managed through bespoke energy trading software)
- Managing and maintaining the microgrid, switchboards and shared battery (if applicable).

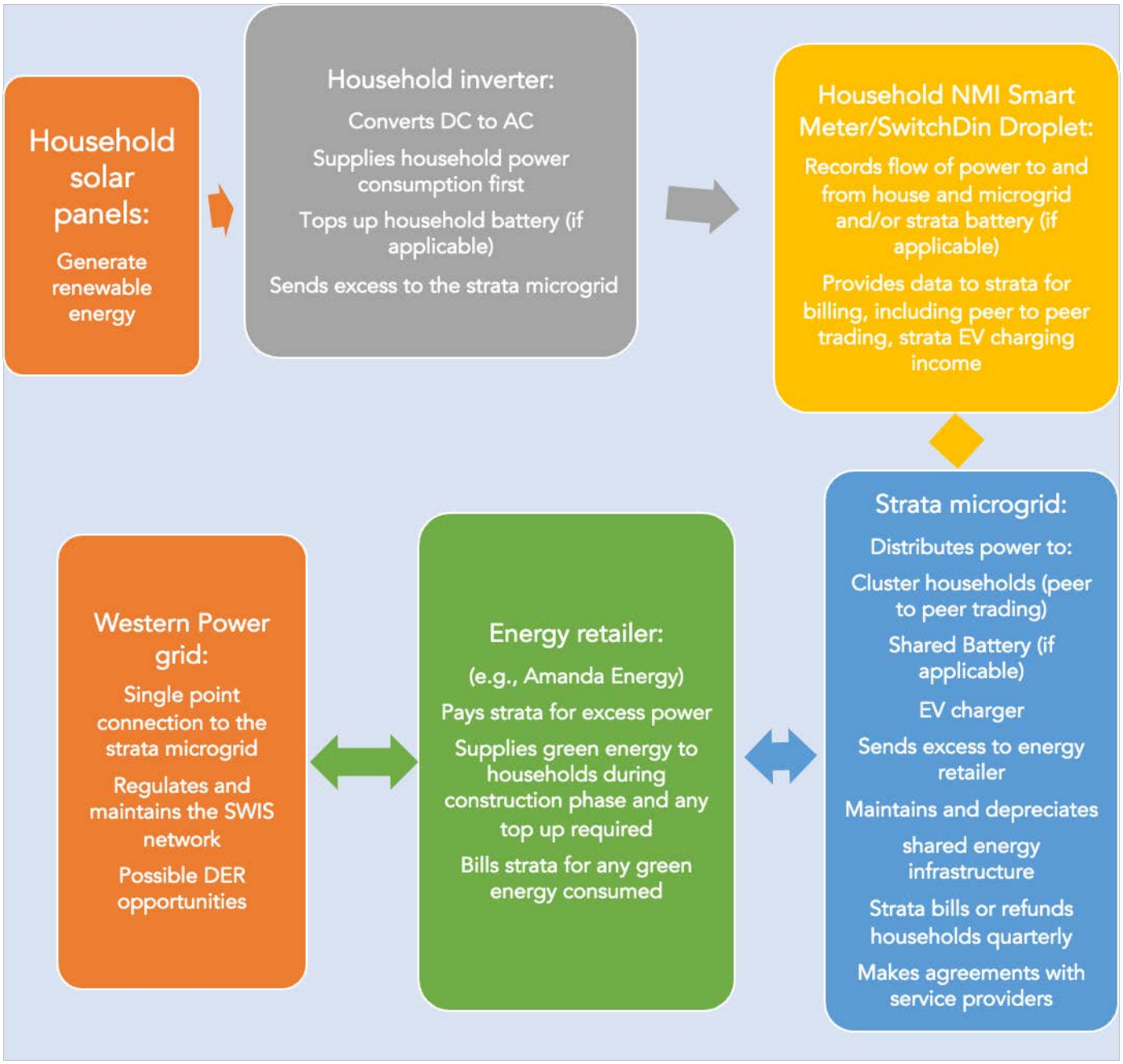


Figure 4. Ecovillage microgrid flowchart

Retail Energy Supply

The Ecovillage Team have undertaken research into the best options for the retail purchase and sale of energy within the development. Amanda Energy Solutions is the private retailer contracted to provide clusters with renewable energy supply, and facilitate the sale of excess energy from each cluster into the wholesale energy market in WA.

Houses in standard subdivisions connected to the Western Power SWIS pay approximately $1.07 per day in supply charges to Synergy. Ecovillage residents currently pay between 19c to 26c per lot per day (depending on cluster

size) in supply charge fees to Amanda Energy. Amanda Energy currently provides a fixed price (bundled) energy package to the clusters at 29.92 c/kWh (+GST) and sells their excess exported energy to the grid for a fixed price of 3.5 c/kWh (+GST). This compares favourably with Synergy's current A1 residential tariff of 30.06c/kWh. There is no obligation for each strata company to stay with Amanda Energy if they want to make alternative arrangements with a different energy retailer in the future.

For more information regarding Amanda Energy, please visit https://amandaenergy.com.au/.

Shared Tesla Powerpack battery (Stages 1-3)

(Provided to the initial stages of the Ecovillage, as per Table 1.)

To be self-sufficient in power, each home needs to be able to access stored renewable power at night when the sun isn't shining. Providing a shared large-scale battery in each cluster was a sustainable, economical, and carbon reducing outcome for the Ecovillage. Each cluster's battery is a 232kWh Tesla Powerpack battery which will enable each home to be self-sufficient in renewable energy through the night. The total Ecovillage battery storage capacity will be more than 3MWh when all the homes are built.

re 5. Cluster 1C's 232kW TESLA Powerpack.

For clusters with access to a shared Tesla Powerpack, the cost of the battery and its installation/connection is all included in the lot prices, with household storage allocation determined by lot type. Each cluster's allocation will vary slightly, due to differing lot numbers and types in each cluster (see p.27-33).

We chose the Tesla PowerPack as the strata scale battery for Stages 1 – 3 due to its:

- proven history/volume in the market,
- reliability,
- industry best 15-year warranty,
- competitive cost;
- maintenance service (Tesla agreed to a significantly discounted servicing rate for the Ecovillage clusters);
- freestanding design (no need for separate temperature-controlled building/shed); and
- has the capacity to add storage in the future.

For more information see https://www.tesla.com/en_AU/powerpack

Electric Vehicle Chargers

Every cluster strata company (excluding short stay, tourism, commercial and R30/40 clusters) will own a 75kW EV charger to enable fast charging of EVs and provide future income to the strata companies. These are located in each cluster's utility and parking area and will be available for Ecovillage residents, tourists and Margaret River locals who want to charge with renewable energy.

The chargers that we have chosen are Tritium chargers, which we chose for their design, innovation and sustainability. The Tritium RTM 75kW (with two charging cables) is a high quality electric fast charger for public spaces. The Tritium RTM 75kW is a reliable and robust electric vehicle fast charger with an attractive design that is easy to own and operate. Its patented liquid-cooling system ensures maximum product life with minimum maintenance. The small footprint and lightweight design of the Tritium RTM facilitates a wide choice of location options and easy installation. The chargers will be coupled with a bankcard swipe system and each transaction will be deposited in the Strata's bank account. Over time, as EV use grows, this is expected to add considerable income to each strata company, significantly offsetting strata fees. We have considerable short stay accommodation within the Ecovillage which we believe will be popular with EV owning tourists who will be able to charge their vehicles at competitive rates from 100% renewable energy.

The first 5 Tritium chargers were installed in clusters 1A, 1B, 1C, 2A and 2B mid-March 2023. The remaining 6 chargers will be installed in our later stages as the village develops.

Tritium RTM 75kW features:

- Liquid cooling
- Slim, compact and stylish design
- Economical installation costs
- Increased reliability
- Durable UV resistant exterior
- Low maintenance
- OCPP Integration
- Australian company.

EV Charging Payment Processing

Strata councils have the choice to research and choose the most appropriate EV charger service for their cluster. Our recommendation is that clusters establish contracts with "Chargefox" but strata councils are under no obligation to do so and may choose another provider.
Chargefox is Australia's largest and fastest growing charging network, managing over 10,000 EV charges per month and is owned by the Mobility Clubs of Australia (which consists of NRMA, RACV, RACQ, RAA, RAC, RACT). Chargefox has been and will be a leading provider and contributor to Australia's transition to full scale EV usage and a low carbon future.

For more information on Chargefox please visit https://www.chargefox.com/

Chargefox Inclusions:

- Monthly billing: providing a monthly statement to each strata
- Monthly payments: direct to each strata's bank account for sales.
- Provision of sim card with a $60 Telstra 4G data plan for internet connectivity
- A 1800 number (visible on a sticker) to call for 24hour assistance
- Remote support - in the event of a malfunction, an alert is sent to Chargefox, GemTech and to the strata directly.
- Chargefox app for immediate accessibility by the public and inclusion in Chargefox's charging network
- Almost all new EVs are now sold with the Chargefox app
- Dashboard for visibility of data and usage stats for each strata
- Monitoring for maintenance purposes to ensure chargers are always working
- Remaining 6 will be installed when clusters have community sheds, houses, etc.

Charger Costs (current May 2023):

- Each charger is equipped with two charging points.
- Discounted rate of $360.75 per annum per plug. (There are 2 plugs per EV Charger = $721.50 per strata). The usual rate is $390 providing a 7.5% discount to the Ecovillage clusters.
- 5% per sale to manage payments (includes bank fees)

After the current 2-year warranty period there is an option for Ecovillage strata companies to extend the warranty for an additional 3 years. Gemtek EV Charging Solutions has installed the chargers and will undertake any servicing or repairs during the 2 year warranty period. Gemtek is commissioned by Tritium who are the makers of the EV chargers. Gemtek will be training our preferred Ecovillage electrical contractor, IEC, to do all such warranty work. Gemtek are providing us with a recommended annual servicing offer, which we'll forward when agreed.

Projected Income:

The proposal is for each strata to charge at the following rates:

- 10am – 4pm @ 35c/kWh (+GST)
- 4pm – 10am @ 50c/kWh (+GST)

Given the current energy import cost of 27.2c/kWh (+GST), the strata will benefit even if energy needs to be sourced from the grid. Although income of 30c/kWh was initially quoted in the 2020 edition of this Handbook for budgeting purposes, these proposed rates will make the Ecovillage an attractive option compared with the current RAC EV charger rate of 45-50c/kWh and Tesla at 62c/kWh (+GST).

Strata Energy Infrastructure Management

Following handover of the Common Property to each cluster at their first 12-month AGM, it is the responsibility of each strata council to manage the maintenance of community gardens, lighting and electrical equipment within the cluster. Microgrid servicing costs are included in the strata budgets.

Electrical faults within clusters should be resolved by the cluster, either by cluster members or by contacting a contractor. Minor faults, for example the tripping of a breaker, are easily resolved by the strata councils and owners. Where rectification by the cluster is not possible, it is our recommendation that these faults are reported to the Ecovillage preferred electrical contractor, Integrated Electrical Contracting (https://www.integratedelectricalwa.com.au/).

Household Power

Solar Panels

Solar power is the backbone of energy production at the Witchcliffe Ecovillage. All homes are required to install a minimum 6.0 kW solar PV array and a minimum 5kW (Fronius) inverter to provide greater than net neutral energy generation. All homes with household batteries (supplied by the developer) are required to have minimum 6kW Fronius Hybrid inverters (Please see specific cluster details in Microgrid Features and Energy Budgets, p26).

PVs and inverters will be purchased by homeowners, who will then be eligible for rebates under the Small-scale Renewable Energy Scheme. For more information on the Small-scale Renewable Energy Scheme, please see https://www.cleanenergyregulator.gov.au/RET/About-the-Renewable-Energy-Target/How-the-scheme-works/Small-scale-Renewable-Energy-Scheme

We recommend that Ecovillage owners purchase high quality PV's with at least a 25 year warranty.

re 6. Example PV's

Roof Area and Orientation

The minimum roof area required for 6.6 kW solar panels is approximately 40m2. To achieve this, panels may be located on the home's main roof, carports, sheds, verandas/patios and other structures, however, having banks of panels located closest to the inverter will reduce installation costs.

The orientation and angle of roof panels will affect their efficiency, with the optimal angle/orientation in Witchcliffe being to face North* at 30-32°, though there is also considerable benefit in east and west facing panels to optimise energy production slightly earlier in the morning and later in the afternoon. Table 2 below provides guidance on the impact of different angles and orientations on the efficiency of solar panels. Attention should be paid to the location of solar panels during the design of homes to ensure that all services/fittings (solar panels, plumbing, electrical, satellite dishes, skylights, etc,) are optimally located.

Solar Panel Efficiency (%)					
Direction (plane azimuth)	Solar Panel Plane Inclination (degrees)				
	12°	22°			
North (0°)	94%	98%	100%	99%	95%
East (90°)	88%	87%	84%	81%	77%
South (180°)	82%	74%	65%	55%	46%
West (270°)	88%	87%	85%	81%	77%
NB: Table is based on *Clean Energy Council GC Design Guidelines* figures for Perth latitude (30°), adjusted to winter sun at 32° for Witchcliffe location. This is general information only to guide your panel placement choices.					

Table 2. Solar panel efficiency by orientation and plane inclination

Phases

All homes at the Village need to be wired for 3-phase power. 3-phase power allows for a more balanced distribution of loads across the three phases, which means that each phase carries a relative equal amount of power. A balance of power across phases reduces the risk of overloading and helps improve micro-grid power stability. 3-phase power can enable higher power loads than that of single-phase power making 3-phase power more suitable for use in houses with large solar arrays, residential batteries and EV chargers. It is essential that electricians balance loads as much as possible across the 3 phases in each home to enable the support of larger loads in the cluster such as EV chargers.

To maintain peak performance and efficiency of the overall cluster energy system, individual solar PV systems need to be installed and connected evenly across the cluster microgrid and careful consideration has been given to the servicing of each home and its permissible solar PV. The distribution of the systems over the network is critical to create a balanced network. The size and type of solar PV system that is connected to each home will depend on the lot type that has been purchased. A breakdown of potential PV size and maximum inverter size is provided per lot type in Microgrid Features and Energy Budgets, p 26-39.

NMI Meter, Inverters and Microgrid Control

NMI Meters

In order to support integrated microgrid control, it is essential that each household installs an NMI meter to read their energy import and export. A NMI meter is specific type of licensed energy meter that is required in Australia if trading energy across the meter. The National Metering Identifier (NMI) is a unique 10 or 11-digit number used to identify electrical network connection points in Australia. It is a requirement that every connection, including commercial and residential, have their own NMI. It is not legal in Australia to trade energy across meters that are not NMI certified.

For requirements for your cluster, please see the specific Cluster Energy Technical Sheet: https://www.ecovillage.net.au/library/document-library/

Inverters

Inverters perform a number of functions but primarily convert DC solar and battery power to AC power that can be used in our homes. All solar systems in the Ecovillage are required to install Fronius inverters to maintain consistency which will ensure the integrity of the microgrids.

We have trialled a Fronius 3 phase 5.0kW inverter with a 6.4 kW Solarwatt PV array at the Ecovillage office in Witchcliffe since 2020 (Figure 3) and have been very satisfied with the inverter's performance and its very usable real-time interface, which is available as an App on smartphones and computer (https://www.solarweb.com/).

Microgrid Control – SwitchDin Droplets

At the Ecovillage, each cluster operates as its own separate microgrid. A microgrid is a group of low voltage Distributed Energy Resources (DERs), e.g., rooftop solar, and loads, e.g., batteries and charging EVs, that can be operated independently in a controlled and managed way, either connected to or independent of the main power grid. SwitchDin is an Australian company which has developed technology that enables DERs to be both visible and controllable and helps integrate these DERs into the grid.

As we move towards a net zero future, changes to Western Power regulations and policies to incorporate increased renewable energy into the existing grid infrastructure are inevitable. Changes to solar export limits in early 2022 (https://www.wa.gov.au/organisation/energy-policy-wa/information-industry-emergency-solar-management) now require another level of technical management and control to be provided on all new solar connections in WA, and on a stand-alone household solar systems. This would generally be via a smart meter, with a 1.5 kW export limit on all systems over 5kva (see also, Solar System Connections to the Microgrid, p 21).

Using ground-breaking technology developed by Australian company SwitchDin, we've come up with what we believe is a better outcome for residents and a world class model for maximising renewable energy integration.

(Please note, this solution is current as of May 2023, and may be varied for stages 4 and 5 if required.)

The microgrid control hardware chosen as the controller in the Ecovillage clusters is the SwitchDin Droplet. Droplets are DER controllers capable of integrating with solar inverters, power meters and load controllers. These Droplets can be deployed for a range of applications including individual energy management for homes/businesses or within larger systems, for example within an Ecovillage cluster microgrid, through SwitchDin's cloud-based application, Stormcloud. We have commissioned SwitchDin to develop a Stormcloud specific to each cluster in the Ecovillage. The Stormcolud app will enable each home/business to be able to view their energy use, import and export. It will also enable each cluster to see overall use and download CSV files for billing purposes. The SwitchDin Droplets fulfil the Western Power requirement for all new solar systems to be installed with smart meters. Fortunately, at around $200 each, they are also considerably more affordable than Fronius smart meters.

The SwitchDin Droplet enables "Private Microgrid Control" which is what is required at the Ecovillage, i.e., an adaptive power network. Residents are required to have Droplets installed at their property. An active internet connection is required for the operation of our Droplets, with Droplets hardwired direct to modems. These devices are critical for both the participation of your residence in the microgrid as well as the correct functionality of the microgrid. Installation of Droplets can be arranged by your electrician.

The SwitchDin Droplets enable "Private Microgrid Control" which is what is required at the Ecovillage i.e. an adaptive power network. In order to achieve this adaptive capability, Droplets will be installed in all dwellings and at various points within each microgrid including at the site main switchboard and the stage 1-3 Tesla batteries. The Droplets will operate autonomously to manage the microgrid so that roof-top solar, battery input/output and output/input to the Western Power grid are controlled and optimised. Droplets will be a critically important piece of the microgrid moving forward, and will one day hopefully enable each cluster to participate with Western Power in significant income producing DER activities.

Costs:

- Supply costs for Droplets are approximately $200 per unit
- A fixed fee of $10/year management fee per Droplet (Stormcloud Porfolio Management Plan – Breeze Tier <30kW) will be payable through the strata for each residential Droplet connected within each cluster. A fee of $10/year will also be applied to the utility Droplet + connected at each Site Main Switchboard within each cluster.
- In order to provide Ecovillage-wide visibility and management of our Energy a fee of $1/month will be payable per Droplet. The benefits this will bring are outlined in the "Benefits" section below.

Benefits:

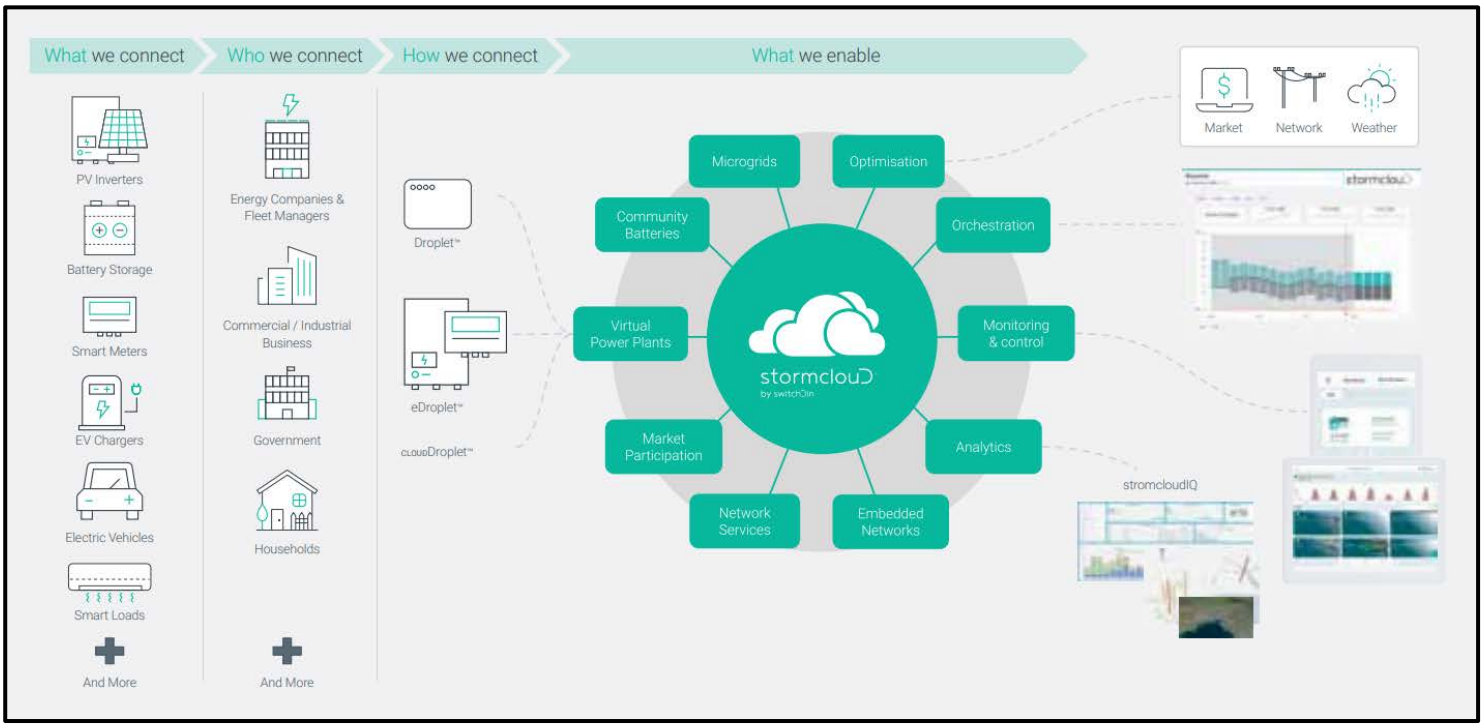
Apart from being a Western Power requirement, how does the SwitchDin technology benefit Ecovillage residents?

- Droplets and Stormcloud will provide cloud-based data (reading meter and inverter output) which will facilitate easier visualisation and processing of billing data (clusters currently manually read meters).
- DER opportunities e.g., paid arrangements to provide energy services to 3rd parties including capacity payments and frequency stability agreements with Western Power - this could provide significant income to each cluster in the future.
- Energy trading within clusters - this technology will enable accurate peer-to-peer energy trading, equitable battery sharing (in stage 1-3) and management of the EV charging income.
- Opportunities to share energy information with research bodies who can potentially demonstrate the effectiveness of the Ecovillage microgrid design. This will help speed the transition to more sustainable settlements throughout Australia and the world. A big win!

To ensure the above outlined energy management optimisation within our microgrids, residents are required to have "Droplets" installed at their property. We are pleased to inform you that the Witchcliffe Ecovillage developers have agreed to cover the cost of the SwitchDin "Droplet" hardware for all homes in Stages 1-3, including 3C, seeing as the Western Power changes came into being after their contracts were signed. Homeowners will have to contact their electricians for installation at their cost.

Stage 4 and 5 lot owners will need to purchase their own Droplets through their electrician at around $200 + GST each, plus installation.

For more information, please visit the SwitchDin website: https://switchdin.com/



re 7. SwitchDin Storm Cloud / Droplet flowchart

Internet Connectivity

The provision of the best available fibre-to-the-home NBN connection is a key feature of the Ecovillage, and was included at significant cost to the project to provide Ecovillage residents with every opportunity to work from home, transfer their city jobs to country life, run home businesses, study online, etc. In addition to this, the NBN connection provides the connectivity and speeds required for the metering and monitoring of our private microgrids, which will allow peer to peer energy trading, equitable sharing of the battery, sale of energy to EV's, etc.

To that end, connection to the NBN for every home has always been included as a requirement of the Witchcliffe Ecovillage Sustainable Building Design Guidelines (page 69): https://www.ecovillage.net.au/library/document-library/

The trenching of the conduit from the roadside NBN pit to houses should be covered in house building contracts. As part of the NBN's "New Connection Charge" (approx. $300) an NBN contractor will pull through the NBN fibre

and set up the home with NBN. Households will then be able to either transfer their current service or choose from a range of providers to provide internet service and the connectivity needed for the Droplet.

Households that specifically do not want to connect to NBN must still provide a suitable microgrid control by either:

- providing an alternative internet connection for the Droplet via a suitable 4G wireless modem (not dongle); or
- purchasing the "Droplet +" and providing an activated Sim card and data plan.

The Droplet hardware requires at least a 4G wireless modem with 2 free ethernet connections. WIFI connectivity via a dongle will not provide reliable enough coverage for accurate metering and monitoring, or for controlling the output of the solar system in peak times (as required by Western Power).

Electrical Connection Process

For technical information regarding the connection of individual lots to the microgrid, please refer to the Technical Energy Specification sheets for your cluster, located in the Document Library:
https://www.ecovillage.net.au/library/document-library/

Solar System Connection to the Microgrid

In 2022, Western Power introduced strict new solar export limits, due to infrastructure issues that Western Power encountered with grid overload in the 2021 summer in Perth. These new limits restrict all new individual household PV systems to an export limit of just 1.5kW on systems greater that 5kW to the Western Power grid at any one time,

Clusters within the Ecovillage have a single 300A/215kW connection to the Western Power grid, i.e., a single Western Power connection to the cluster microgrid rather than individual Western Power connections to each lot, so approvals for solar systems are applied for as a strata cluster, not as individual households. We have therefore negotiated actively with Western Power to re-approve the planned capacity of our embedded microgrids and solar export capacity, particularly as the Ecovillage systems are designed with significant battery storage to mitigate the effect of peak solar export in summer.

Despite our 215kW connection size, Western Power's new solar export limits will initially limit exports to 100kW per cluster, i.e., it will be possible to connect 215kW of solar systems, but we will be limited to exporting 100kW of solar or battery power to the Western Power grid at any one time. The 100kW export limit isn't an issue, as it will be quite some time before we are exporting more than this from each cluster as houses continue to be built, by which time it is anticipated that Western Power will have increased the Ecovillage cluster export limit. Western Power have indicated that they will reassess the export limit when all of the cluster micro-grid controls and infrastructure are proven, to enable larger export on the shoulder periods, when the grid needs it. This works well for our systems as residents can fill batteries and heat pumps during peak solar periods and get higher rates for exported energy during the shoulder periods.

For technical information regarding the connection of solar systems to the microgrid, please refer to the Energy Connection Technical Specification sheets for your cluster, located in the Document Library:
https://www.ecovillage.net.au/library/document-library/

Individual Household Batteries (Stages 4 & 5 & Short Stay)

As part of the Ecovillage vision and to enable the storage of our clean, renewable rooftop solar energy, Tesla "Powerpack" community battery storage units were installed in the Stage 1-3 clusters. As battery technology changed so rapidly over the last number of years, Tesla discontinued the production of their "Powerpack" and replaced this with a "Megapack", which is far too large for the energy production and storage requirements of our individual clusters. We have therefore decided to provide individual household batteries to short stay lots and lots in stages 4 & 5 to meet residents' energy storage needs.

BYD batteries are currently providing the most favourable solution for the stage 3C, 4 and 5 cluster storage needs. BYD batteries have a proven track record, a 10-year warranty and have been chosen over Tesla Powerwalls as BYD offer 3 phase power whereas the Powerwall only supports single phase power. Buyers need to be aware that the provision of household batteries by the Developer is on the condition that their home is under construction within the commencement time frame noted in the Repurchase Option condition of their sales contract. While BYD is the current battery choice, the Developer reserves the right to make variations in the case that a better option becomes available, or that supply issues are experienced.

All homes with household batteries need to install a Fronius Hybrid inverter (Min size 6kW). Please refer to your cluster's Energy Technical Specification Sheet for maximum inverter size for your lot.

The battery capacities offered to residents will vary depending on lot type.

Lot Type	Battery capacity
Groupie	11 kWh
Cottage	11 kWh
Family	13.8 kWh

Table 3. Battery provision by lot type

Installation of the battery will take place as part of the lot owner's solar system installation by a qualified electrician and at the home owners' cost. The battery will be owned by the lot owner and will need to be covered under the lot owner's home insurance coverage.

State Planning Policy 7.3, the "Residential Design Codes" require all new residential houses to provide an enclosed storage space or shed, and we suggest that lot owners design their storage spaces/sheds to also house their battery. Many people in Stage 1 & 2 have built lockable storage spaces into the framework of their carports, which is an ideal place for battery storage.

For more information, see: https://www.wa.gov.au/government/document-collections/state-planning-policy-73-residential-design-codes

For more information on battery installation requirements, please

- visit the BYD website: https://bydbatterybox.com/;
- talk to your builder;
- check your cluster's Energy Technical Specification Sheet: https://www.ecovillage.net.au/library/document-library/; and
- pay regard to any other Building Code or Australian Standards requirements.

Energy Efficient Appliances

Even though households will be producing the majority of their energy needs from the sun, it is still important to minimise household energy consumption—to maximise carbon emission reduction and increase the amount of renewable energy going back into the Western Power grid (which in the Margaret River area is mostly supplied from coal fired power generation) and into charging electric vehicles. Heating and cooling, refrigeration, household appliances and water heating together account for **over 60%** of each home's operational carbon footprint.

Ecovillage residents should install energy efficient fixtures (hot water systems, air conditioners, stoves and ovens, etc.) throughout their homes, choose the most energy efficient free-standing appliances (fridges, washers, televisions, etc.) wherever possible, and upgrade to the most efficient they can afford whenever an appliance needs replacing. The Energy.gov.au website provides helpful information regarding how to interpret the Australian energy star rating system for household fixtures and appliances (https://www.energy.gov.au/households/energy-rating.)

The Ecovillage Design team can provide advice during the house design process regarding recommended fixed energy efficient appliances. This is particularly important with higher energy use items. For example, the Ecovillage team have negotiated a great deal on one of the top performing, Japanese made, hot water heat pump systems; Reclaim Energy's CO2 Heat Pump Hot Water System. Reclaim's system uses an average 2.1kWh electrical input for 315L hot water delivery as opposed to 15kWh electrical input to heat 315L using a standard electric element system, i.e., being 500% more efficient! In addition to this, Reclaim's smart interface technology enables users to program heating cycles coinciding with excess solar power production during the day, and the unit has an industry leading warranty.

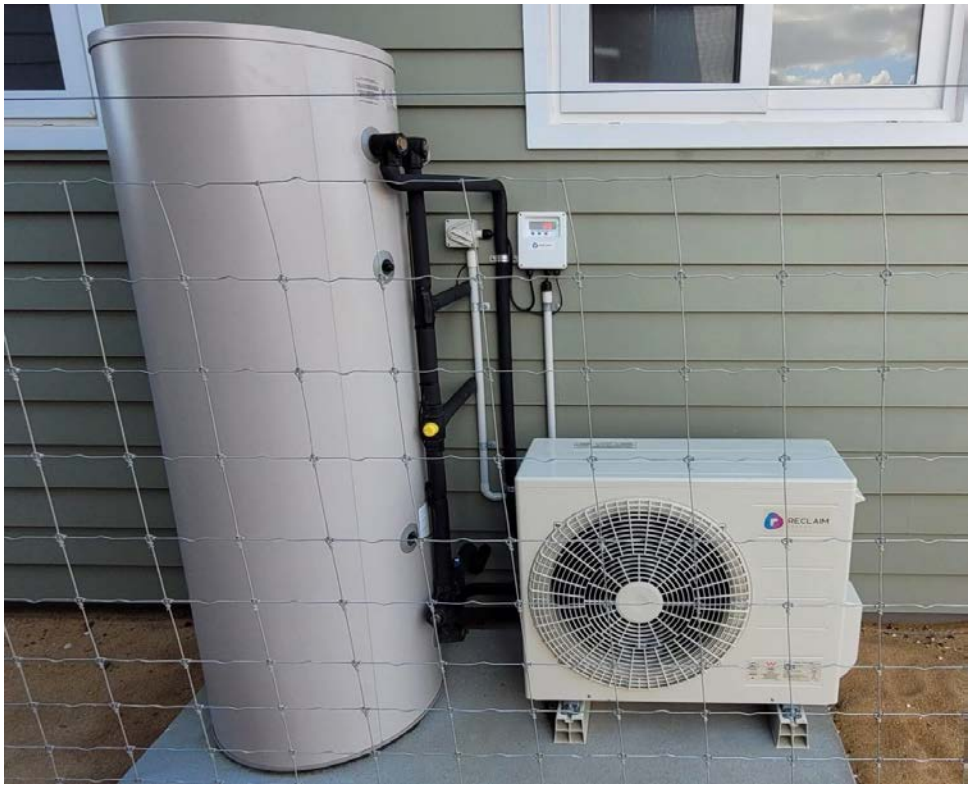


Figure 8. 315L Reclaim system installed in cluster 2B

Electric Vehicle Charging

We strongly believe that EVs are the low carbon, household scale transport solution of the future, particularly in regional areas like South West WA, with low population densities and limited public transport options. In addition, they are much cheaper to run than petrol or diesel fueled cars, particularly when using PVs to charge the vehicle each day. The average annual cost saving estimate of driving a solar powered EV in Australia is approx. $2,400 per annum, in running and servicing costs. For more information on EVs, visit the Electric Vehicle Council's website: https://electricvehiclecouncil.com.au.

Residents will be able to slow charge their electric vehicles (EVs) in their own carports directly from their panels during the day. The Sustainable Building Design Guidelines require that households provide at least one undercover AC power point within easy reach of a car parking space. Residents with electric vehicles may wish to add additional battery storage capacity if they expect to frequently charge their cars overnight. For unexpected trips, or for when time is short, each strata cluster provides a 75kW fast charger in their community garden utility/parking area. This service will also be available to tourists and visitors and will be a source of potential income for the strata companies.

Figure 9. EV Charger in Cluster 1B

Microgrid Features and Energy Budgets

The microgrid features and energy budgets for each cluster in Stage 1-4 are available in the cluster specific Energy Technical Specification Sheets, located in the WEV Document Library: https://www.ecovillage.net.au/library/document-library/.

References

"Energy." YourHome. (p. 309-404.)

Energy Rating. https://www.energyrating.gov.au/

Josh's House. https://joshshouse.com.au

"Josh's House Year 1 Performance Report 2013/14." https://joshshouse.com.au/wp-content/uploads/2014/11/141121-JH-Year-1-Performance-Report-Design-Version.pdf

Mobbs, M. Sustainable House. Marrickville, NSW: Choice Books. 1998.

Sustainable Settlements. "Witchcliffe Ecovillage Building Design Guidelines." https://www.ecovillage.net.au/library/document-library/

Wittig, M., and D. King. The Smart Living Handbook. 2014.

Appendix 1 - Household Energy Disclosure Template

As per the Building Design Guidelines and each cluster's strata bylaws, lot owners must provide an accurate Household Energy Budget to the WEV Design Team during the building application process, as well as to prospective purchasers as part of the sales process if the house is sold in the future.

Property details	
Lot number	Lot
Cluster number	Cluster
Address	
Household details	
Bedrooms / proposed occupants	
Energy production	
Solar PV brand	
Total kW	kW
Orientation and angle of panels	kW @ _____º
North	kW @ _____º
West	kW @ _____º
East	kW @ _____º
Inverter brand	
kW capacity	kW
Smart Meter brand	

Electrical Fixtures	Brand / Type	Star rating / capacity / specifications /energy use
Hot water:		
Air conditioner:		
Underfloor heating:		
Stove top:		
Oven:		
Lights:		
Rainwater pump		