



## Draft Residential Energy Supply Handbook (Updated Feb 2024)

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## *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.*

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# 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 an example of best practice for residential projects 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 February 2024 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.

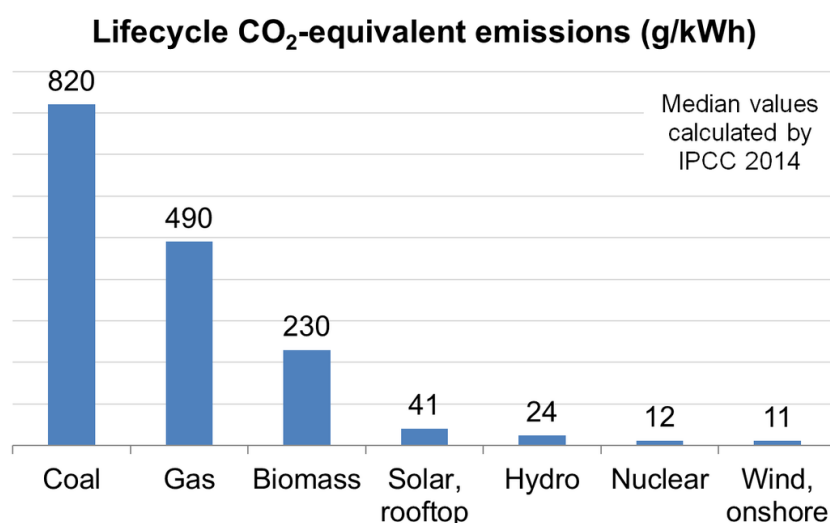


Figure 1. IPCC comparison of energy sources by carbon footprint (<https://www.solar.com/learn/what-is-the-carbon-footprint-of-solar-panels/>)

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 will provide each home with as much or more energy storage, but leads to individual battery ownership, see p 23.

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, as per Table 1, above.

A single Western Power connection is provided to each cluster/strata to enable export of excess renewable power back to the grid, and provide supply of renewable energy via our energy retailer 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 each strata to each other, the central battery (if applicable—see Table 1), the Electric Vehicle (EV) charger (only supplied to the 11 x large residential clusters), and the Western Power grid, to enable each household to export their excess renewable energy for sale to other households, the EV charger & community battery (if supplied), or the grid. The 300A connection to the large residential clusters 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 has to connect to the Western Power grid via the State's energy retailer, Synergy. However, as each of the Ecovillage's residential clusters have a single point connection to the Western Power grid, and are large enough to be considered "contestable," we have been able to negotiate with a range of private energy retailers to achieve better value renewable energy purchase agreements, for both supply and export.

While residents will be able to charge their future EV's at home, each residential 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/Margaret River region 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 the Australian Strategic EV Integration Project (SEVI). The Witchcliffe Ecovillage has agreed to become an industry partner in the SEVI project as our state-of-the-art renewable energy system is headlining this case study in Australia.

For more information on the SEVI Race for 2030 project, please see:

<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





## 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, which is connected to 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.

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

## Commercial Scale Solar Connections

Other than the 3E & 4E 'affordable' strata lots, each strata in the Ecovillage will ultimately be classified as a Commercial Scale Connection with Western Power once they require more than a total of 30kW of inverter connections. As such the developer's electrical engineer makes application for each cluster to connect up to 215kW of total inverter capacity, which needs to be approved before any additional inverters above the first 30kW (total) can also be approved. The total inverter capacity has been approved in each of the first 4 stages. Stage 5's applications have recently been lodged now that land titles have issued. Western Power have agreed to the total of 215kW in each of the large residential clusters, but as each cluster has a different configuration of lot numbers and lot type inverter limits, each cluster has to be submitted independently.

Once the large solar applications are approved, we then have to make various changes to equipment in each cluster's SMSB to ensure the main switch will trip if the solar export exceeds 100kW (read SwitchDin Droplet section below to confirm how each strata prevents this from happening). This requirement was imposed by Western Power after all of our infrastructure had already been approved and constructed in each of the eleven large residential clusters. Once the new switches and CT are installed, the system has to be tested by independent Grid Protection Testing (GPT) engineers to confirm compliance. Once that is completed in stages 1-3 (clusters with Powerpack battery), our electrical contractors perform a Power Quality Assessment (PQA) on the Powerpack which picks up all of the solar that has been installed by that point. These reports are then assessed up by our electrical engineer and lodged with Western Power for approval.

Due to the amount of time it takes Western Power to approve each application, lot owners that are building soon after purchase (that aren't included in the initial 30kW of connected inverters – first 3 to 5 homes) need to be aware that there may be delays before they can turn on their solar and battery system. However, the process is becoming more streamlined due to the experience our team and Western Power have gained from Stage 1, which was the first in the State with such large solar and battery in a residential community that's connected to the SWIS.

At the time of writing this update, Stage 1's batteries and solar have been assessed, approved and providing 100% renewable energy to each cluster for six weeks, since January 11, 2024. The SMSB upgrades have been completed in Stage 2 & 3, have been tested by the GPT team (Feb 19). The Powerpacks are being commissioned by Tesla this week, following which the PQA assessments on the Powerpacks and installed household inverters will be completed. These reports will be assessed

and lodged with Western Power in the first week on March. We hope to receive the Western Power approvals within 6-8 weeks, at which point the Powerpacks and all solar installed and tested in this PQA can be turned on.

Due to the commercial classification, each solar system (or group of solar systems), that are installed after this process is completed, will also need to have a PQA from their Electrical Contractor (Integrated Electrical provide PQA) which has to be lodged with Western Power and approved before the system can be turned on. PQA's are ideally performed on multiple household inverters at the same time to enable the home owners to split the \$1100 (approximate) cost of assessment. Please remember this cost needs to be added to the cost of your solar system. Thankfully a large portion of the solar system is rebated through the Federal Government's STC rebate program, and the battery is provided by the developer.

All stratas with household batteries (which don't include a single Tesla Powerpack) are also currently required to do PQA's on their solar systems. We have lodged an Embedded Generation Exemption application with Western Power for these Stratas, but until such time as that is approved, all solar systems will require PQA approval. To make this affordable for each home, we recommend waiting until there are at least 5 homes ready to turn on solar systems, so the \$1000 (current price) cost can be shared by as many homes as possible. This is effectively a cost that all homes need to add to the cost of installing a solar system.

As arduous as this process is, it's well worth persevering with as we have done very well to achieve large export capacity (up to 100kW per cluster) which can be sold to our energy retailer, way beyond what can be achieved with systems over 5kW in standard (green titled) residential homes that are applying for new solar systems. Once approved, your solar and battery system in the Ecovillage will enable you to be 100% self sufficient in renewable energy, and earning money from exporting excess energy to the grid.

## 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 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 their batteries, sell energy (collectively) to households within the same cluster that are using more energy than they are producing/storing, sell excess power to an energy retailer, and, for those stratas that include an EV charger, sell energy to visitors' with EV's via the charger located in their EV carpark.

The strata companies' responsibilities include:

- receiving data from household NMI smart meters;
- receiving invoices and payments from the energy retailer;
- 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 software); and
- managing and maintaining the microgrid, switchboards and shared battery (if applicable).

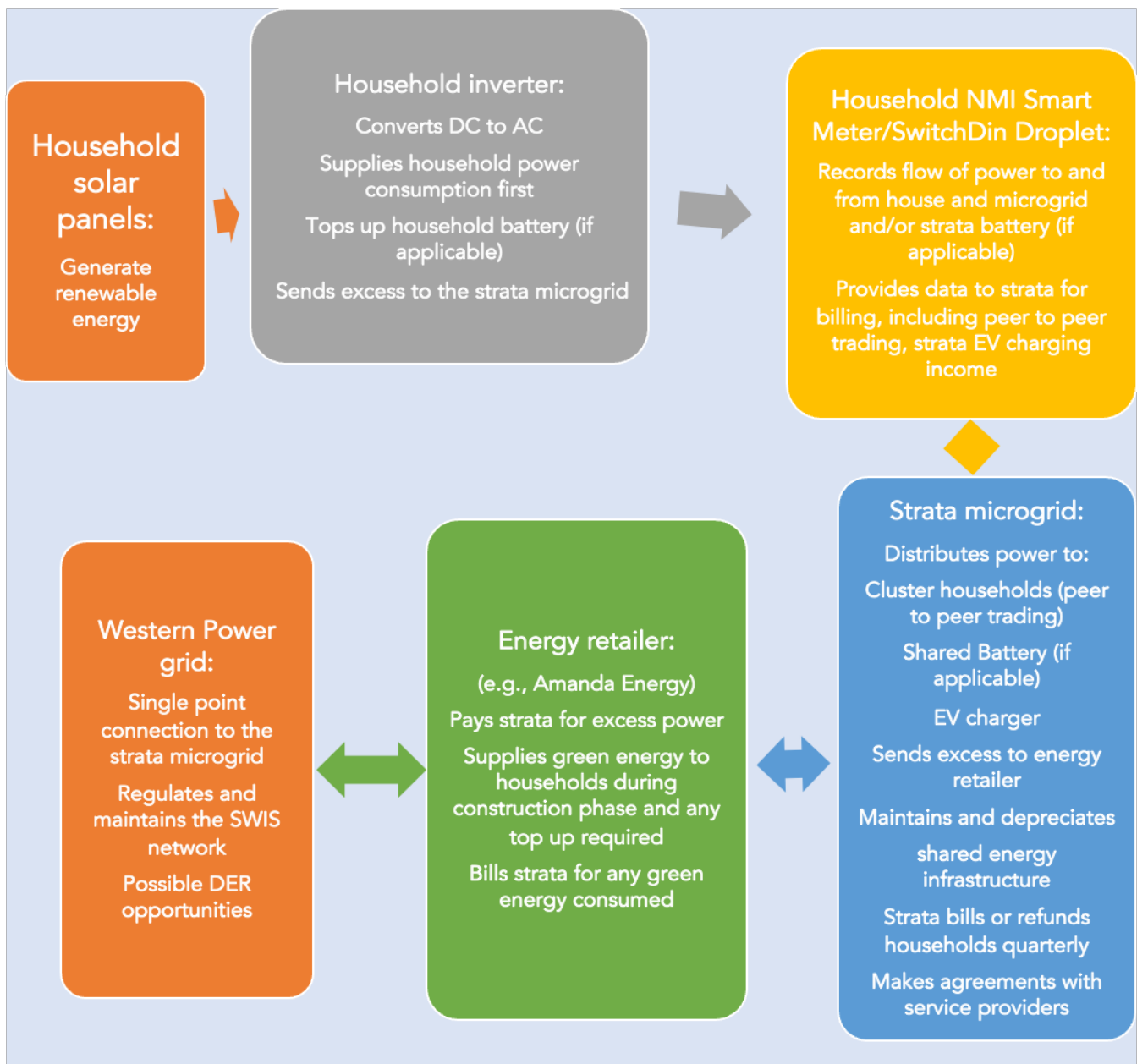


Figure 4. Ecovillage microgrid flowchart

## 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.

Households 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 10.5c to 26c per lot per day (depending on cluster size and energy supply agreement) 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). As each cluster gets built out and their batteries come on line, they will move to unbundled energy pricing with lower connection fees, higher energy fees (which won't matter as each home should be self sufficient in renewable energy from their solar and battery), and the same buy back price of 3.5c/kWh (these prices are subject to change). 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)

To be self-sufficient in renewable energy, each home needs to be able to access stored renewable energy after sunlight/solar hours. Providing a shared large-scale battery in each cluster was a sustainable and CO2 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.

For clusters with access to a shared Tesla Powerpack, the cost of the battery and its installation/connection is 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 Energy Tech Sheets in Resident's Library).

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
- ideal size for our clusters (232kWh)
- maintenance service (Tesla agreed to a significantly discounted servicing rate for each cluster in the Ecovillage)
- freestanding design (no need for separate temperature-controlled building/shed)
- has the capacity to add storage in the future.

For more information see [https://www.tesla.com/en\\_AU/powerpack](https://www.tesla.com/en_AU/powerpack)



Figure 5. Cluster 1C's  
TESLA Powerpack

## Electric Vehicle Chargers

Each of the 11 large residential clusters will own a 75kW EV charger to enable fast charging of EVs and provide income to the strata. 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 fast charge with 100% renewable energy at reasonable rates.

The chargers that we have chosen for the first seven clusters are the latest Tritium RTM 75kW Best, which we chose for their design, innovation and the fact that they are a world leading Australian company. 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. It's patented liquid-cooling system is developed to provide 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 are coupled with a swipe system to monetise each transaction (via an EV charging transaction company) which will ultimately 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, which we expect to significantly offset strata fees in due course. There are 55 short stay accommodation lots 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. Along with other EV driving tourists visiting the Margaret River region.

The first 5 Tritium chargers were installed in clusters 1A, 1B, 1C, 2A and 2B in 2023. The remaining chargers will be installed in later stages when sufficient homes are built to supply solar power to their chargers.

## 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 sufficient homes to provide enough renewable energy to run their charger.

#### Charger Costs (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)

\*These rates could be subject to change

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 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:

- 8am – 5pm @ 33c/kWh
- 5pm – 8am @ 45c/kWh

These proposed rates will make the Ecovillage an attractive option compared with the current Electric Highway EV (EH-EV) charging rate of 45c/kWh (which includes the 50kW Margaret River and Busselton chargers), and the Tesla Supercharger rate of 70.4c/kWh. Comparable rates include GST. However, RAC members get a 20% discount through Chargefox EH-EV chargers, which reduces them to 36c/kWh.

## 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 each strata's common property. Anticipated Microgrid & Tesla battery 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's preferred local electrical contractor, Integrated Electrical Contracting (<https://www.integratedelectricalwa.com.au/>), as they are very familiar with all energy systems and equipment deployed throughout the Ecovillage.

## 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/use. All homes with household batteries are required to have minimum 6kW Fronius Hybrid inverters (Please see specific cluster details in Energy Tech Sheets available in our website's Residents' Library).

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 25 year warranty.

All Strata's that enable a total of more than 30kW on solar inverter capacity are considered to be of a commercial scale by Western Power. This therefore requires additional processes for approving all solar after the first 30kW of total inverter capacity has been installed (see Commercial Scale Solar Systems, above). The only strata's in the Ecovillage that will have less than 30kW will be the R30/40 affordable home lots in 3E & 4E.

### Roof Area and Orientation

The minimum roof area required for 6.6 kW solar panels is approximately 40m<sup>2</sup>. 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°, however, there is 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. Whilst efficiency is best at 32 degrees North, household systems will produce more energy if they split their system 50:50 on East and West facing roofs, and benefit their community micro-grid with more energy in the early morning and late afternoon.

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°	32°	42°	52°
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 approx 32° for Witchcliffe location. This is general information only to guide your panel placement choice.

**Table 2. Solar Panel Efficiency guide**

## Phases

All homes in the Ecovillage 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 each Strata's Energy Tech Sheet.

## NMI Meter, Inverters and Microgrid Control

### NMI Meters

In order to support integrated microgrid control, it is essential that each household installs a 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 (that is compatible with our SwitchDin Droplets). It is not legal in Australia to trade energy across meters that are not NMI certified.



The two NMI meter's that are compatible with our Droplet's are SATEC & CTI (3 phase models). We have pre-purchased SATEC meters for Stages 1, 2 & 3A which need to be purchased (at cost) from our office when your house plans are approved by our office. All other clusters/stratas are able to purchase meter's directly from Integrated Electrical when connecting their builder's power board to the micro-grid.

A NMI meter must be connected to the builder's power board before it is energised. Energy will not be available on building sites until the meter is paid for and connected.

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 3 Phase inverters to maintain consistency and ensure the integrity of the microgrids.

Inverter sizing and types differ between clusters. Please refer to your Cluster's specific Energy Tech Sheet to confirm requirements for your lot.

## SwitchDin Droplets

At the Ecovillage, each cluster operates as its own separate microgrid. Our microgrids connect each home to their cluster's EV charger, battery, common infrastructure (shed, irrigation pumps & path lighting). These are known as low voltage Distributed Energy Resources (DERs) 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 stand-alone household solar systems.

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 February 2024, and may be varied for future stages.

Droplets are capable of integrating with solar inverters, power meters and load controllers.

The SwitchDin Droplet enables "Private Microgrid Control" which is what is required at the Ecovillage, i.e., an adaptive power network, due to the commercial scale of our solar and battery systems. Droplets are critical for both the participation of your residence in the microgrid as well as the correct functionality of the

microgrid. Droplet + devices (a larger Droplet capable of running up to three DER's) will be connected to the EV charger, Mains Meter, and Tesla PowerPack battery (in stages 1-3) in each cluster by the developer. The Droplets will operate autonomously to manage the microgrid so that roof-top solar and battery input/output 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, i.e. providing excess battery energy to the SWIS during peak demand periods in summer.

**All homes are required to have Droplets installed at their property, at the home owner's expense, before the solar system is turned on. An active internet connection is required at all homes for the operation of our Droplets, with Droplets hardwired direct to modems. Home owners need to ensure that their builder & electrician know to run an electrical conduit from the home's power board where the NMI meter and Droplet will be installed, to where the home's internet modem will be located inside the house. This is to enable internet cable to be installed between the Droplet and Modem.**

Standard residential homes that are connected to Western Power's SWIS are now required to connect via a smart meter, with a 1.5 kW export limit on all systems over 5kva. However, after extensive negotiations and review, Western Power have enabled each cluster in the Ecovillage to export 100kW (continuous feed) from total cluster Solar into the grid (SWIS). This is around 5kW from each home (depending on cluster size). The droplet's will enable us to be able to allow the cluster's inverters to export at full capacity on the shoulders of solar export, say 6am to 11am (extended due to the batteries re-charging from 10am) and say 3.30pm to sunset, each day. The Droplets will reduce the export capacity of each inverter by between 1-2kW between say 11am to 3.30pm (will vary from cluster to cluster based on total inverter capacity and average battery use) to ensure no more than 100kW is exported into the SWIS at anytime.

SwitchDin anticipate dynamic control of household inverters (via household Droplet) from the clusters Droplet + (in the cluster's Site Main Switch Board) in the future. This will further improve the outcome as household inverters won't be restricted during peak solar if they are are exporting to the cluster's battery or 75kW EV charger. Therefore enabling greater export from household solar systems when internal demand requires it, whilst still limiting export onto the SWIS to Western Power's 100kW limit.

We have commissioned SwitchDin to develop a Stormcloud specific to each cluster in the Ecovillage. The Stormcloud 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 most smart meters.

Installation of Droplets can be arranged by our preferred local electrical contractor, Integrated Electrical, or other SwitchDin certified electrical contractors.

**Costs:** (at time of writing this handbook)

- Supply costs for Droplets are approximately \$200 per unit
- A fixed fee of \$10/year management fee per Droplet (Stormcloud Portfolio 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. This will enable ECL to manage negotiations with power utilities, etc.

## 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.
- Enabling each cluster to conform with Western Power's 100kW maximum output/export per cluster.
- 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 peer-to-peer energy trading (income shared between all exporters), equitable battery sharing (in stage 1-3) and management of the EV charging income.
- Opportunities to share energy information (how efficient and renewable our homes/clusters are) with research bodies who can potentially demonstrate the effectiveness of the Ecovillage design guidelines and microgrid design. This will hopefully help speed the transition to more sustainable settlements throughout Australia and the world.

The Witchcliffe Ecovillage developers have covered the cost of the SwitchDin "Droplet" hardware for all homes in Stages 1-3 that were sold before 14/02/2022 (that start building within their original contractual commencement date) as the Western Power changes came into effect after these contracts were signed. Homeowners will have to contact their electricians for installation of the Droplet at their cost.

All other lot owners (contracts post 14/02/2022) will need to purchase their Droplets through their electrician at around \$200 + GST each, plus installation.

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

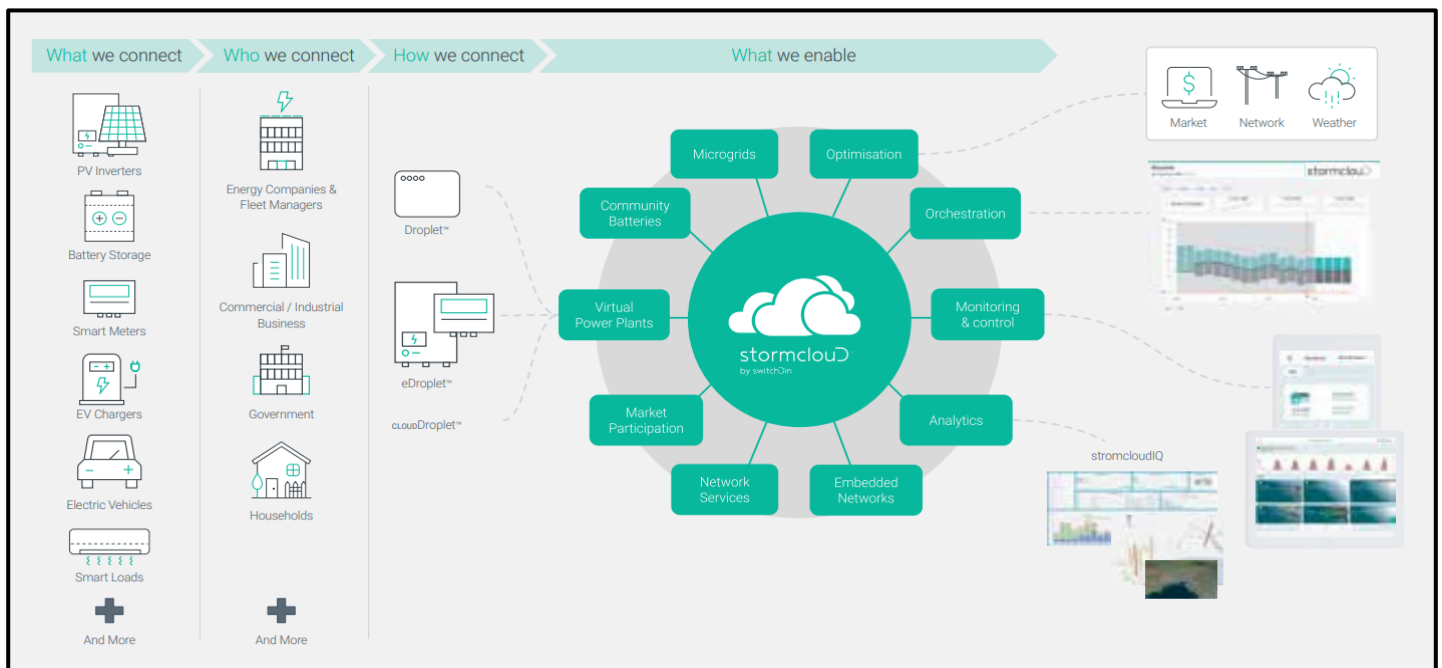


Figure 7. SwitchDin Storm Cloud / Droplet flowchart

## Internet Connectivity

The provision of the best available fibre-to-the-home NBN connection is an important 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 internet connection to their Droplet for remote meter reading and solar export control by either:

- providing a reliable alternative internet connection for the Droplet, via a suitable 4G wireless modem (not dongle); or
- purchasing the "Droplet +" (approx. \$550) 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/>

All lots in Stages 1-3 are connected to their micro-grid via an orange electrical conduit that runs between each lot (on the community garden side of the lot) and one of the clusters Distribution Boards.

When your builder is ready to start construction of your home (after plans approved by WEV, AMRSC and a Building Contract has been signed) they need to call Integrated Electrical to confirm a date to install the cable to the lot, for connection to your builder's temporary powerboard. The Developer covers the costs of running the cable to the lot (pays I.E. directly) on the condition that the home starts construction within the commencement time frame noted in the Repurchase Option condition of the original sales contract with the Developer. This offer is not transferable to third parties that have not purchased directly from the Developer, i.e. any lots on sold by the original purchaser. Owners that are not eligible for cable supply and connection to their lot at the developers expense

are required to contact Integrated Electrical to arrange installation at the owners expense. Current costs range from \$1500 - \$2000, depending on the location of the lot.

Stratas 3C, 4A, 4B, 4C, 4D, 5A, 5B, 5C & 5D all have green domes located on each lot for direct connection to the home.

## Solar System Connection to the Microgrid

On February 14, 2022, Western Power introduced strict new solar export limits via new Embedded Generation Technical Rules, due to infrastructure issues that Western Power encountered with solar overload during the 2020/21 summer in Perth. These new limits restrict all new individual household PV systems connected to the SWIS that are greater than 5kW to an export limit of 1.5 kW.

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 negotiated a significant increase on the new solar due to our significant battery storage and micro-grid controls (Site Main Switch Board & Droplets) 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., they have approved total inverter connections up to 215kW, but we will be limited to exporting 100kW of solar (constant export, not kWh) or battery power to the Western Power grid. This is export only, so doesn't include energy that solar systems are supplying within homes, or within the micro-grid to the battery or EV charger.

Western Power have indicated that they will reassess and increase export limits when dynamic micro-grid controls are available and proven in the future. However, the 100kW limit works quite well for our system sizing at present, and we are hopeful of more dynamic inverter controls by the time all homes are built in each cluster.

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 all short stay and residential lots in stages 4 & 5 that are purchased directly from the Developer, to meet our desired 100% renewable energy requirements.

BYD batteries are currently providing the most favourable solution for all strata's supplied with household batteries. BYD batteries have a proven track record, a 10-year warranty and provide a 3

phase household battery, which is essential to our micro-grids (Tesla Powerwall is single phase only). The BYD also offers the great advantage of being able to add cells to increase battery storage. 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 (within budget) 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 and cluster. Please refer to your strata Energy Tech Sheet to confirm battery size for your lot type.

Installation of the battery will take place as part of the lot owner's solar system installation by a qualified electrician 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 homes to provide an enclosed storage space or shed, and we suggest that lot owners design their storage spaces/sheds to also house their battery. As example, many people in Stage 1 - 3 have built lockable storage spaces into the framework of their carports, which is an ideal place for battery storage.

Residents receiving household batteries from the developer must provide at least four months notice to Sustainable Settlements P/L ([info@ecovillage.net.au](mailto:info@ecovillage.net.au)) of when the battery will be required. Homes with household batteries still require NMI meters and SwitchDin Droplets, and are also required to install their Droplets before they can turn on their solar systems. Household battery systems will also require a Fronius Smart Meter.

The approval process for the first 30kW of solar systems installed is completed by the electrician installing the solar and battery system. The increase to 100kW of export, will be the same as Stages 1-3, albeit with different battery configuration. The application for 215kW total inverter capacity at each of the Stage 4 & 5 clusters is approved, and the applications for 100kW solar export has been lodged. Once these are approved, the same process for the PQA's of all solar must be completed by Integrated Electrical (or other EC that does PQA's) and approved by Western Power.

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 & electrician;
- 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.

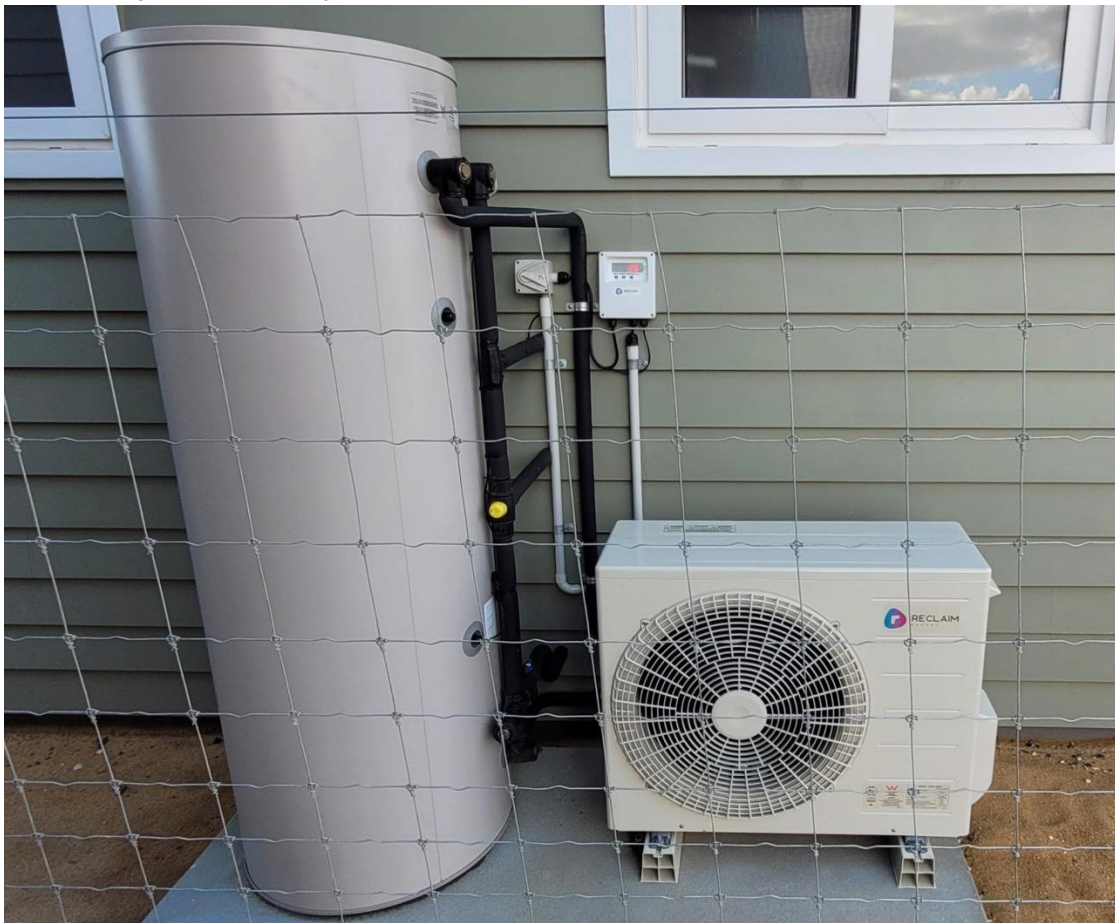
## Energy Efficient Appliances

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 CO2 emission reduction and increase the amount of renewable energy going back to the micro-grid DER's (neighbours, battery, EV charger) and SWIS. 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](https://www.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 highest household energy use in the SW is typically the hot water system. To combat this, the Developer has 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 = 500% more efficient! In addition, it is whisper quiet and comes with an industry leading 6 year warranty on the heat pump and 10yrs on the water tank. Reclaim's smart interface technology enables users to program heating cycles coinciding with excess solar power production during the day.

Please don't let anyone talk you into an inferior heat pump as these are the best and come at an incredible price to Ecovillage residents only.



## Electric Vehicles

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 excess solar energy 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 (and significantly more if charging from your solar system). 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 solar systems during the day. The Sustainable Building Design Guidelines require that residential households provide at least one undercover AC power point within easy reach of a car parking space (please note, different rules apply for short stay lots). 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 of the 11 large residential clusters 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 in front of Powerpack battery, EV Charger and SMSB in Cluster 1B



## Microgrid Features and Energy Budgets

The microgrid features and energy budgets for each cluster in Stage 1-5 are available in the cluster specific Energy Technical Specification Sheets, located in the WEV Residents Document Library, which owners can access with their link and password.

## 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.

1. Property details		
Lot number		
Cluster number		
Address		
2. Household details		
Bedrooms / proposed occupants		
Date built		
3. Energy production		
<b>Solar PV brand</b>		
Total kW		kW
Orientation and angle of panels		kW @ _____°
North		kW @ _____°
West		kW @ _____°
East		kW @ _____°
<b>Inverter brand</b>		
kW capacity		
<b>Smart Meter brand</b>		
4. Electrical Fixtures	Brand / Type	Star rating / capacity / specifications /energy use
Hot water:		
Air conditioner:		
Underfloor heating:		
Stove top:		
Oven:		
Lights:		
Rainwater pump		