Building Standards - Smart Grid Technologies

Narara Ecovillage infrastructure incorporates advanced smart grid technology. For homes in the smart grid to work effectively, there are several technologies that need to be installed, and there are additional energy saving technologies that can be deployed as optional extras by Lot Owners.

Most importantly for our selected Home Energy System supplied by switchDin owners are asked to meet the following wiring standards.

Please ensure your electrician installs a pink Cbus rated CAT5 cable from the home router (NBN Modem) to inside the electrical switchboard and one from the home router (NBN Modem) to the inverter location. Both the Home Energy Management system, which will be installed in your switchboard, and your PV inverter require a hard internet connection. If you plan to have no NBN connection in your house, please notify NEV Power immediately. The Home Energy Management system in the switchboard also requires a double GPO in the top right-hand corner.

Minimum switchboard size is a standard 600x600 metal box and the enclosure (bottom left) inside needs to allow at least 4 extra single pole spaces that are unused. The mains power meter can be in the main enclosure or a separate 2 pole enclosure – 6 pole for 3 phase. Minimum size mains are 16mm2. Soldered main earth connections not allowed – please use earth bars either incorporated in enclosure or a standard earth bar on the rear of the board.

You can download a copy of these guidelines here - NEV Wiring recommendations - Dec 2019

Please note there is also some useful information on establishing your NBN internet connection here. ***NBN Connections to your house.***

Home Energy Options for Narara Ecovillage prepared for NEV Power by Beast Solutions summarises the home energy options and provides performance specifications which can be used as a home design guide. The specified technologies are summarised as follows:

Mandatory Installation Technologies

As part of developments sustainability mandate, each home will be required to install a 3.0 kW photovoltaic array as a minimum. In the Narara climate, a 3.0 kW photovoltaic array will generate 4,270 kWh / annum. The generated power will feed into the home distribution board, with excess power being sold to the grid or stored in a home battery. Ideally all homes will be self-sufficient over a 24 hour cycle, and therefore the 3.0 kW is a minimum. The system will need to be coupled with a hybrid (battery ready) inverter. The inverter size should be 4.0 kW minimum to allow sufficient battery storage connectivity.

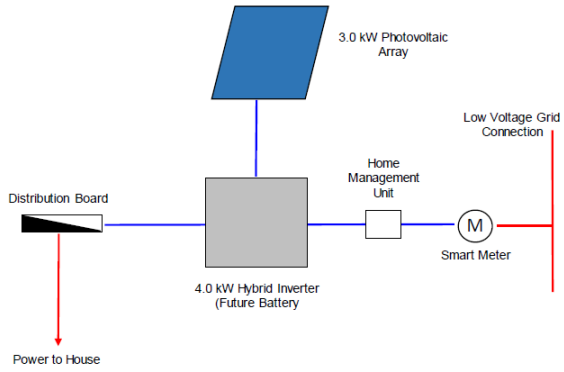

Figure: Photovoltaic Schematic

There are several suppliers of photovoltaic panels and a sample performance specification is provide below. Recommended manufactures of photovoltaic panels include:

- Trina Solar.
- LG Solar.
- Kyocera Solar.
- Mitsubishi Solar.
- Opal Solar.

Hybrid inverters can simultaneously manage inputs from both solar panels and a battery bank, charging batteries with either solar panels or the electricity grid. The inverters generally have an in-built management and control system that can optimise generation, storage and use. The controls can also interface with a home energy management system or site wide smart grid control system. There are several suppliers of hybrid ready inverters and a sample performance specification is provided below. Note that the inverters should have a remote reactive power control.

http://www.beast.solutions/

https://microgridknowledge.com/

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- Home Energy Options for Narara Ecovillage

Recommended manufactures of hybrid ready inverters include:

- SMA.
- Fronius.
- Solax (does not have a standard remote reactive power control)
- Selectronic.
- ABB.

Figure: Typical Hybrid Inverters (Fronius)

A smart meter is an electricity meter that measures and records electrical data at set intervals. They are typically set-up to record data on 15min or 30min intervals and record power use, voltage, current and power quality. The output data can interface with a home energy management system or site wide smart grid control system. This interval data allows better understanding of a home's energy use profile and allows a home energy management system to optimise equipment use. Additionally, the electronic recording of energy data allows for simpler billing especially in cases where power is being imported and exported from the home. It is becoming increasingly more common for home energy management systems to provide smart meter functionality.

There are several suppliers of smart meters, recommended manufactures include:

- Ceta.
- ABB.
- Landis and Gyr.
- GE Energy.
- Schneider.

Figure: Typical Smart Meter (Ceta)

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Home energy management systems are multi-function controllers that optimise equipment use within the home. It is becoming more common for home energy management systems to provide smart meter functionality as well. Home energy management systems can interface with solar inverters, smart meters and wide smart grid control system. A typical home in Narara Ecovillage will include the following home energy management system:

- Central controller with access via an internet connection. This can be a 3G, 4G or landline connection. The internet connection is critical as it allows control data to be sent / received between the home and the smart grid control system.
- Demand management control interface with the following home equipment.
    - Hybrid solar inverter
    - Smart meter.
    - Hot water system.
    - Heating / cooling (air conditioning) system.
    - Electric vehicle charger (if installed).
- In addition to the above interfaces the home energy management system can also interface with the following home control systems to allow remote access:
    - Lighting control system.
    - Security system.
    - Smart appliances (refrigerators etc).
    - Plugged devices with an infrared interface.

The home energy management system shall operate in a way to minimise import and export of energy from the house nano grid. Excess power generated from home PV systems shall be allocated to local loads such as hot water and batteries before export from the building unless requested by the demand management controller and smart grid. There are several suppliers of home energy management systems and a sample performance specification is provided below.

Recommended manufactures of home energy management systems include:

- CarbonTRACK.
- Samsung.
- Panasonic.
- Schneider.

Figure: Typical Home Energy Management System (CarbonTRACK)

Additional Energy Saving Technologies

The Narara Ecovillage site will have a centralised battery which will be used to store energy to support central services (water pumping, street lights, etc) when there is no available solar. Batteries can be either A.C. coupled or D.C. coupled, sketches for these options are attached as an appendix to this document. Networked battery and PV systems are also possible, sketches for a network option are also attached as an appendix to this document Individual homes are encouraged to install batteries to balance the loads within the home environment. While current prices remain high, it is anticipated that battery prices will reduce significantly over the next 2 years as additional products are released.

There are several suppliers of battery systems including:

- Lithium Ion.
    - Tesla.
    - LG.
    - Panasonic.
- Zinc Bromide.
    - Redflow.
- Salt Water.
    - Aquion.
- Lead Acid
    - Century Yuasa
    - Panasonic.
    - APC.

Figure: Typical Lithium Ion Battery (LG)

A sample performance specification for a lithium Ion battery is provided below.

Heat Recovery Air Source Heat Pump

Air source heat pumps have the ability to use the air as a heat source or a heat sink. With these systems, a reversible refrigeration process is used to generate heated water or chilled water, with the added benefit that the heat rejected through the cooling process can also be used to generate heated water. Electricity is used to drive the heat pump; and these systems have very high energy efficiency ratios even at low ambient conditions (-10 OC to 0 OC).

Space heating and cooling is delivered via concealed fan coil units and domestic hot water is stored in an insulated vessel via a heat exchanger with an electric heating element for emergency back-up. There are several suppliers of these systems and a sample performance specification is provided below

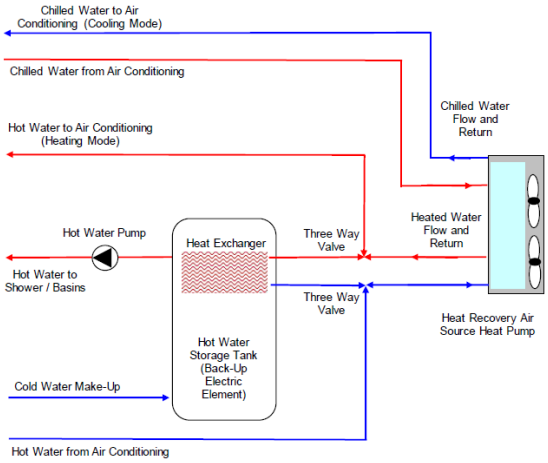


Figure: Heat Recovery Air Source Heat Pump Schematic

Air Source Heat Pump Heating / Cooling

Air source heat pumps have the ability to use the air as a heat source or a heat sink. For space heating and cooling a reversible refrigeration process is used to generate heated refrigerant or chilled refrigerant. Electricity is used to drive the process; and these systems have high energy efficiency ratios. Space heating and cooling is delivered via concealed refrigerant based fan coil units. However, there is no heat recovery with these systems and therefore they do not generate hot water. There are several suppliers of these systems and a sample performance specification is provided below.

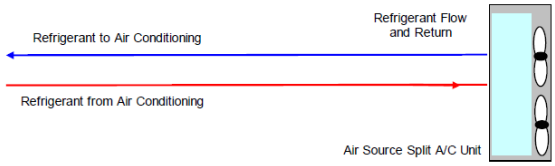


Figure: Air Source Heat Pump Schematic

For domestic hot water a refrigeration process is used to generate heated refrigerant. The heated refrigerant is then pumped through a heat exchanger to store domestic hot water. Electricity is used to drive the process; and these systems have high energy efficiency ratios, even at low ambient conditions (-10 OC to 0 OC). Domestic hot water is stored in an insulated vessel with an electric heating element for emergency back-up. There are several suppliers of these systems and a sample performance specification is provided below.

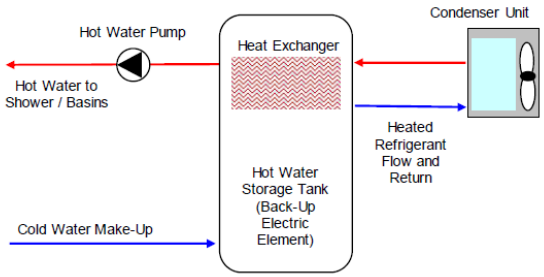


Figure: Hot Water Air Source Heat Pump Schematic

Home wiring essentials

The following 5 steps will help you understand what sort of technology you may want in your home and give you an idea of the basic cabling and wiring you need to get it.

You don't need to have all the high-tech options that are possible right now, of course. But putting in the right cabling and outlets when building means the house is set up for whatever comes along.

Better still, Smart Wiring is National Broadband Network ready and that means your home can easily handle everything the National Broadband Network can offer today and well into the future..

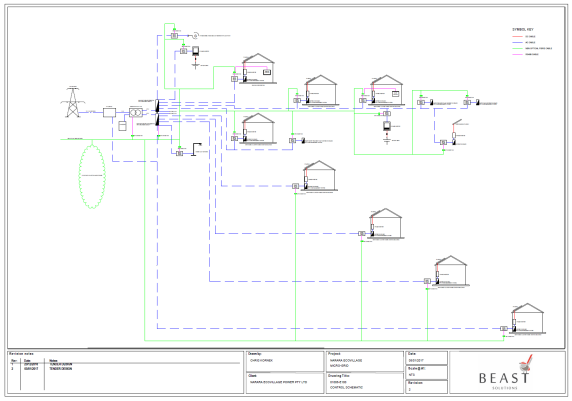
Remember its going to be much cheaper to install the cabling during the build than it will be to retrofit cabling later. So you are better off covering potential needs now rather than later

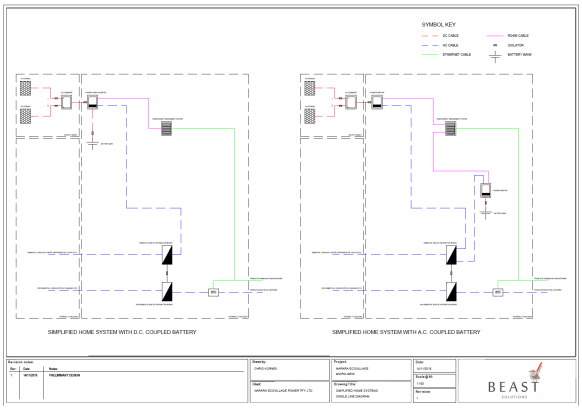
OUR FIVE STEPS ARE:

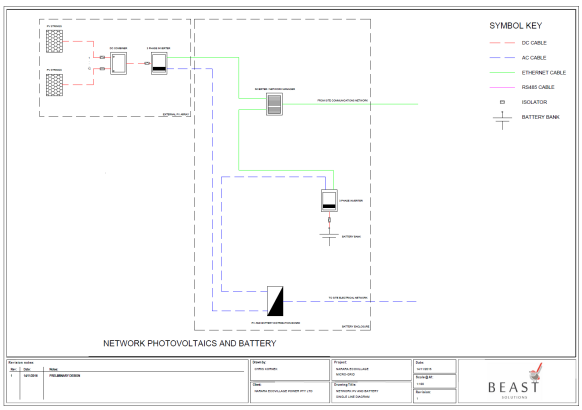
- What Services are possible
- What cabling is needed
- Select the services you think you are likely to need.
- Mark out your house design to show where you need cables and connection points
- Discuss with your architect/ designer and builder/electrician.

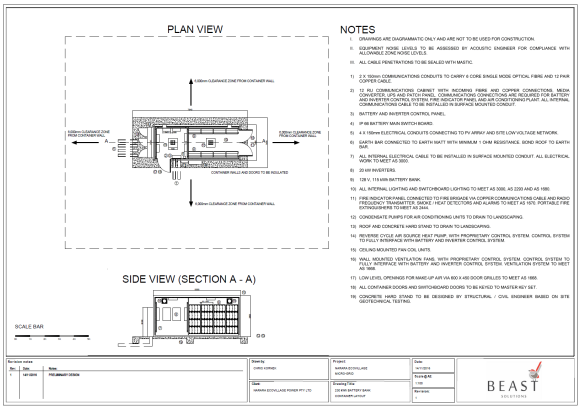
The attached Quick Guide to Smart Wiring provides a fairly simple tool to allow you to think about what wiring solutions you may need in your new home.

Technical Drawings









Design Specification

1. Demand Management
2. Inverter

3. Photovoltaic Panel
4. Reverse Cycle Air Source Heat Pump
5. Reverse Cycle Air Source Heat Pump Energy Recovery
6. Reverse Cycle Air Source Heat Pump Hot Water Unit