

NEV Power – Smart Grid Project

Lessons Learned Report October 2020



NEV Power Pty Ltd

Mail: c/o Company Secretary, 25 Research Road, Narara NSW 2250

e: power@nararaecovillage.com p: (02) 4328 1588

w: nararaecovillage.com ABN: 51 611 577 103 ACN: 611 577 103

Table of Contents

Acknowledgment	3
Project Overview	3
Lessons Learnt	5
Uncontrollable dependencies	5
Energy Distribution Provider Engagement	7
Project Team Skills and Third-Party Support	8
Going Forward	9



Acknowledgment

This Project received funding from the Australian Renewable Energy Agency (ARENA) as part of ARENA’s Advancing Renewables Program. The views expressed herein are not necessarily the views of the Australian Government, and the Australian Government does not accept responsibility for any information or advice contained herein.

Project Overview

The ARENA-funded Smart Grid project (‘project’) commenced in September 2016 and aims to enable NEV Power (‘NEV’), a wholly owned subsidiary of Narara Co-operative Ltd, to operate a smart grid system using solar PV and battery storage to achieve a net carbon neutral community title subdivision of approximately 150 dwellings in total – an ‘ecovillage’ model for sustainable living including social, economic as well as environmental outcomes.

NEV Power aims to connect its smart grid to the Ausgrid network as a high voltage embedded commercial customer. From the point of the view of the grid, the project will demonstrate a solution for minimising grid impacts from high export levels of solar generation and battery storage from a medium density housing development, while on the residential side the project will show how an urban community can increase energy resilience and sustainability.

The project involves the design and construction of the energy system at the Narara Ecovillage greenfield housing development in Narara on the NSW Central Coast. The system will operate on a behind the meter basis, incorporating a smart grid to optimise energy use within the community and better match to the distributed energy generation that will be deployed on site. The system will be deployed over time, while the key activities can be separated into the following four stages:

1. System tender finalised and contracted
2. Installation of smart grid infrastructure
3. Connection of 50 dwellings to the smart grid
4. Provision of key knowledge including system performance and behavioural consumption over time

Community smart grids and microgrids offer a unique model, particularly where there are new housing developments being designed to optimise the energy systems through the integration of renewable energy and enabling technologies. Deploying smart grids can significantly reduce network infrastructure investment, particularly when on-site generation can be combined with storage and energy load.

Additionally, a microgrid enables energy generated on-site to be used within the Ecovillage either via other residents within the community or through on-site utilities rather than exported back into the National Electricity Market (NEM) at substantially lower tariffs. These types of developments face a number of financial and technical challenges such as maintaining voltage levels and significant regulatory barriers in owning and operating a power system. The project will demonstrate that a high level of renewable energy penetration can be achieved across residential properties through a combination of distributed energy generation, energy storage and demand side management combined with a control system to optimise the matching of intermittent generation and energy consumption. The project aims to achieve the following outcomes to develop:

1. A model for home energy packages to integrate with the smart grid
2. A model for further deployment of smart home and grid solutions in community projects
3. A model for seamless grid interaction using a high level of local renewable generation
4. Significant data on the interaction of the micro grid with the utility network
5. Significant data on social impacts and resident behaviour
6. Lessons learned on delivering a community micro grid.

A key goal is 'Sharing the Knowledge' of the project experience amongst like communities, regulators, academics, government and other energy market participants. The Ecovillage is unique in a number of ways and with that comes challenges, technical or otherwise, that have needed to be navigated. The smart grid is still in development however the lessons explored below are allowing the project to evolve and manage the unknowns.

Lessons Learnt

The development of the Narara Ecovillage has concurrent streams of work that differ in ways from standard developments in approach and expected outcomes. There is no Ecovillage without houses and moving the project to the point where houses can be built has been seen as an uncontrollable deliverable from the smart grid project team.

The project differs from standard developments in that the people involved are, at the same time, the landowners, the property developers, the financiers and the future residents and are working collectively on the project. While there are many skills to draw on, technical and specific regulatory knowledge requires third-party experts.

Uncontrollable dependencies

A key deliverable of the project is to have 50 houses connected to the microgrid, which early in the project design was thought to be easily achieved. There was motivation and enthusiasm from members to get the Ecovillage built and move on-site. However, there were dependencies to work through before commencing the first house build.

While there was support from most institutions such as local council and state government bodies, the project encountered uncontrollable dependencies and delays, including:

- **Site features:** Latent conditions of the site were discovered during construction that required special measures to fix, including working with regulatory bodies and consultants in defining water courses (creeks, streams etc.) that require different control measures such as managing bushfire asset protection & riparian zones and stormwater detention measures. Both of these challenges increased cost and delays to the project.
- **Council amalgamation:** The project's Stage 1 Development Application (DA) was approved by Gosford City Council, however a number of amendments to the DA and the final issuing of the Subdivision Certificate was handled by the newly formed Central Coast Council. Their newly appointed staff had not been involved with the project previously and did not understand many of the unusual features, including:
 - provision of water services through onsite water and wastewater treatment facilities under the Water Industry Competition Act (WICA);
 - community title with common property and private roads that allowed for variations in standard controls and setback and siting; obligations under a Voluntary Planning Agreement imposed by the vendor,
 - Detailed and complex conversations with the Council CEO needed to be undertaken before various Council departments could make assessments. When elected councillors and mayor finally were put in place after a two-year period with an Administrator only, Narara Ecovillage had to begin the process

of education and engagement with the new Council.

- **Legal issues:** A Voluntary Planning Agreement (VPA) required the dedication of a parcel of land in lieu of Developer Contributions that neither the Council nor the Ecovillage were in favour of. Through discussions with the CEO of Central Coast a path forward was found to allow a better outcome. However, this discussion/negotiation took more than 12 months and impacted the issuing of titles and subsequent start of construction of individual houses.
- **Community Title subdivision** difficulties with the Community Title registration with Land Registry Services such as administrative backlogs and amendments to the Section 88B instrument (Conveyancing Act 1919) covering the community and easements for the subdivided titles. As above, this was mitigated through engaging with appropriate agencies at the right level through an expert surveyor.

The sub-division was granted 15th March 2018 with registration of the Community Plan taking place on 8th June 2018. Certificates of titles were then issued shortly after. However, prior to that house construction could not begin and without houses built the Smart Grid could not begin to be developed, hence the project was delayed.

Building is now underway with 50 dwellings expected to be built by December 2020. These buildings consist of passive solar designed houses with novel materials including straw bale, hempcrete and compressed earth bricks along with modular buildings, tiny houses and traditional light timber framed houses. These building designs are highly energy efficient and will provide valuable knowledge in terms of energy consumption and the supply and demand profiles of the planned community battery.

With each challenge through to subdivision, the best course of action was to create partnerships and engage with the appropriate organisations and people. If appropriate, through skilled experts too. This learning has been taken into the smart grid projects as shown in the following sections.

Energy Distribution Provider Engagement

The Narara Ecovillage is part of the Ausgrid network and as such are required to meet their connection requirements. Ausgrid standard NS194 which is based on the national standard Australian Standard AS4777 is of particular relevance as it relates to embedded generation capacity over 30kW. The Ecovillage will install 380kW solar generation capabilities and it's expected to be close to 1MW for the 150 planned houses.

Ausgrid NS194 details the grid protection requirements for sites with generation capacity greater than 30kW. Grid protection is required to protect the broader distribution network at times of grid instability e.g. over voltage, grid offline etc.

While the project began prior to the ratification of the standard, the impacts of changing requirements was unanticipated as it was assumed the prior in-principle support carried through. Ausgrid had indicated that the Ecovillage could be a test site both due to its high penetration of solar generation but also for the installed automatic tap transformer. The Ecovillage is aware of only three of these transformers installed in Australia and the only on the Ausgrid distribution network.

As the project began installing the photovoltaics, they were made aware that the in-principle support was for a 12-month period which had lapsed while the above mentioned sub-division challenges were solved. As a result, the project team needed to re-engage with Ausgrid on the grid protection requirements.

There were large delays in re-engaging with the right teams within Ausgrid due to:

- **Change in personal:** A change in personnel and roles at both Ausgrid and the Ecovillage meant the original conversations and agreements needed to be restarted and prioritised. The Ecovillage was looking for bespoke support through their innovation initiatives while the standard Ausgrid process was through their Major Connections teams.
- **Navigating the process:** The Ecovillage project team's lack of understanding in the Ausgrid solution delivery project meant that key information wasn't developed adequately to make timely decisions.

The primary lesson learnt, that is as yet unresolved, is to ideally find an appropriate way to embed the energy distributor into the project team. As discussed above, engaging with teams focussed on innovation and new technology developments would hopefully bring an unconstrained partnership with novel projects such as ours. Research has shown this approach working in other distribution networks such as the Yackandandah mini grid on the

AusNet network¹ and the Mornington Peninsula “Community Grid Project” on the United Energy network² However, if this isn’t achievable or appropriate, another option is to engage with the right skill sets as is discussed with the next lesson learnt.

Project Team Skills and Third-Party Support

The ethos of the Ecovillage is one of grass roots development to build a demonstration urban environment compatible with environmental and sustainable practices. How this translates into reality is that a large part of the organisation is run by member volunteers. This is true with the Board representatives, the marketing, legal and finance teams, and other operational teams such as food production and landscaping. It also translates throughout operational management and project solutions development.

While generally it was possible to draw on knowledgeable members across business management, electrical engineering and solar installation skills, specific industry knowledge had to be drawn from paid external consultants with knowledge and experience of the Ausgrid networks and emerging microgrid and community battery solutions. This need was identified during discussions with Ausgrid in relation to the Grid Protection where detailed electrical engineering designs and drawings were required to progress even conceptual solutions through the approval process. It was anticipated these details would be needed during the implementation stage however to save costs it was hoped that an adequate conceptual solution could be found through a collaborative partnership with Ausgrid.

As the solution stalled, a decision was made to engage with third- party subject matter experts to design a solution that was largely known to be appropriate based on previous approvals.

An initial design was worked through however was found to be beyond the project budget due to specialised parts from the manufacturer. A second design iteration is underway using more “off the shelf” products.

As with the above learning, where possible and cost effective, the project should aim to retain these third-party experts throughout the entire process. Since engaging more with third parties, the project has been able to navigate aspects of the solution that, in hindsight, would have taken far longer if only leveraging internal skills.

¹ <https://www.ausnetservices.com.au/en/Misc-Pages/Links/About-Us/News-Room/News-Room-2017/Australias-first-community-mini-grid-launched-in-Yackandandah>

² <https://www.communitygridproject.com.au/partners-2>

Going Forward

Now that houses are being built and the network integration challenges are clear, the primary activities going forward are:

- **Network Integration:** As noted above the Ecovillage must comply with the Ausgrid requirements relating to NS194 and is a non-negotiable for projects such as the Ecovillage where the total generation exceeds 30kW.

To date the project team have largely tried to navigate this process directly with Ausgrid however it's clear, based on the learnings above, that third party external support is required.

These third parties must have experience designing complying grid protection systems, importantly how they will interact with the mid and longer term goals of the Ecovillage and in working with Ausgrid through the processes.

It's anticipated that the battery storage will be designed and quoted on as part of this work to ensure a workable, cost effective, end to end solution.

- **Battery design and procurement:** While the third party provider will design the battery storage it's become evident that the standard costs are prohibitive for the project and alternate technical and commercials need to be found to progress the battery installation.

There are some news reports that battery prices have fallen by as much as 50%³ or more this has not been reflected in the quotes received recently. There may be a level of risk built into the quotes due to the currently unknown network integration design requirements. However, it's anticipated the project team will need to find creative ways to build a battery solution that is cost effective.

³ <https://about.bnef.com/blog/battery-pack-prices-fall-as-market-ramps-up-with-market-average-at-156-kwh-in-2019/>

Ideas that are being explored are:

- **Partnering with research organisations** that can gain in-depth knowledge on battery requirements for community sized installation such as the Ecovillage.
- **Use of recycled Electric Vehicle batteries.** This has the additional benefits of being well aligned to the philosophy of the Ecovillage in reducing and upcycling waste streams.
- **Crowd funded or Carbon Offset schemes** where the cost of the battery storage can be funded through offering of benefits to investors / purchases that are also part of the Ecovillage.
- **Philanthropic support** through identifying people or organisations that wish to support what the Ecovillage is trying to achieve as a model for future communities.

Achieving one or more of these options will both improve the cost effectiveness of the solution but also provide insights for future projects of this nature.

This report was written by the NEV Power smart grid project team, led by Lincoln De Kalb Head of NEV Power.

For more information on the Narara Ecovillage please visit www.nararaecovillage.com.au or reach out to NEV power at power@nararaecovillage.com

