THE UNIVERSITY OF QUEENSLAND
AUSTRALIA
CREATE CHANGE

Millaa Millaa Energy Resilience Meeting

Summary of meeting held at Millaa Millaa CWA Hall 7pm – 9pm Wednesday 23rd March 2022

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Contents

Meeting details

Thanks to QCWA for the use of the hall and for the catering, tea and coffee. Thanks to everyone who attended.

Present:

Local community: 48 members of the wider Millaa Millaa Community

University of Queensland: Stephen Snow (facilitator), Mashhuda Glencross

Energy Consumers Australia: Caroline Valente

Tablelands Regional Council: Dave Bilney

Ergon Energy: Sara Collins

Lions Club of Millaa Millaa: Pat Reynolds (president), other members

Introduction

Purpose of meeting

Millaa Millaa, like other small towns in Far North Queensland, is susceptible to interruptions to electricity supply due to cyclones, storms and scheduled maintenance. The town has also experienced brown-outs, e.g. power frequency disruptions which can cause lights to flicker and can damage sensitive electronics such as fridge or air conditioning inverters.

The University of Queensland in collaboration with Millaa Millaa Lions Club and supported by Energy Consumers Australia is conducting a feasibility study towards addressing these issues through microgrid technology. The Feasibility Study – if accepted – allows us to bid for up to $2 million of federal funding to assist this venture through the Australian Renewable Energy Agency (ARENA) Regional Australian Microgrids Pilot Program. The feasibility study requires detailed studies of any proposed microgrid's that consider the following:

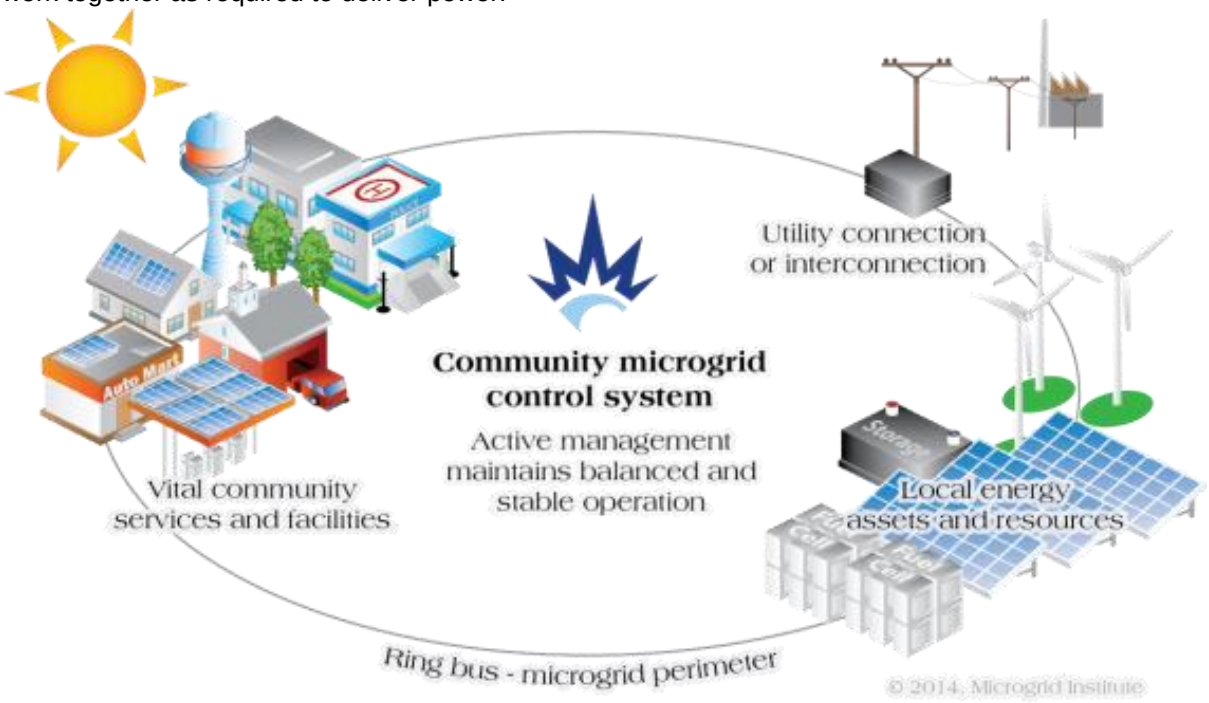
1. Technical feasibility
2. Economic feasibility
3. Regulatory feasibility (e.g. does the solution fit in with Australia's "National Electricity Rules" and with Ergon's network operations?

But before committing substantial resources to these components, or going into detail of specific solutions, we felt it was vital to speak to you first and hear your thoughts on the proposal and how it might work. This was the impetus behind the CWA Hall meeting and we thank you all so much for turning out in such strong numbers and sharing your ideas, concerns, suggestions.

For those who were not able to attend, the following provides an overview of (1) UQ's presentation (the slide deck is also available on our project website (https://itee.uq.edu.au/project/resilient-and-renewable-aiming-greater-power-resilience-millaa-millaa), (2) how a microgrid could work, (3) workshop outcomes including an overview of questions asked and (4) next steps in our feasibility study.

What is a microgrid?

A microgrid involves installing technology to enable the isolation of a small portion of the existing electricity grid and operate when the network is down, using its own electricity generation resources (picture below). Microgrids involve the connection of distributed energy sources such as solar, wind, hydro and (if required diesel backup) to power the microgrid when the network is down and software to enable these sources to work together as required to deliver power.



Source of figure: http://www.microgridinstitute.org/

Microgrid pilot projects exist in different parts of Australia, including Esperance, Kalbarri and Onslow in Western Australia. Microgrid feasibility studies are underway in Queensland including Yarrabah near Cairns and Claireview/Stannage Bay, north of Rockhampton.

Further sources of information on Microgrids include (click on the hyperlinked purple text to visit each of these websites):

- The International Microgrid Association
- Western Power (WA) microgrids, with links to further information on the website.
- A report on power options for the Daintree (QLD)
- Proposed Daintree (QLD) microgrid
- The Yararabah (QLD) microgrid feasibility study

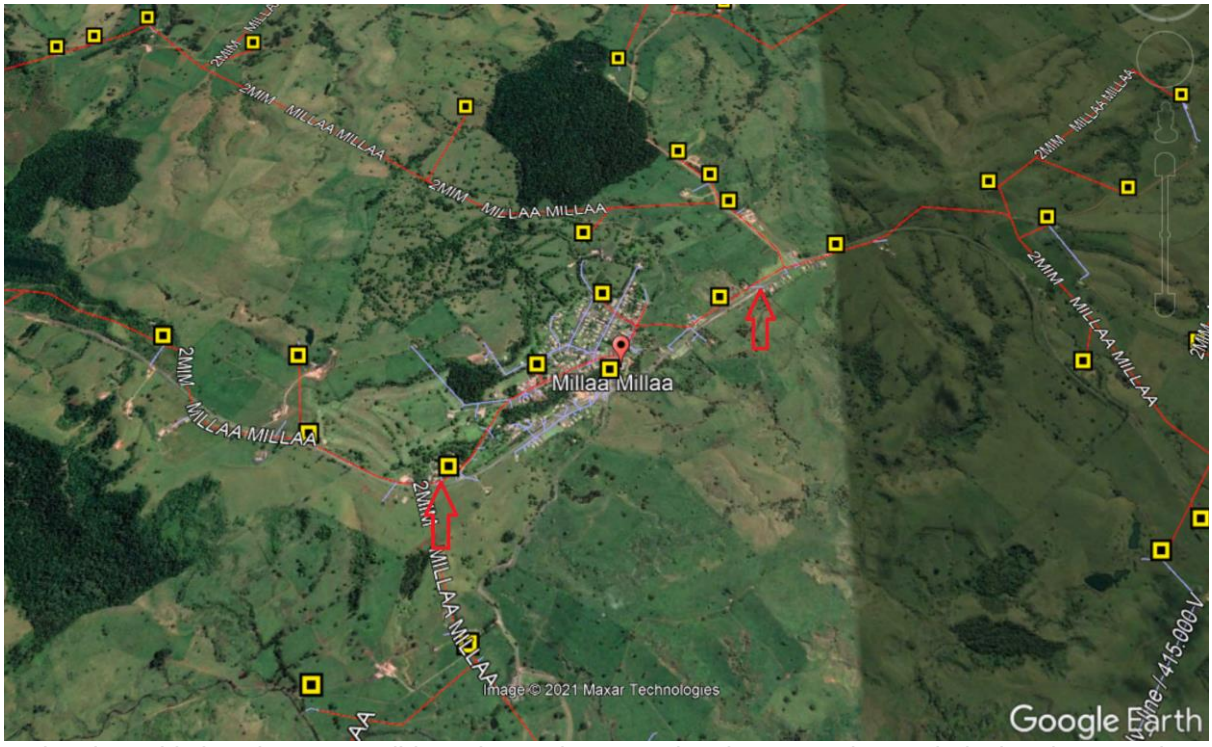
A microgrid is typically built to be capable of switching between normal network operation and microgrid (isolated) operation seamlessly. However, we are looking at the substantial cost savings possible by instead designing a manual changeover to microgrid operation in the event of a network outage (involving a short blackout to enable this changeover), which is far cheaper than the technology required for seamless/autonomous changeover. Once established, if the network loses power, network switches could be activated to isolate the town itself and energise the microgrid. This means the town would regain power in ~30 minutes and retain power, even during a prolonged network outage.

> *"Microgrid operation":* Refers to when the microgrid is activated, when the network is down, but the town has power through the microgrid.

"Normal operation": Refers to the other 99.9% of the time when there is no network outage and the microgrid is not activated. In these circumstances, the town draws power from the network as it currently does.

Microgrid operations: How could a microgrid provide power to Millaa Millaa when the network is down?

The map below shows the 11kV transmission lines (red lines), 415V wires to houses (purple lines), and the location of power transformers (yellow squares) that distribute power to houses and businesses. One option would be to isolate the town by installing network switches at the locations denoted by red arrows. Normally the network switches are open and the town draws its power from the electricity grid. But if the network switches are closed, the town is "islanded" and commences microgrid operations.



To be clear, this is only one possible option and we are planning to conduct technical and economic feasibility studies for a range of potential options and will come back to discuss these with the community once we have done so. This option above is simply one option which we believe would be technically possible**.**

How would a microgrid in Millaa Millaa get it's power?

Microgrids can accept power from a range of sources, e.g. solar, wind or petrol/diesel generation. If being used for microgrid operations (i.e. keeping the town or part of the town powered in a blackout), those sources of energy need to come from within the town, rather than outside the town.

Stationary battery: It is likely that a stationary battery would form part of the microgrid. An example of a stationary battery is the one operated by UQ, which you can be read about HERE. UQ would not operate a stationary battery as part of a microgrid in Millaa Millaa. This is because it is unlikely to be feasible to gather the required energy to power the town from installations of household scale solar and batteries alone. Solar is not always available following a cyclone and it is important to have energy stored up. A stationary battery provides an important source of power to the microgrid when it is in operation (during network outages), but can be a revenue generating asset for the 99% of the time when there is no network outage. This is achieved by the battery buying electricity (i.e. charging) off the grid when the spot price is low and selling electricity to the grid (i.e. discharging to the grid) when the spot price is high. The fluctuations of the spot price of electricity in Queensland (and other states) can be seen on the Australian Energy Market Operator's

price dashboard HERE. We envisage income generated by the battery being used to cover some of the operational expenditures of upkeep of the microgrid.

> **Specific actions for UQ:** Detailed technical and economic modelling is required to determine if (a) a stationary battery is required to meet the town's power needs in a blackout and (b) if so, the most cost-effective option for providing it, (c) identification of potential third parties to operate the battery.

Household solar/batteries: As well as a stationary battery, we expect a solution might involve both voluntary uptake of rooftop solar/battery. Rooftop solar with batteries can reduce household's power costs in the short term through reducing consumption of grid power. More information on household scale battery storage is HERE, with links to further information. Already around 5% of Queenslanders own household scale batteries with their solar panels. If successful, we envisage the ARENA Grant funding could be used to subsidise the purchase cost of household-scale batteries, because households would not have complete control over their battery all the time, hence it is fair to provide a subsidy.

Other sources of power: Because of the low availability of solar post-cyclone and existing petrol generators in town, it is likely that petrol/diesel backup may be necessary for a microgrid solution for Millaa Millaa, but would not form the primary fuel. We will look at micro-scale wind generation (not largescale such as Kaban) and also hydrogen, however these latter two may not be economically feasible, even if they are technically feasible power sources.

Normal operations: How does the microgrid work for the other 99.9% of the time when grid power is available?

It would not make economic sense to invest in all the necessary batteries, solar, battery management software, network assets and other infrastructure involved in a microgrid, if the infrastructure was only utilised when there was a prolonged blackout. Any option needs to make economic sense and return on investments for the other 99.9% of the time that Millaa Millaa is supplied with power by the network.

Virtual Power Plant (VPP): An option to ensure continuous return on investment is to utilise the assets supplied as part of microgrid funding as part of a VPP. Installing a stationary battery as well as other household-scale solar/battery packages and potentially small-scale wind energy, means Millaa Millaa could (potentially) contribute to energy supply to the local region through a VPP. A VPP involves simultaneous and remote orchestration of distributed power generation assets (e.g. rooftop solar) to supply power to the network. VPP's already exist in Australia and are a valuable to energy networks as a means of grid stability, read about examples HERE and HERE.

Broadly speaking, it is possible to make money from VPP's, as Queensland's electricity spot price can fluctuate broadly. Note the "spot price" is not the retail price customers pay, but the price that retailers pay to buy the power themselves from generators in the National Electricity Market (NEM). The electricity spot market is similar to the stock market. You can observe fluctuations in the spot price of electricity HERE. With household scale batteries and/or a stationary battery installed as part of a solution that can power a microgrid, it is possible to orchestrate these assets to charge up when the spot price is low and sell the energy back to the market when the spot price is high. This behaviour allows the assets to make money (normally via a third party) to ensure they are fully utilised assets and the money invested in the microgrid enjoys a return on investment.

Further economic feasibility studies are required to determine who might run a VPP on behalf of the town and suitable monetary and power sharing arrangements.

Workshop outcomes

Very broadly speaking there was good support from those in attendance regarding a solution to improve power resilience in the town. As well as gathering feedback on different options and potential solutions, the meeting was hugely beneficial for UQ, being able to draw on the depth of local knowledge and experience you all have.

The Millaa Millaa community answered many of UQ's questions:

For example we were able to answer questions we had around existing infrastructure, finding that:

- Town water is supplied by Tablelands Regional Council (TRC). TRC have recently secured funding to install backup power generation to ensure that the water supply to the town is secured even if there is no power.
- There is a Telstra and an Optus comms tower in the vicinity. The Telstra tower is believed to have independent power backup, while the Optus one does not.
- There are independently operated sources of hydroelectricity on properties out of town which could be utilised as part of a Virtual Power Plant (VPP), when there is network power.
- The community contributed excellent first-hand accounts of the impacts (direct and indirect) of Cyclones Winifred (1986), Larry (2006) and Yasi (2012).
- Residents' reports of "brown-outs", e.g. lights flickering, fridge motors blowing, suggest there may be intermittent issues with power quality, separate to actual blackouts. We will investigate these and the potential role of batteries in power quality stabilisation.
- If you feel any of this information needs correcting please get in touch: s.snow@uq.edu.au.

Questions asked during workshop

The purpose of the workshop was to listen to the community and we were pleased to field many questions about the energy resilience. Here we paraphrase some of the questions received and Steve's (approximate) responses. Note this is **not** a complete list of questions and are provided as an overview only. Many other questions and points were raised about energy provision and Ergon Energy's role and operations, which Sara Collins (Ergon Energy) answered.

Q: Who operates this stationary battery? And hence who benefits from the money it generates?

A: All this is dependent on the outcome of economic modelling which we will carry out subsequently. At this stage, we envisage a stationary battery would be an asset which be operated by a third party, e.g. an private energy services company. It is unlikely that the community itself, or the Tablelands Regional Council would have the required knowledge or capacity to operate the battery itself. It would be important that any company engaged to provide this service would enter into a contract such that any profits resultant from the battery (after the operational expenditures and third party costs) are fed back to the community.

Q: Could the community own and operate the stationary battery?

A: Yes in theory, but we're not convinced it's a good idea. Community battery schemes do exist (https://www.ausgrid.com.au/In-your-community/Community-Batteries). But these are typically opt-in initiatives, where only customers who opt-in draw benefits and we are not aware of community batteries that are used for essential services, e.g. supplying power to a microgrid used to isolate a town during network outages. If the battery was community owned and operated, it would (in theory) require monetary input from every customer in town, because every customer in town would benefit from it when it was supplying the town when the network is down. We don't feel like it would be fair to (a) ask every householder in Millaa Millaa to stump up cash to contribute, or (b) expect only certain customer who opt in, to pay for a service that everyone benefits from.

Q: If we were to have a battery / solar that was feeding into the microgrid (when it was in operation when the electricity network was down), we'd be feeding it for free, but other customers would be paying for that electricity they use. So isn't Ergon making money off us unfairly?

A: The actual amount of time that the network is down is typically not very long, i.e. 12 hours – 2 days max. Under microgrid operations households would be urged to conserve power, meaning perhaps consuming 5-6kWh per day, which at Ergon's 24c per kWh means around $1.20 per day per customer. We feel that the value of keeping the power on to the town far exceeds the fact that you might be losing feed-in tariff / control

of your battery during this time. Plus Ergon would be proving in-kind support to the microgrid (if the funding proposal is successful) by agreeing to install some required infrastructure.

Q: If we isolate the town itself, if a tree falls on a power line within the town itself, does this mean the microgrid fails?

A: Essentially yes. But by limiting the size of the microgrid to the town boundaries (or even the main street, which is also an option), we reduce the risk of a fault occurring within the microgrid area itself. At present, if a tree falls anywhere along the 11kV feeder line, anywhere between the Evelyn Zone Substation and Millaa Millaa (~15km), the power goes off. By limiting the geographic size of the microgrid we reduce the risk of this happening, but we can't eliminate risk completely.

Q: What if you were to create two or three separate microgrids in the town to protect against this scenario?

A: This is a possibility we will look into. The more network switches we need to install to isolate specific components the more expensive it would become, but limiting the microgrid to the houses/businesses connected to a single poletop transformer is definitely a possibility and would reduce the risk relative to having the whole town (or an even larger area) isolated.

Q: Is there a possibility of portable batteries that households can charge?

A: Yes, it's possibility. But being conscious of the weight of batteries meaning not everyone can carry them and the relatively small capacity (i.e. amount of electricity stored) in batteries that are light enough for most people to carry, this is not considered a standalone solution, but could potentially form part of a solution. It may alternatively be possible to have a bank of charged batteries in town available for users to borrow if they wish on an as-needed basis.

Q: There is privately owned hydro-electric on properties in the area, could these feed electricity into a virtual power plant (VPP) when the network is active?

A: Potentially yes, this is something we will investigate

Q: It can rain or remain cloudy for weeks after a cyclone. Is solar really a viable option for providing power and charging batteries post-disaster in a network outage?

A: As part of the feasibility study we will be undertaking modelling which takes into account the required electrical loads of the town, solar surface radiation and other variables. Solar would not be the only source of power and while we're exploring wind and whether the local hydro could be used, we feel it is likely that some diesel generation would be required for microgrid operation (only when the electricity network is down).

Q: I'm planning on buying battery myself in the short term. Can you advise on what brand/type of battery I should buy to ensure I'll be compatible with the microgrid if your funding bid is successful?

A: It's great you're thinking about this, we'll look into it and get back to you once we've carried out further technical feasibility studies. The feasibility study is due in October and between now and then we will carry out the requisite technical and economic feasibility studies and return the results of these to you through a second visit.

Q. We have 20KW of solar and no battery, will this allow for batteries to be put in and used when grid needs it and used by [our business] when it needs it in the evening.

A: We would definitely look at utilising available local generation resources such as your solar generation, whether installed on-site (at your premises) or ensuring your solar feeds into a stationary battery located elsewhere.

Q. Is there somewhere we can find out more information, see a functional system and better understand how it all works?

A: See above for some links, also look on Western Power's website or google "western power + microgrid" because Western Power (the electricity network in Western Australia) has commissioned (or is planning) microgrids.

Q. What is the time structure? What are we looking at in terms of the duration of the feasibility?

A: The feasibility study is due in October, ARENA will take (at a guess) around 3 months to review all feasibility studies, then we have an outcome. If successful, a full bid would take approximately 6-9 months. We'll get back to you with exact timelines.

Q. What about aging solar panels? They only last 20 years, who is responsible for replacing them?

A: If a microgrid solution involves households opting in to purchase panels or batteries, these would would remain your property, even if you received a subsidised cost. The choice to replace them after their usable lifespan would be yours, the same as if you paid full price for panels or battery. Under no option do we expect to require people to purchase panels. This would only be on an opt-in basis.

Q. Stakeholder engagement, has consultation happened with telco?

A: Not yet, we wanted to talk to you (the community) first before committing further resources. Now we have general support, we will do this.

Q: During Larry we went without water because water requires power to pump.

A: It is our understanding that Tablelands Regional Council is installing backup generation to ensure that water reticulation can continue in the event of power cuts.

Q. If we get a direct hit, would Ergon come and fix the microgrid?

A: Ergon remains owners of poles, wires and all infrastructure that is currently Ergon assets. In this case, Ergon would fix their assets as they currently do. A stationary battery would need to be insured, with payments making up part of the operating costs. This would cover costs of major repairs if it was damaged in a cyclone.

Next Steps

Now that we feel we have (broadly speaking) support from the community for a solution involving a microgrid to improve energy resilience in Millaa Millaa. Given this in-principle social feasibility, we will return to UQ and commit resources to explore other critical aspects of feasibility and return with some more specific and costed solutions.

The feasibility study is due to ARENA by October 2022. Before then, the next steps involves:

1. **Further interviews and community consultation**
    a. We'd love to speak with as many people as possible, please get in touch: s.snow@uq.edu.au or visit our project website (https://itee.uq.edu.au/project/resilient-and-renewable-aiming-greater-power-resilience-millaa-millaa) and click "Register your interest" and we can organise a short interview over the phone and organise you an energy monitor.
    b. We need to understand electricity loads from the town. **Please adopt an energy monitor!** Reach out to s.snow@uq.edu.au and we can send you an energy monitor free of charge. This is a vital piece of our Technical Feasibility modelling (below) and will help you better understand your energy consumption and potentially identify ways you can reduce costs!

2. **Technical feasibility and modelling**
    a. We are already liaising with Ergon Energy to gather various data required to model the effect and feasibility of different solutions on the power network.

b. Discuss battery management solutions with potential third parties, e.g. Redback Technologies (Qld) or Reposit (NSW).
c. Identify potential battery control arrangements for households who adopt (likely subsidised) rooftop solar and batteries which can contribute to microgrid operations.
d. Liaise with Tablelands Regional Council to continue to discuss potential options and (if required) potential agreements for use of TRC resources.

3. Economic feasibility and modelling

a. Economic modelling of different potential solutions to determine the most sustainable in terms of capital expenditure (i.e. initial outlay) and operational costs.
b. Identity potential subsidies for households wishing to adopt solar/batteries that would assist microgrid operations.
c. Assess the required amount to request from ARENA Regional Australian Microgrids funding relative to other sources of potential funding.

4. Regulatory feasibility

a. Identify how any proposed solutions align with Australia's "National Electricity Rules" and with Ergon's network operations.
b. Gather available network data from Ergon (already in progress).
c. Liaise with Ergon regarding our meeting the appropriate regulations and legislation for any feasible option.

5. **We'll be back!**

a. Once we have more specific options which we have deemed to be technically, economically and regulatorily feasible, we will come back to Millaa Millaa to discuss these options in detail with the community.
b. In the mean time we will be in touch through interviews, households who would like to adopt a Powersensor energy monitor (to do so just get in touch!)

Please stay in touch! Keep an eye out on Millaa Millaa Matters Facebook page and feel free to email me at any time with any questions at all: s.snow@uq.edu.au