

Energy security outcomes from uptake of renewable energy by pre-paid meter customers; An assessment of the Marlinja Community Solar Project



Image: Marlinja Community Solar Microgrid, commissioned July 2024.

INTRODUCTION

As Australia's energy system is radically reconfigured, with close to 4 million households adopting rooftop solar, significant disparities in access, consumer protections and benefit distribution persist for First Nations' energy customers.

For many regional and remote First Nations' communities where electricity prepayment supply arrangements are common, households must "top up" the meter or run the risk of sudden disconnection when the credit runs out. Facing regular disconnection - especially during periods of extreme heat - prepay households have long been underserved by solar power that would secure their own energy needs due to regulatory and financial barriers.

While multiple studies have established links between energy insecurity and adverse health outcomes, and solar access to enhance energy security, the remedial potential of solar for prepayment-related energy insecurity in low-income First Nations' communities has rarely been examined in Australia.



This report is a preliminary evaluation of Original Power's Marlinja Solar Microgrid project, analysing changes in the incidence (frequency and duration) of involuntary self-disconnection associated with prepay, and electricity network resilience, when combined with access to the financial benefits of solar and batteries.

Summary of innovation and outcomes generated by the Marlinja Microgrid project ⚡

Community Energy Security

- The first community-owned microgrid in the NT with permission to connect to existing PWC infrastructure
- Grid forming BESS unlocks ability to supply energy to community when existing network faults
- Potential for microgrid to export upstream to expand commercial opportunities and assist with grid stability and decarbonisation of Elliott system
- Developed a product within the prepayment existing functions replicating bill crediting of FITs
- Daily credit uploads will ensure households experience direct intervention in disconnection rates and reliable, measureable behind the meter benefit
- Affordability improvements reduce bills and frequency of disconnections

Operation and Maintenance

- Marlinja employment opportunities in deployment a requirement of EPC contractors
- Local O&M capabilities supported by remote monitoring reduces contractor costs and retains benefits
- Project expansion activities including energy efficiency and export arrangements to be managed by newly established community-controlled ownership entity Marlinja Bujbu Cooperative.



MARLINJA ENERGY CONTEXT

In the Northern Territory, over 10,000 First Nations' households access energy via a mandated prepayment supply arrangement. When credit on the prepayment meter runs out, the home automatically de-energises, leaving households without access to essential functions including cooling, communications and safe storage of food and medicines.

Prevailing regulatory and policy settings exclude prepayment customers from consumer protections and choice, including the ability to access or benefit from consumer energy resources such as rooftop solar to lower energy costs. These include a lack of enabling policy through the NT Housing Department to allow solar fixtures to government-owned or leased housing, in addition to conservative load hosting limits at remote power stations preventing any significant solar connections without storage and grid-forming capabilities.

The small remote community of Marlinja in the Northern Territory's Barkly region, located on the traditional lands of the Mudburra and Jingili people, is emblematic of the energy security challenges faced by prepayment customers.



Marlinja comprises 16 households, with fluctuating population numbers between 60 and 90 people due to seasonal mobility. Families reliant on prepaid electricity faced regular household disconnections (up to ~40 per year), leaving them without cooling, refrigeration, or essential services. Network instability from nearby Elliott power station causes frequent long outages and voltage fluctuations that damage appliances.

In 2020 Marlinja Elders invited Original Power to partner with the community in an effort to solve these energy challenges, by exploring opportunities to build resilience and independence through development of a community-owned renewable energy project.

The resulting Marlinja solar microgrid project was conceived of as a blueprint for inclusion of First Nations' communities in the clean energy transition. The project team, working with Marlinja residents, set about creating a proof of concept model for how community-owned energy, integrated with prepayment metering, that is beginning to deliver tangible improvements to household energy security, affordability and overall network resilience.

Lessons and innovations derived from Marlinja's real-world project development experience are now defining and derisking pathways for prepayment customers and remote communities to share in the benefits of lower cost renewable energy for the first time.



Image: Marlinja residents explain the challenges of staying connected on prepayment meters, 2023.

MARLINJA MICROGRID OPERATIONAL OVERVIEW

In June 2024 Original Power and the Marlinja community delivered Australia's first First Nations' owned and grid-connected solar microgrid. Deployment followed four years of investment in project design, product research and development, and the navigation of connection assessment pathways and commercial negotiations with NT Government-owned utility Power and Water Corporation and energy retailer Jacana.

Technically, the project is a 130kW solar microgrid and 136kWh grid-forming BESS, situated on a parcel of land within the Marlinja Aboriginal Land Trust and connected to the Elliott diesel/gas-powered network.



The project was financed through Original Power's philanthropic networks and assets are owned by the community. The project's Power Purchase Agreement aims to replicate the benefits of direct consumption rooftop solar for prepay customers in social housing, where consumer energy resources on homes are not permitted under existing NT Government Housing Department policy.

The most significant achievement arising from the project is the successful development and implementation of an innovative benefit sharing mechanism that allows prepay residents to benefit for the first time from direct application of solar credit from the microgrid to households. This innovation was enabled by research and product development between Original Power and the meter manufacturer SecureMeters, in collaboration with the NT Government's energy retailer Jacana.

INNOVATION IN PREPAYMENT METER CREDITING FROM MICROGRID

Solar credits are now being produced proportional to solar production at the Marlinja microgrid. A weekly distribution of \$35 to all 16 Marlinja households occurs on a Friday afternoon, keeping residents connected over the weekend where 'friendly credit' loans from the retailer were commonly relied upon. These payments represent an average 70% saving on pre-microgrid household energy expenditure. As of January 2026 the Marlinja microgrid has generated \$23,147.77 for the community.

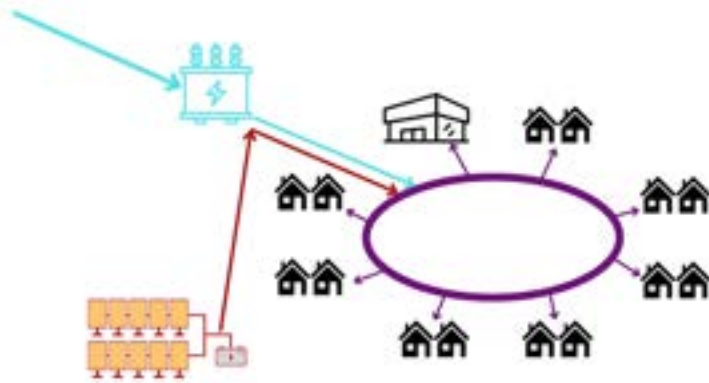
The process has been implemented iteratively, first with credit applied manually by staff onsite as service provider program implementation issues were worked through, and now through an automated retailer process in the SecureMeters SFE portal.

The Marlinja prepay meter crediting assumes an agreed wholesale cost basis that is informed in part by NT Government retailer Jacana Energy's allowable rate. Jacana receives production data from their meters at the community microgrid and household consumption data which is cross validated with inverter data reported by community. Assuming successful reconciliation Jacana pays a bulk amount to the microgrid customer account.

80% of this amount is then distributed to Marlinja's 16 households on a weekly basis, with the remaining 20% withheld in a pool which acts as a buffer where weekly credits can be disbursed from in the event of a system fault or extreme seasonal production variances impacting energy production and therefore revenue.

Based on historical production data, Wet and Dry season tariffs have been developed and will be iteratively refined using data from the year prior. The program in its entirety is designed to minimise the disruption of reliable weekly household crediting to ensure minimum impact on household budget planning by residents.

This first-of-its-kind mechanism delivers the benefits of the microgrid, proportional to solar generated at the microgrid, direct to the meters of families who were previously excluded from the clean-energy transition.



System Size PV: 130 kW BESS: 136 kWh Inverters: 2x 100kW hybrid inverters
Anticipated Annual Dispatch ~98.95MWh
Anticipated Annual Demand ~123.77MWh
Responsible Parties to Crediting Jacana, PWC, OP

Image: Marlinja microgrid energy distribution pathway.

EVALUATION OF IMPACT - FIRST 12 MONTHS OF OPERATION

While the project experienced significant delays between commissioning and the application of an automated process for benefit sharing to household prepayment meters (approximately 12 months) due to uncertain regulatory processes, product development, testing and implementation and multi-agency cooperation challenges, it is now delivering the intended outputs to enable effective evaluation.

This has resulted in a split data set in which manual top ups to household meters were occurring fortnightly at a slightly higher rate than the current automated process which occurs weekly. Our analysis also adjusts for variability in household occupation, and focuses only on its current Wet season operation.

These delays are reflected in the high level of innovation and implementation coordination required to establish commercial and benefit distribution pathways for community solar and prepay meters.

Despite this, the evaluation has produced the earliest evidence that community-owned solar can operate effectively alongside pre-paid metering, removing access barriers for First Nations' energy customers excluded from renewable benefits.

Over 10 months the Marlinja microgrid has reliably generated and distributed solar credits to 16 pre-paid households, improving energy security by reducing frequency and duration of household disconnections and strengthening resilience during supply-side outages and extreme weather.

Evaluation of this first phase of meter crediting arrangements and microgrid performance is now underway using a preliminary, ongoing mixed-methods assessment of how the Marlinja microgrid improves household and community energy security for prepay households.

A participatory, community-guided evaluation framework integrates residents' lived experiences together with smart-meter data to track changes in energy use. This framework has identified key indicators of the systems' impact, including:



INDICATOR	MEASURE
Reduction in household disconnection and credit top up frequency	A measurable indicator of improved energy security and a key community objective guiding project development.
Improved energy affordability	Households experiencing an average <70% cost reduction since solar crediting applied
Improved system reliability.	Performance data from the microgrid also demonstrates strong improvements in community-wide energy resilience to outages and voltage fluctuations with the microgrid providing grid forming capability in the event of outages
Community perspectives	Residents report in household surveys pre and post-microgrid project success in terms of longer-lasting power, fewer top-ups, and reduced stress around disconnections. This aligns with the evaluation’s focus on changes in disconnection and reconnection patterns to measure impact.

Household surveys taken prior to and post-microgrid installation a year apart reveal residents consistently describe project success in terms of longer-lasting power, fewer top-ups, and reduced stress around disconnections. This aligns with the evaluation’s focus on changes in disconnection and reconnection patterns to measure impact.

As one community leader put it: *“This Wungu – solar power – it’s helping us a lot. The power lasts longer, it goes further... it’s changed our life. It’s changed the community.”*

These qualitative insights correspond with emerging meter data showing a downward trend in self-disconnection events. This analysis provides important lessons for policy and regulatory reform, including practical requirements for integrating solar credits with prepaid metering and the governance, regulatory, and commercial barriers that must be resolved to allow the scaling of these benefits to other prepay communities.

RESEARCH AND EVALUATION METHODOLOGY



This research seeks to build upon and scale a previous evaluation study of Original Power’s rooftop solar and prepayment meter integration trial in 2019 which found that access to subsidised solar wholly mitigated the incidence of involuntary ‘self-disconnection’ for a single (the first) prepay household to connect to solar.¹

Based on this case-study, our present hypotheses are that solar PV could ease experiences of household energy insecurity across a single (prepay) community, whose residents experience frequent (involuntary) household disconnection from energy services.

Few studies have focussed on this potential, as:

- *The energy insecurity of this cohort has remained ‘hidden’, absent from most public facing utility reporting and;*
- *Prepay customers have long been precluded from the necessary connection agreements that are a vital prerequisite to connect consumer energy resources such as rooftop solar.*

The working hypothesis is that we will be able to demonstrate the benefits for household energy security that providing subsidized access to a known quantity of clean energy provides for Marlinja residents. In addition to this, we will aim to demonstrate the viability of the Liberty 120 pre-paid meters as the distribution mechanism that shares this benefit as ‘solar credit’ with local households, direct to their meters, thus reducing the amount of grid-drawn electricity needed and reducing household energy expenditure and disconnection rates.

Findings are validated using 15-minute household electricity interval data collected pre and post solar installation between February 2022 and February 2026.

Community-wide household energy surveys have also been undertaken to support assessment of the customer experience of key project outcomes and metrics both pre and post microgrid installation, and against key operational milestones including manual and automated crediting application.

This project uses quantitative (regression) analysis to investigate changes in rates (frequency and duration) of household disconnection from energy services, with the aim of answering the following question:

Can access to solar PV reduce the frequency and duration of household ‘self-disconnection’ from energy services - a known indicator of energy insecurity for prepay customers?

¹ The trial was conducted by Original Power at the home of Norman Frank Jupurrurla and his family, House 6, Village Camp in the town of Tennant Creek, NT in 2019. Evaluation report accessed at [Full article: Connected: rooftop solar, prepay and reducing energy insecurity in remote Australia](#)



SUMMARY OF DATA ANALYSIS

This statistical analysis is based on the first set of data provided by energy retailer Jacana, capturing customer energy usage data between February 2022 and February 2026.

Future quarterly analysis will build on this foundation to capture additional variables and further observations across operating seasons during the post-microgrid period.

We focus on three key outcomes:

- *Reductions in disconnection events,*
- *Changes in electricity use due to energy efficiency interventions*
- *Reduction in out-of-pocket costs for households after the solar credits are applied.*

Key findings:

- *There were significant reductions in disconnections on Fridays and lower rates of disconnections on Mondays. The impacts on friendly credit will be assessed when Jacana provides further data.*
- *An expected increase in energy consumption has been observed of approximately 100 kwh per day in the six months following microgrid commissioning.*

This coincides with the six month hotter Wet season data available for analysis and results from the installation of 65 new split system air conditioners across households, replacing more expensive and inefficient box air conditioning units and drastically improving thermal comfort and wellbeing for households.

Energy consumption increases are notably related to the daily maximum temperature. At 25°C electricity use is similar but then diverges as it gets hotter.

- *Marlinja households are spending less out-of-pocket on electricity. The impact on out-of-pocket costs differs by temperature. For all temperatures below 46°C, Marlinja households are spending less out-of-pocket on electricity even with the increased electricity use during hot temperatures. At colder temperatures, households are spending up to \$34 less on electricity per week.*

DATA AND ANALYSIS

For the purposes of this evaluation, Jacana provided data on electricity use and disconnection events. Data starts in February 2022 and ends in the summer of 2025/26. This has allowed us to capture a robust period of historical data before the microgrid was installed, the period of microgrid operations prior to the implementation of auto-crediting, and the period of operations since auto-crediting including a notable part of the 2025/26 summer. Disconnection rates have been compared against pre and post auto-crediting seasonal analysis. Future analysis will analyse the impacts of automated crediting (introduced by service



providers in September 2025) during different seasons. Weather station data was sourced from The Bureau of Meteorology.

We have estimated two models of disconnections and electricity use using regression analysis, which was conducted using Stata. The data was aggregated to daily-level observations to match with temperature data. In these next sections we focus on the results across days of the week (disconnection) and maximum temperature (electricity use and expenditure).

Impact on Disconnection Rates

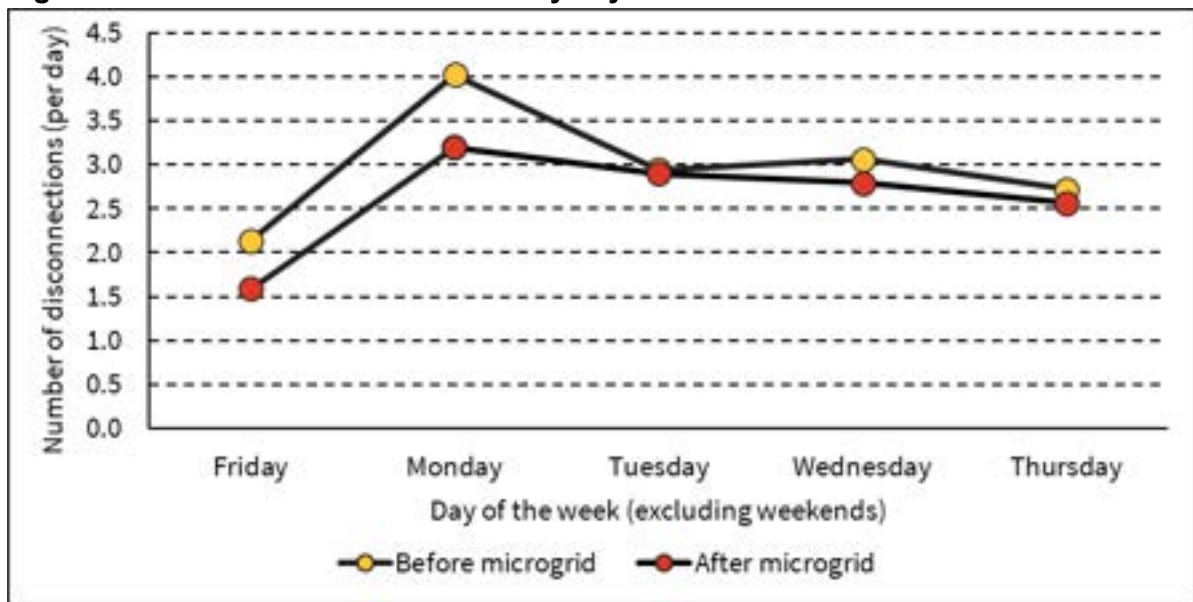
Jacana took over meter crediting processes in September 2025, moving from manual to automated through the retailer’s SFE portal. This provides a \$35 credit to all 16 households via the meter on Friday afternoons.

To assess the impact of these credits on the number of disconnections per day, we estimated a model of daily disconnections using a statistical regression with Newey–West standard errors to adjust for serial-correlation. This provides estimates of the average number of disconnections per day, and we have extracted these estimates across days of the week. Weekends are accounted for in the model but not presented here as the estimates are close to zero, which is as expected due to solar credit being applied during weekends.

Figure 1 shows that there were significant reductions in disconnections on Fridays. Lower disconnections also occur on Mondays. Since the credits were paid on Fridays, the impact of the credits occurs on the same day and the next day that customers can be disconnected.

It is likely that this is coinciding with a decrease in the use of friendly credit during weekends, but this will be confirmed when Jacana provides further data in the remaining 2025/26 Wet season period.

Figure 1 – Number of disconnections by day of the week



Electricity Use and Expenditure

In addition to the installation of the microgrid, Marlinja households also installed split system air-conditioners in November 2025. This means that the most recent summer was likely to have different patterns of electricity use during typical extreme temperature periods. To account for this, we developed a model of electricity use that was estimated using a Fixed-effects linear model that accounts for a first-order autoregressive disturbance.



Image: Energy efficiency program works to improve energy literacy and thermal comfort in homes, while improving productivity at the Marlinja microgrid, November 2025.

In this model, we incorporated two temperature variables. These were a variable for the daily maximum temperature across the entire sample and a daily maximum temperature variable that was greater than zero for the period after the split system air-conditioners were installed. This provides two estimates of the relationship between electricity use and the daily maximum temperature.

Figure 2 shows that greater electricity use has occurred after the microgrid and split system air-conditioners were installed. This increase is related to the daily maximum temperature. At 25°C electricity use is similar but then diverges as it gets hotter.

It is important to note that this hasn't necessarily increased out-of-pocket expenditure on electricity as Marlinja households now have both split system air-conditioners and solar credits. Figure 3 compares the amount of expenditure per week before and after the microgrid. The estimates for the relationship after the microgrid are shown with and without the solar credits (of \$35 per week).

For all temperatures below 46°C, Marlinja households are spending less out-of-pocket on electricity even with the increased electricity use during hot temperatures. At colder temperatures, households are spending up to \$34 less on electricity.

Figure 2 – Electricity use per week by temperature

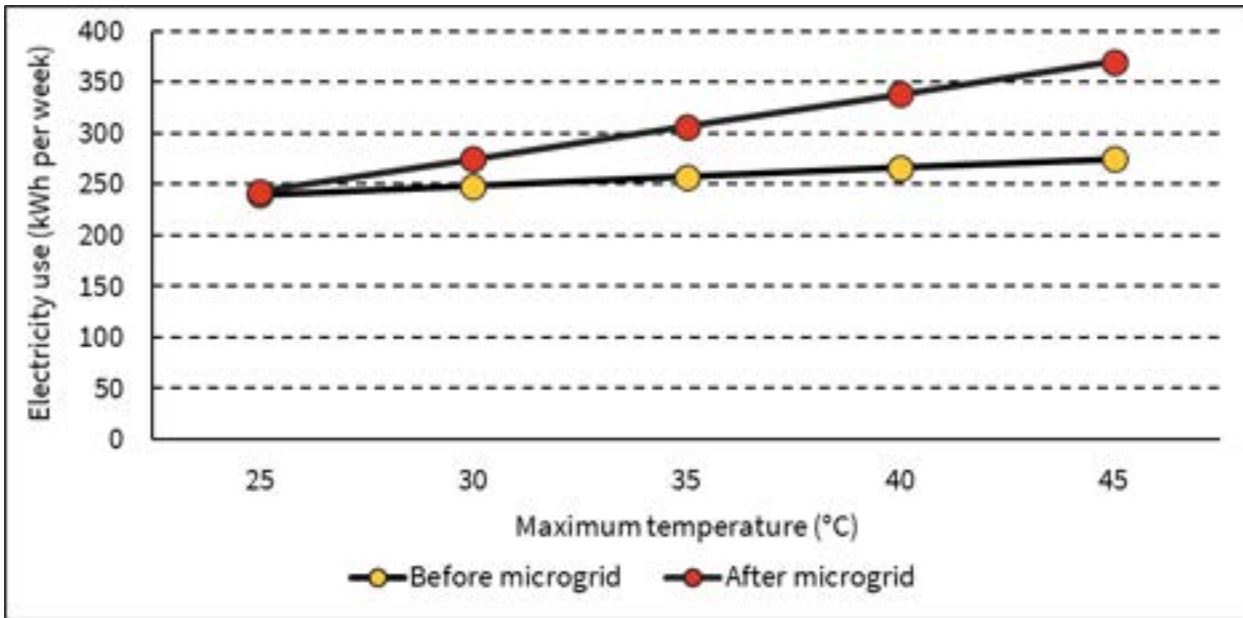


Figure 3 – Expenditure by temperature

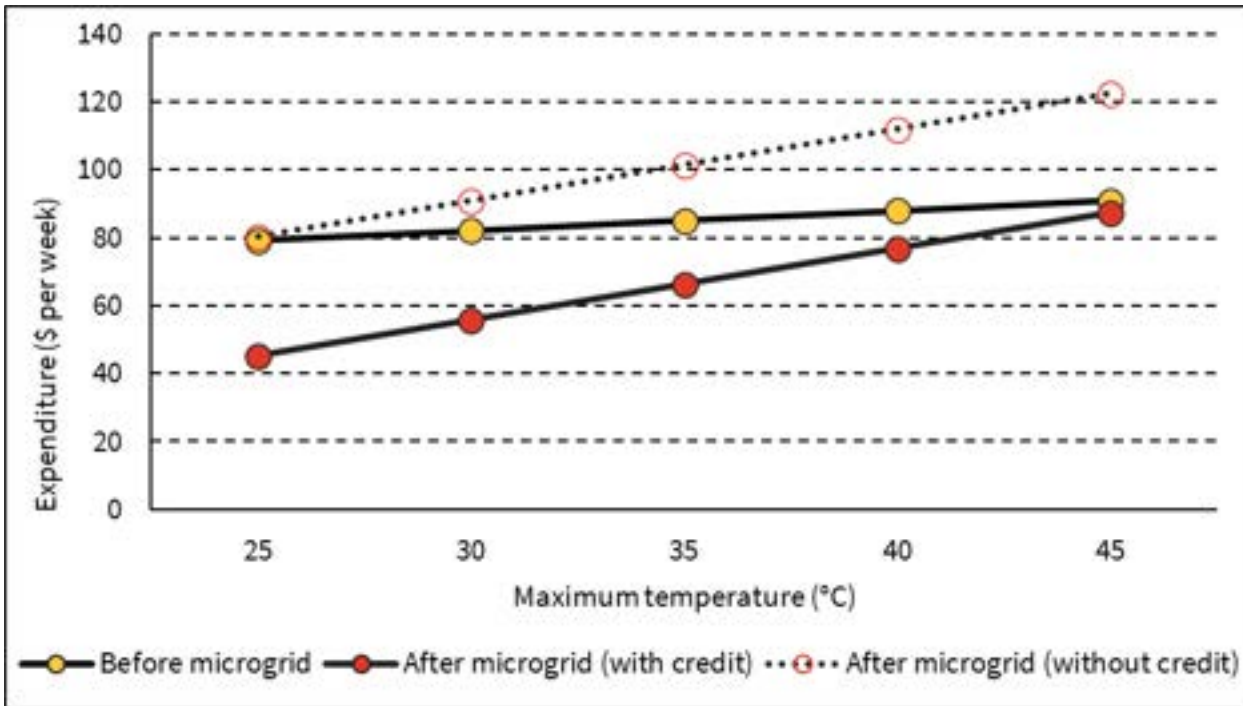




Image: Marlinja microgrid is deployed on site, July 2024.

KEY LESSONS AND RECOMMENDATIONS

The Marlinja Microgrid project has opened up a set of opportunities, technical, social and policy, that for the first time can enable equitable inclusion of First Nations and prepaid communities to participate in and genuinely benefit from the transition to renewable energy. The project has established novel regulatory and technical pathways that remote communities, utilities, and policymakers can foreseeably build upon to models of equitable First Nations' community clean energy initiatives at a programmatic scale.

This first-of-its-kind mechanism creates an opportunity for broader reform of prepaid energy systems in the Territory, and for new investment models that finally include households historically excluded from legacy energy systems and the rapid solar transition.

For Marlinja, the microgrid has created opportunities for greater community control and future revenue-generating potential (should export limits change). It has also strengthened local capacity: the project's co-design approach has deepened energy literacy, governance capability, and confidence in making long-term decisions about community infrastructure going forward.

The project also positions Marlinja as a local, regional and national example - opening pathways for knowledge-sharing with other communities, industry and government, and scaling of First Nations'-led clean energy initiatives. In solving its own immediate energy challenges, Marlinja community has also created new possibilities for community-driven energy futures in and far beyond the Northern Territory.



Image: Marlinja residents share their project development story with visiting ARENA and utility representatives, 2024.

TECHNICAL AND REGULATORY REFORM RECOMMENDATIONS

1. **Challenge:** Conservative load hosting limits at remote power stations. PWC initially indicated limited grid capacity for solar, requiring a design with a zero-export grid connection with subsequent restrictions and commercial performance impacts. Technical barriers were de-risked by accepting an initial zero-export agreement with the capacity to expand in future. Progress relied on identifying the key decision makers and establishing a transparent and collaborative working relationship for a win-win outcome. The microgrid system proved to flexibly address constraint concerns and improved resilience for Marlinja consumers.

Recommendation: Community developers and utilities consider pursuing a staged solution approach to assessment and allow for modularity of system design to accommodate system size increase upon proof that a novel system does not threaten system security.

2. **Challenge:** Existing Power and Water Connection assessment processes are not fit for purpose, with the Marlinja microgrid requiring development of a custom assessment process. Open ended assessment timelines and changing evaluation criteria presented ongoing process risk and cost to the project over a four year period of engagement.

Recommendation: Utilities should pre-identify pathways for novel third party solutions to be assessed to reduce process risk and the resulting resource allocation risk, experienced by utility and community proponent, required to metabolise that process risk, which results in avoidable project costs that need to be recouped in commercial arrangements.

3. **Challenge:** Navigating policy barriers including a ban on rooftop solar by NT Housing required the community and proponent to spend significantly more to develop a centralised option.

Recommendation: Not all communities are able to mobilise a highly nascent clean energy project like Marlinja. Departments of Housing across all jurisdictions should commit to the timely provision of programmatic solutions for vulnerable First Nations energy consumers to access the benefit of renewables at a demonstrated efficient rooftop cost and scale.

4. **Challenge:** Prepay meter crediting and reconciliation process had to be designed from the ground up in partnership with PWC and Jacana, with product development paid by the community proponent.

Recommendation: Utility revenue should be incentivised on a performance basis with rewards for innovative service and product design and community collaboration to ensure they are responsive to consumer needs and system efficiencies through iterative process modernisation.

COMMERCIAL RECOMMENDATIONS

1. **Challenge:** The impact of zero export terms and a more expensive centralised design meant we had to decide whether this demonstration project achieved pay back on the investment or energy cost reduction for residents. Both were no longer viable.



2. **Challenge:** Requirement to build novel pricing agreement with retailer. The pricing agreement with Jacana was first of its kind and required an internal change of appetite for innovation to engage. New product design for credit application to household meters and a negotiated fee structure needed to be undertaken to facilitate the benefit sharing arrangement that could replicate a ‘behind the meter’ benefit similar to rooftop solar but within the limitations of the pre-paid metering system.
3. **Challenge:** The requirement to invest in a battery to meet PWC grid-connection requirements and overcome power-station load hosting limits added an additional project cost of approximately \$550,000. This capital was raised through philanthropic assistance by Original Power and the community.

Commercial barriers were largely resolved by philanthropic funding and industry partner assistance in the shared pursuit of de-risking innovation for energy security. As with regulatory barriers the commercial evaluation of the credits and reconciliation was possible due to collaboration with stakeholders with an appetite and means to engage beyond their remit.

Recommendation 1: Utilities must modernise their commercial products to support consumer access to transition benefits including offerings for prepay meter customer rooftop solar and community system exports which provide two fold benefit; to the proponent’s investment viability and the efficiencies of the local network performance and resilience.

Recommendation 2: Access to a third party export product or aggregated rooftop solar product as well as mandates for utilities to provide defined, fit for purpose connection assessment pathways for nascent solutions will help significantly de-risk processes and scale back the need to rely on philanthropic funding, effectively moving community solutions closer towards market.



Image: Marlinja microgrid launched and lit up at night, July 2024.