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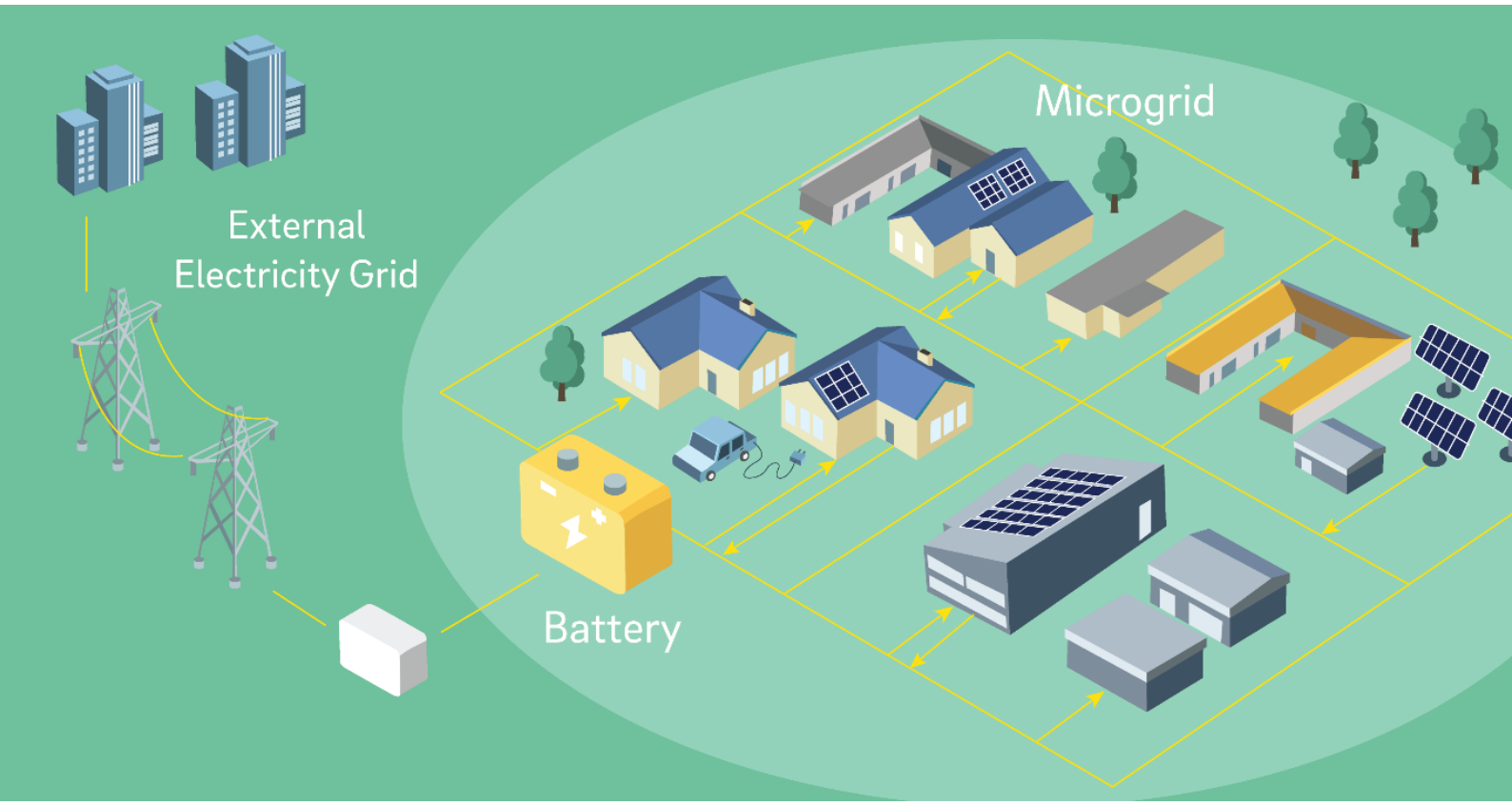
Enova Energy: Byron Bay Arts & Industrial Estate Microgrid Project

Summary Report #1
May 2021



UNSW AUSTRALIA

wattwatchers
DIGITAL ENERGY

essential energy

1 Executive Summary

The Microgrid research study serves to investigate, trial and accelerate learnings related to microgrids.

Led by Enova Energy Pty Ltd (Enova), University of New South Wales (UNSW), WattWatchers (WW) and Essential Energy (Essential) are working in partnership on the Byron Industrial Estate Microgrid Study (The Microgrid).

This is the first report derived from the energy consumption data collected from participants of the Microgrid. This report summarises the financial outcomes for the 23 participants of the Microgrid when a novel 'Microgrid Tariff' is applied to their current electricity usage over a 6-month period, from March to August 2020. The results were compared against a hypothetical 'bill' based on Enova's new Business Economy Plus tariff.

Under the microgrid tariff, customers can buy solar energy from their neighbours more cheaply than they can buy electricity from the wider grid. They also receive more than the standard feed-in tariff for electricity they sell to their neighbours. The modelling undertaken by the UNSW for the study demonstrated the potential for a Microgrid to deliver financial benefits to consumers. When the microgrid tariffs are applied to the participants' existing electricity consumption, the modelling showed that out of the 23 participants, 15 were clearly better off and could potentially save an average of $74 per month on their electricity purchases compared to electricity purchases they would make at the Business Economy Plus tariff. However, 6 participants experienced slight increases in their electricity bill of between $1-$2 per month. There were 2 customer bills that remained unchanged. Of the 9 solar customers, all were better off. The microgrid tariff also results in reduced revenue for Enova (20.7%), Essential (4.9%) and Transgrid (11%).

Note that these financial impacts don't take into account the additional costs associated with setting up a microgrid. In particular, the additional metering and the bespoke data management and billing create costs that are higher compared to regular mass-market customers. Consequently, microgrid solutions need to reach economies of scale to be a financially sustainable business to retailers.

This report is a summary of the outcomes from the UNSW modelling software prepared by Rob Passey and Hou Sheng Zhou of the University of New South Wales. This report analyses data from a six month period (March to August 2020).

A final report analysing 12 months of data will be published shortly. The ideal of these studies are to demonstrate that local microgrids are able to deliver financial benefits to customers, networks, transmission network and retailers. Ideally high functioning microgrids will generate power more cheaply due to the local generation, storage and circulation of energy, and therefore networks and retailers will realise lower revenues from microgrid participants. A Local Use of System charge (LUOS), where costs are lower for distributing power in a microgrid area, combined with batteries reduces energy costs for participants.

The construct of the microgrid tariff in this study results in financial benefits to the microgrid customers (small businesses) and not to the network, transmission network or retailer. Regulatory changes (Local Use of System charges) and incentives are required to encourage networks and retailers to consider the longer term financial, social and environmental benefits of microgrids, rather than short term financial gain. Enova Energy, in leading this research, sees this research as a foundation for considering new microgrid models and tariff structures to benefit customers and market participants.

2 Introduction

Enova Energy Pty Ltd (Enova), University of New South Wales (UNSW), WattWatchers (WW) and Essential Energy (Essential) are working in partnership on the Byron Industrial Estate Microgrid Study (The Microgrid).

This study serves to investigate, trial and accelerate learnings related to microgrids. The project forms a part of a broader Enova 'Sustainable, Resilient Regions' initiative, which encourages self-generation of renewable energy and resiliency in energy supply arrangements amongst other objectives, in support of energy resilience within the rural energy network.

In this study, the term "**microgrid**" refers to a group of interconnected loads (business participants) and distributed energy resources (roof top solar PV) within a clearly defined boundary (geographic area), where energy is generated, shared, can be stored, and acts as a single controllable entity with respect to the wider grid.

The financial modelling within this report provides an indication of how a Microgrid Tariff would impact stakeholders, namely, the retailer (Enova), the distribution network provider (Essential), and the transmission network provider (Transgrid) and customers within the microgrid (both with and without solar PV). A total of 23 businesses in the Byron Bay Arts & Industrial Estate were monitored for a 6-month period, as part of a 12-month monitoring project. This report is the first release of the outcomes of the research project.

The Microgrid tariff was designed to encourage 100% use of solar PV generated electricity available within the microgrid before drawing from the wider grid electricity. Solar generation peaks across sunlight hours, namely from 10am to 2pm each day, which in the tariff shown below has been labelled 'Sun-time'. The assumption is, if participants take advantage of the excess solar from those businesses with solar PV generation, they could potentially save on their energy bill given that prices during Sun-time will be at a lower rate than buying from the retailer. Additionally, pressure on the immediate network is reduced, and more solar generated energy is consumed.

Further benefits from a Microgrid include social and environmental outcomes for participants; support of a more efficient wider grid, in terms of increasing solar and storage in the microgrid, increasing distributed renewable energy resources and enabling participants to use and share locally created and distributed energy.

2.1 Regulatory Challenges with Microgrids

Microgrids have not managed to find ground within our current network infrastructure. There are several existing barriers to making a microgrid financially feasible for all stakeholders, as well as finding the right applications that will optimise on localised electricity usage.

Network costs play a critical role in realising the return from consuming electricity within a defined local area of the network. As it currently stands, there is no recognition by network providers to compensate locally generated, stored or consumed electricity, neither by way of reduced tariff charges nor the potential to build a more resilient grid by utilising locally generated renewables from DER.

While microgrid arrangements are working effectively within embedded network scenarios such as within an apartment building, there is scope to develop this to encompass geocentrically designed homes and businesses, greenfield developments etc. with support of regulatory changes that are required to realise such scope.

It is recognised that a connection to the wider grid would be ideal to ensure supply security outside of the electricity that is supplied within a microgrid, yet to support a microgrid arrangement, network providers need to consider applying new tariff structures such as a Local Use of System charge (LUOS) coupled with tariffs that incentivise usage during times when solar is at its highest generation. Currently, the cheapest tariffs are off-peak which are applied across the night-time.

It is necessary to recognise a wider perspective in terms of the potential benefits that may be realised from a microgrid arrangement. The outcomes of this report only look at the direct revenue losses and/or gains from utilising locally generated renewables from DER within a microgrid. It does not consider the

consequential capital cost savings that may be associated with developing a localised microgrid infrastructure, for example, reductions in investment in network augmentation costs.

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3 Method

3.1 Data from WattWatchers' Devices

Half hourly consumption and solar generation data from each of the 23 business participants was extracted using WattWatchers' [WW] devices from 1 March to 31 August 2020. There are 9 prosumers (businesses with solar) and 14 consumers (businesses without solar).

3.2 The development of the new Microgrid Tariff

For this trial, a special Microgrid Tariff was developed. The rationale for providing a novel Microgrid Tariff was to encourage more consumption of the solar PV generation that is generated within the Microgrid. Under the Microgrid Tariff, customers receive more than the standard feed-in tariff for electricity they sell to their neighbours (i.e. 7.5c/kWh compared with the 6c/kWh on the Business Economy Plus tariff). Additionally, participants of the Microgrid also benefit from consuming both the excess solar from their neighbours and general usage electricity at a lower rate during Sun-time (10 am to 2 pm).

Table 1: Microgrid Tariff vs Enova's Business Economy Plus Tariff

Microgrid tariff		
Supply charge		2.39 $/day
Charges for energy that flows in/out of the national grid		
Energy charges	Peak-times	28.1 c/kWh
	Sun-time	14.0 c/kWh
	Night-time	16.7 c/kWh
Feed-in-tariff for solar		-4.5 c/kWh
Charges for energy that flows within the virtual microgrid		
Energy charges		12.0 c/kWh
Feed-in-tariff for solar		-7.5 c/kWh
Time-of-use structure		
Structure valid for 7 days/week:		
Peak-times	7am–10am and 2pm to 9 pm	
Sun-time	10am-2pm	
Night-time	9pm-7am	

Enova Business Economy Plus (TOU interval meter)		
Supply charge		2.39 $/day
Energy charges	Peak	33.9 c/kWh
	Shoulder	25.9 c/kWh
	Off Peak	19.5 c/kWh
Feed-in-tariff for solar		-6.0 c/kWh
Pay-on-time discount		-3% off of energy charges
Time-of-use structure		
Essential Energy	*BLNT2AL LV Business ToU_Interval meter*	
Peak	5pm–8pm on weekdays	
Shoulder	7am–5pm and 8pm–10pm on weekdays	
Off Peak	all other times	

As you can see from Table 1 above, Microgrid tariffs have different rates and times for 'Peak rate', 'Sun-time' and 'Night-time' rates, compared to Enova's Business Economy Plus tariffs.

The Microgrid tariff was created using the first 3 months of data available from WattWatchers (see Table 1 below). The financial analysis is based on 6 months of data for this report. Pricing principles that form the basis of the Microgrid tariff include:

- A simple TOU (time of use) structure to incentivise customers to use locally generated PV electricity. The cheapest energy for the consumer is the locally generated PV electricity regardless of the time of the day it is generated and used. Because the consumer cannot know for sure when the locally generated PV electricity is available, the price for the "Sun-time", which is every day from 10 am to 2 pm, is only slightly above the microgrid tariff price.
- Network components were created based on Essential Energy's Low Voltage network tariff BLNT2AL (LV Business ToU_Interval meter). DUOS (distribution use of system) and TUOS (transmission use of system) charges were first reduced to reflect the fall in consumption from the wider grid as the internal energy flows from businesses were excluded (15% on Shoulder and 4% on Off Peak). The new microgrid tariff was then shaped to enable the above-mentioned incentivising while keeping the revenue constant.
- Retailer energy components for the wider grid-energy are priced for the virtual gate-meter, i.e. as a large customer, but reflecting any external costs and obligations based on the physical set up of the meters and the related market rules. The feed-in-tariff for any exports that are not used internally within the microgrid and so flow to the national grid reflects the wholesale value of the energy and are set at 4.5c/kWh.
- Fixed daily retail charges were kept at the same level with the traditional tariff. This holds an assumption that some economy of scale is achieved in the billing costs of the individual customers, who would no longer use mass-market products.
- No retail profit margin has been applied to the microgrid internal energy flows, i.e. the generator receives what the consumer pays, less the external costs incurred to the retailer at the NMI (National Meter Identifier) (Network charges, environmental obligations, and market charges). This means, that the generator receives 7.5c/kWh feed-in-tariff instead of the 4.5c/kWh and the consumer pays only 12c/kWh instead of the Sun-time or Peak-time prices.

For an average customer in this data set the bills under the Microgrid Tariff are about 11% cheaper than the comparison tariff (assuming pay-on-time discount of the comparison tariff is fully achieved by the customers). Approximately 77% of solar generated within the microgrid is used within the microgrid, representing 16% of the total consumption within the microgrid.

3.3 Models

UNSW's Collaboration on Energy and Environmental Markets (CEEM) Tariff Tool was used to calculate the financial outcomes for the conventional TOU tariff. The financial outcomes for the novel microgrid tariff were calculated using the CEEM Community Microgrid model. It is an economic modelling tool which can take into account time-of-use tariffs, customer electricity use profiles, contribution from privately-owned PV arrays and potential contributions from any connected energy storage, allowing for a concise energy comparison.

Two different scenarios were run:

1. Normal operation – based on the current user profiles and PV generation over 6 months, on Enova's Business Economy Plus tariffs.
2. Microgrid operation – based on the current user profiles and PV generation over 6 months, on the dynamic 'Microgrid Tariff'.

It should be noted that the "total financial outcome" in the analysis is not the gross profit or margin for each party, as the non-electricity costs of operating the retailing, distribution and transmission businesses are out of scope of the study.

4 Results

4.1 Impacts on Customers

Table 2 and Figure 1 show the aggregate financial outcomes for all customers on the original tariff and on the microgrid tariff.

Overall, the customers are better off. This is because the usage tariffs are lower and the tariff structure benefits day-time consumers of energy, which small businesses typically are. Most customers are clearly better off, with only 6 customers worse off encountering bill increases of only $1-$2/month, which is insignificant and likely to vary from month to month as a natural variation in their usage patterns occur.

Specifically, 15 customers were better off, with the greatest bill decrease being $204/month and the average being $74/month, while 6 were worse off, with the greatest bill increase being $2/month and the average being $1.33/month.

The 9 solar customers were all better off in this scenario.

There is a clear relationship between total electricity use and the business participants bill charges, with large users experiencing the greatest reduction. This is because, in the microgrid tariffs the usage charges are lower than Enova's standard Business Economy Plus.

Table 2 Aggregate Financial Outcomes for all Customers ($avg./month)

Tariff	*Grid elec. cost*	*Grid fixed cost*	*Microgrid elec. cost*	*Sale of PV elec. to neighbours*	*FiT income*	*Total*
Original tariff	9,124	1,679	-	-	412	10,391
Microgrid tariff	7,044	1,679	1,025	380	80	9,288
Difference	(2,080)	-	1,025	380	(332)	(1,103)

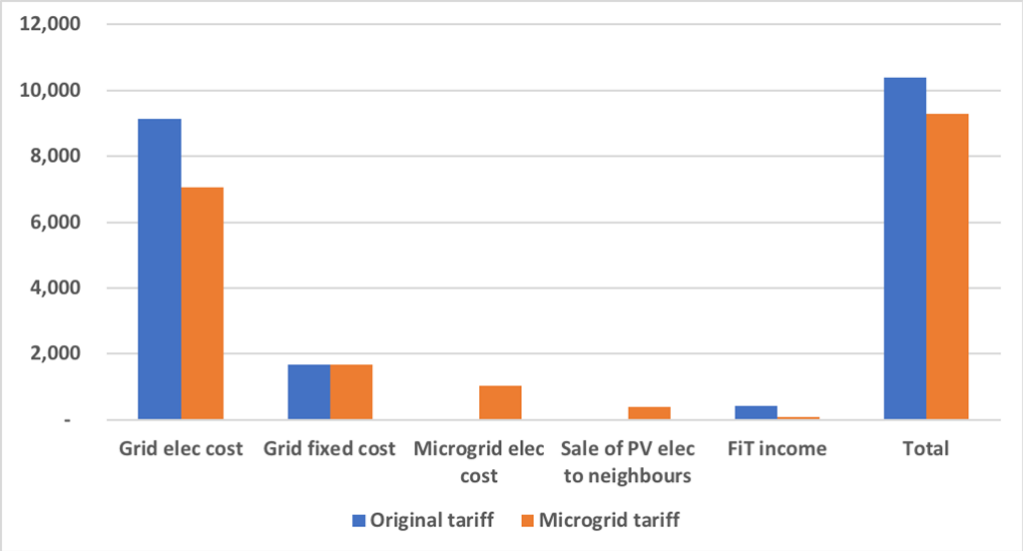

Figure 1 Aggregate Financial Outcomes for all Customers ($/month)

4.2 Impacts on Enova

the microgrid tariff.

Enova experiences a net loss of about 20.7% in revenue with the Microgrid tariff. The 'revenue' loss is a result of the combination of lower prices and different tariff periods.

The Retailer, Enova Energy is exposed to increased fixed costs related to invoicing and other Microgrid specific charges. This could be overcome by:

1) Increasing the fixed supply charge of the microgrid tariff
2) Allocating some profit margin on the microgrid internal flows. In this study the difference between microgrid internal energy charges and feed-in was set to match the retailer's external costs to create the maximum incentive for the consumers to shift their load. However, if this approach is applied on a future microgrid that generates and stores almost all of the energy needs, the retail service would need to be fully funded from the fixed fees.
3) Further reducing the network tariffs for the microgrid in the form of a Local Use of System charge (LUoS) could support the retailer component without impacting the overall tariff on offer to the participants.
4) Use of an external storage device, allowing coverage of peak periods i.e. minimising any external purchasing of electricity.

Table 3 Financial Outcomes for Enova ($avg./month)

Tariff	*Grid elec. sales*	*Grid fixed sales*	*Microgrid elec. sales*	*Grid elec. cost*	*Microgrid elec. cost*	*FiT cost*	*Total*
Original tariff	5,318	663		1,904		412	3,665
Microgrid tariff	3,866	663	487	1,650	380	81	2,905
Difference	(1,452)	-	487	(254)	380	(331)	(760)

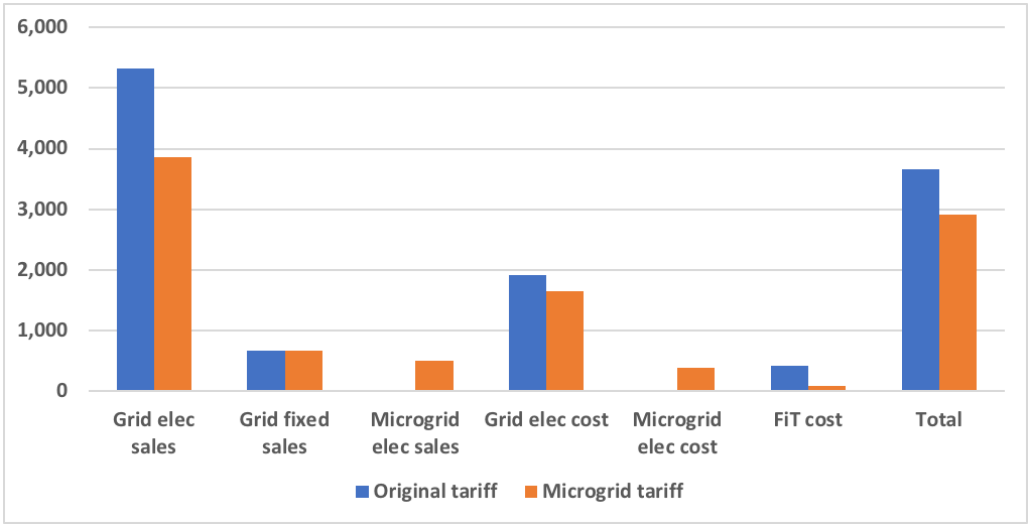

Figure 2 Financial Outcomes for Enova ($/month)

4.3 Impacts on Essential Energy

The Australian energy market is transforming rapidly, presenting customers with more options on how they obtain and consume electricity. As we look to the future, it is the responsibility of distribution networks to balance ongoing commitments to efficiently deliver electricity safely and reliably with their increasingly complex and emerging role as an active facilitator of domestic and grid-scale renewable energy.

Essential Energy is embracing this transformation, with a vision built around empowering communities to use and share energy for a better tomorrow. The business is engaging with customers to gain insights into their needs and expectations, implementing new technologies (including Microgrids), and embarking on a transformation program to safely deliver the efficiencies required to maintain downward pressure on electricity prices for all customers.

The scenario captured in this report takes into consideration discounted network charges supported by reduced demand on network services shown in initial modelling outcomes. This has translated into a 15% reduction of network revenue during the Shoulder and 4% during Off Peak. These percentages are an approximation of the reduced impact on the infrastructure of the network as a result of full consumption of renewables generated by solar within the Microgrid.

Table 4 and Figure 3 show Essential Energy's aggregate financial outcomes on the original tariff and on the microgrid tariff.

Essential Energy experiences a loss of 4.9% over the period March to August, simply because its microgrid tariff rates are on average slightly lower than the original tariff. The variance is due to the overall decrease in network tariffs applied, and the adjustment in the time periods for the microgrid.

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Table 4 Financial Outcomes for Essential Energy ($avg./month)

Tariff	*Grid elec sales*	*Grid fixed sales*	*Microgrid elec. Sales*	*Total*
Original tariff	2,685	1,023		3,708
Microgrid tariff	2,412	1,023	92	3,527
Difference	(273)	-	92	(181)

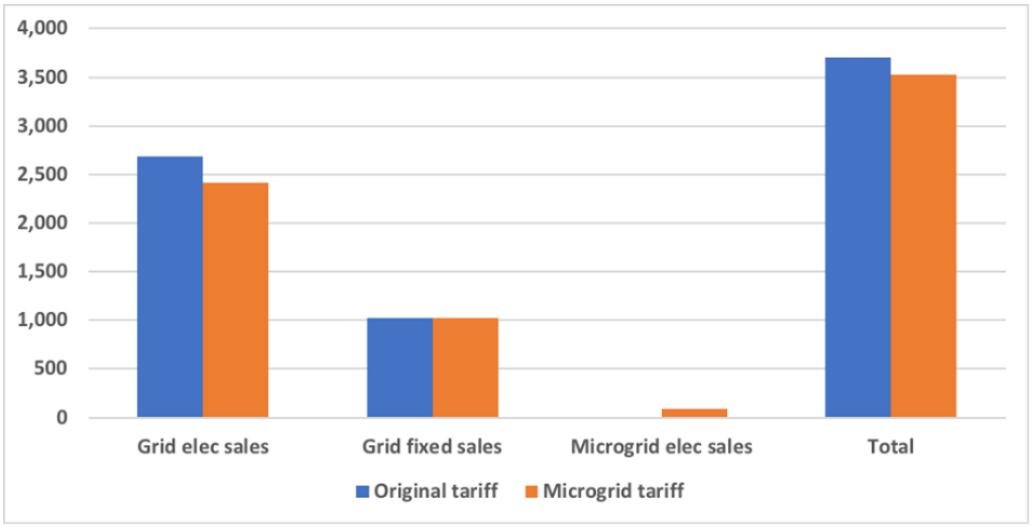

Figure 3 Financial Outcomes for Essential Energy ($/month)

4.4 Impacts on Transgrid

Table 5 and Figure 4 show Transgrid's aggregate financial outcomes on the original tariff and on the microgrid tariff. The Microgrid tariffs for Transgrid are calculated in the same way as network tariffs for Essential Energy in 4.3.

Accordingly, a reduction in Transgrid network fees is a reflection of reduced usage of the transmission network infrastructure. Transgrid experiences a loss of 11% over the period March to August, simply because its microgrid tariff rates are on average slightly lower than the original tariff. The variance is due to the overall decrease in network tariffs applied, and the adjustment in the time periods of energy usage and tariff rates for the microgrid.

Table 5 Financial Outcomes for Transgrid ($avg./month)

Tariff	*Grid elec sales*	*Grid fixed sales*	*Microgrid elec sales*	*Total*
Original tariff	830	-	-	830
Microgrid tariff	712	-	27	739
Difference	(118)	-	27	(91)

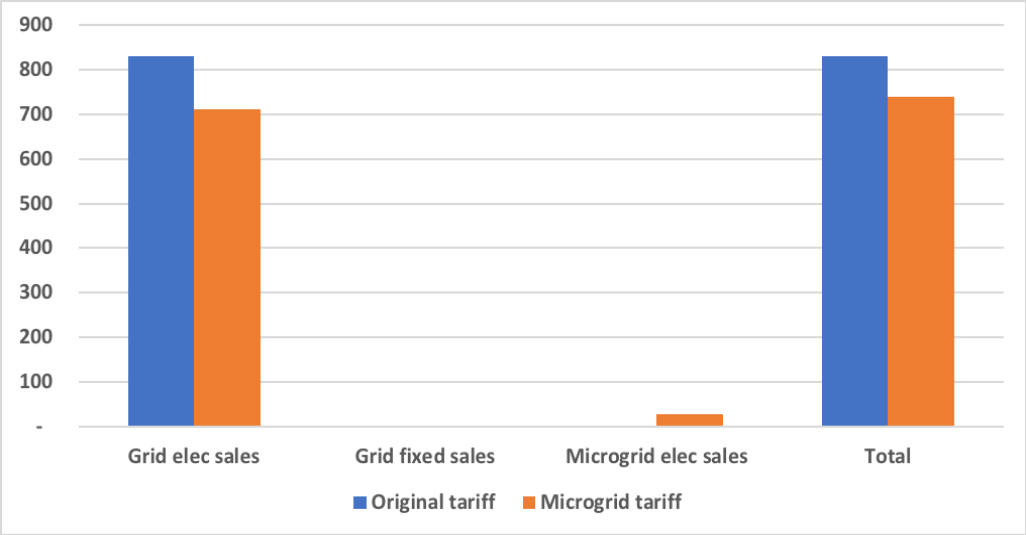

Figure 4 Financial Outcomes for Transgrid ($/month)

5 Conclusion and Next Steps

2020, reveals there are financial benefits to participants (businesses who consume energy) within a Microgrid framework. Additionally, the results show a direct relation to the participants' level of usage, with solar owners benefiting at all times.

When the novel 'Microgrid Tariff' was compared to Enova's new Business Economy Plus rates, the modelling showed that out of the 23 participants, 15 were clearly better off and could potentially save an average of $74 per month on their energy purchases compared to energy purchases they would make at the retail price. However, 6 participants experienced slight increases in their electricity bill costing between $1-$2 more per month. There were 2 customer bills that remained unchanged. Of the 9 solar customers, all were better off.

Microgrid participants consume less energy from the wider grid as they are consuming more from the solar rooftop generation within the Microgrid.

Moreover, the retailer experienced a net loss of 20.7% in revenue, whilst the network provider saw a slight 4.9% loss and Transgrid an 11% loss. 'Revenue' loss is a measure of the revenue lost as a consequence of reduced wider grid energy consumed by participants, compared with increased usage of solar PV energy within the microgrid.

There are additional costs associated with setting up a microgrid. In particular, the additional metering and the bespoke data management and billing create costs that are higher compared to regular mass-market customers. Consequently, microgrid solutions need to reach economies of scale to be a financially sustainable business to retailers.

A community consultation looking at Microgrid participants' ability to change their energy usage behaviour to optimise benefits from a Microgrid Tariff is part of this research project, and the results of this consultation will be included in the final report (12 months of data). It is anticipated the outcomes of such a consultation would provide valuable insight into the overall implications of a Microgrid framework. The Microgrid framework and associated special tariffs considered in this first report clearly indicate that there will be benefits to the customers who operate within it. To make this a feasible offering, the retailer would need to ensure that costs connected with establishing a Microgrid are sufficiently covered. Additionally, the transmission and distribution companies would need to adjust the pricing principles for their tariffs to reflect microgrid consumption patterns which reduce demands on the network assets.

A final report analysing 12 months of data will be published shortly and include modelling battery facilities. The idea of these studies is to demonstrate that local microgrids are able to deliver financial benefits to customers, networks, transmission network and retailers.

The construct of the microgrid tariff in this study results in financial benefits to the microgrid customers (small businesses) and not to the network, transmission network or retailer. Regulatory changes (Local Use of System charges) and incentives are required to encourage networks and retailers to consider the longer term financial, social and environmental benefits of microgrids, rather than short term financial gain. Enova Energy, in leading this research, endeavours to provide a foundation for considering new microgrid models and tariff structures to benefit customers and market participants.

Context

The Enova Microgrid research study has been designed and executed as a virtual Microgrid, and all positions within this paper are theoretical. All trial participants acknowledge that the findings within this paper are theoretical and while essential to inform participants understandings of consumption and renewable integration with the grid, the results will need to be further validated over the long term and in a live environment.