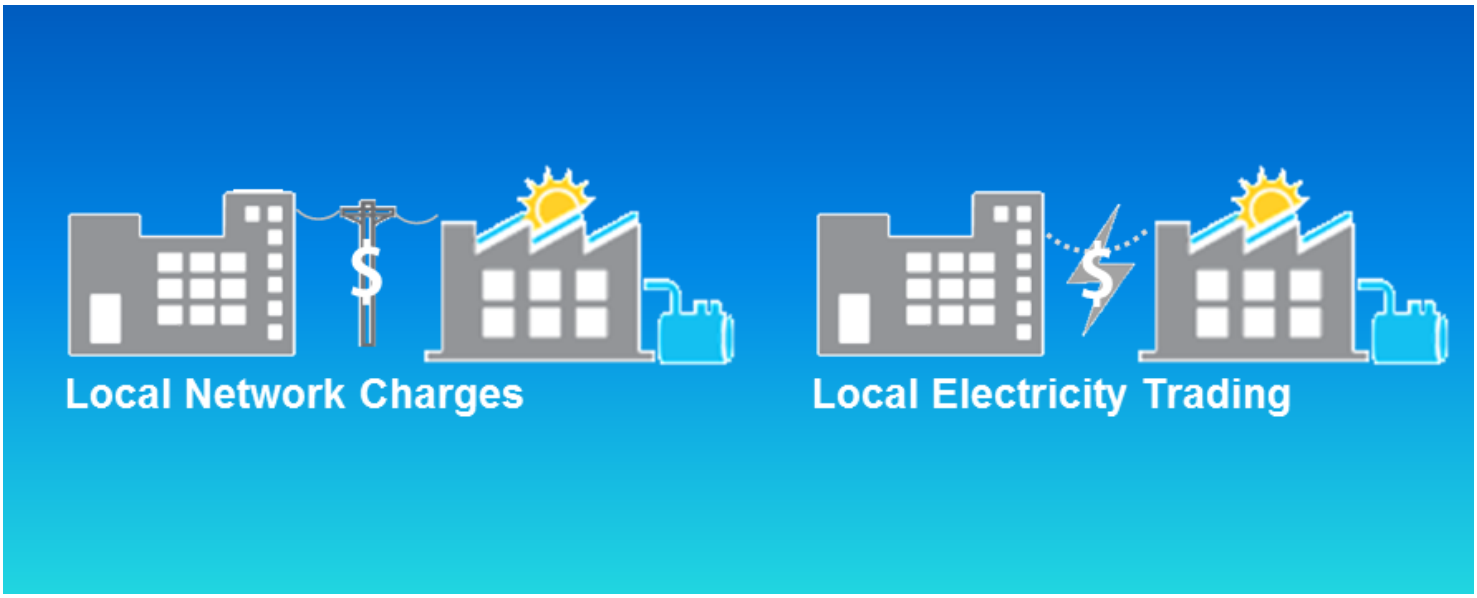

UTS: INSTITUTE FOR SUSTAINABLE FUTURES

VIRTUAL TRIAL OF LOCAL NETWORK CREDITS AND LOCAL ELECTRICITY TRADING: BYRON SHIRE COUNCIL

Case Study Report, July 2016

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2016

ABOUT THE AUTHORS

The University of Technology Sydney established the Institute for Sustainable Futures (ISF) in 1996 to work with industry, government and the community to develop sustainable futures through research and consultancy. Our mission is to create change toward sustainable futures that protect and enhance the environment, human well-being and social equity. We seek to adopt an inter-disciplinary approach to our work and engage our partner organisations in a collaborative process that emphasises strategic decision-making.

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DISCLAIMER

This paper is prepared as part of the ARENA funded project ‘Facilitating Local Network Charges and Virtual Net Metering’.

The project is due to be completed by August 2016 and results and papers are publicly available on the project webpage: http://bit.do/Local-Energy

For further information visit: **www.isf.uts.edu.au**

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FIGURES AND TABLES

LIST OF ABBREVIATIONS

AEMC	Australian Energy Market Commission
AER	Australian Energy Regulator
ARENA	Australian Renewable Energy Agency
ISF	Institute for Sustainable Futures
kW	kilowatt
LET	Local Electricity Trading
LGC	Large-scale Generation Certificate
LGNC	Local Generation Network Credit
LNC	Local network credit
LRMC	Long run marginal cost
NEM	National Electricity Market
PV	Photovoltaic
SRES	Small-scale Renewable Energy Scheme
TEC	Total Environment Centre
TOU	Time of use
UTS	University of Technology Sydney
VNM	Virtual Net Metering

SUMMARY RESULTS AND CONCLUSIONS

The Byron Shire Council trial tested the economic impact of Local Network Credits (LNC) and Local Electricity Trading (LET) on a proposed Council solar energy project, and assessed the real-world requirements for these two measures to be applied.

TRIAL KEY FACTS	
Proponent	Byron Shire Council
Network service provider	Essential Energy
Electricity retailer	Origin Energy
Generator	150kW new Solar PV
Location	Cavanbah sports centre (generation site) and the West Byron Sewage Treatment Plant (netting off site)
Generation/customer model	Single entity, 1-to-1 transfer between two Byron Shire Council sites. The Cavanbah sports centre with low consumption and good roof space transfers energy to the nearby sewage treatment works which has high consumption but little space.
Project status at time of trial	25 kW installed, with very small amount of export. Council is investigating adding 150kW at the Sports Centre, with a significant proportion of the generation exported to supply the West Byron Sewage Treatment Plant.

What the trial looked at

The trial compares the business case for new solar generation in current conditions, as well as with and without a LET arrangement and an LNC. The trial scenarios look at the impact on the proponent, the network business, and the retailer. The different scenarios are:

- **BAU**: business as usual – current electricity and network charges, without any new generation.
- **Current Market**: installation of new generation, with the market as it is now.
- **LET only**: new generation with Local Electricity Trading in place for the exported electricity.
- **LNC only**: includes new generation, with payment of a Local Network Credit.
- **LNC and LET:** new generation with both measures in place.
- **Private wire:** new generation, with the two sites are connected together with a private wire so they become the same meter point.

Trial results

The total cost shown in the graph is the energy cost, net of costs and income, for the two Byron Shire Council sites. The table shows the results by stakeholder. The project has a positive payback for Byron Shire Council even though there is a loss in the first year under the current market conditions (shown in the annual savings). This is because of inflation, which means that the capital repayments decline relative to energy costs in future years.

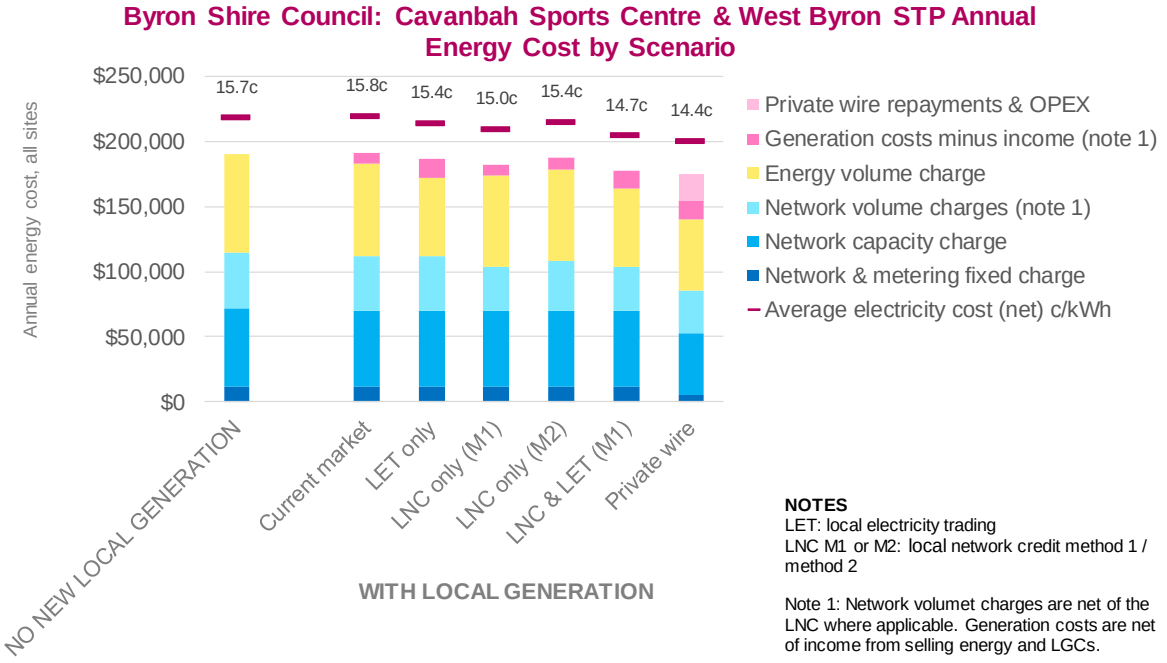


Table 1 Results by stakeholder

	Current market	LET only	LNC only (M1)	LNC & LET (M1)	Private wire
Byron Shire Council: Annual savings compared to BAU	-$1,200	$3,300	$7,400	$11,900	$15,400
Byron Shire Council: simple payback	11 years	10 years	9 years	8 years	8 years
Net effect on network charges	-$2,700	-$2,700	-$11,300	-$11,300	-$29,400
Effect on retailer income	-$2,800	-$6,100	-$2,800	-$6,100	-$6,900
Greenhouse emission reduction (all scenarios with new local generation)					229 tons/yr

Conclusion

All scenarios **except** the current market conditions result in a saving compared to business as usual, so the project has a cost benefit with the assumptions used with either LET or an LNC, or with a private wire. The private wire scenario results in the greatest benefit, with estimated annual saving of $15,400. The next most advantageous is the scenario with both the new measures, the Local Network Credit and Local Electricity Trading.

Network charges are the most significantly affected in the private wire case, with a loss of $29,400. This is 2.6 times worse than the next best scenario from the network's point of view. However, the effects for Byron Shire Council are very similar in the two scenarios.

We recommend that in the short term Byron Shire Council explores the possibility of a LET arrangement with their retailer, and also investigates the private wire option further. In the longer term, the project would also become viable with a lower cost PV system, or in the event that an LNC was available from Essential Energy.

1 INTRODUCTION

This report provides results of the virtual trial undertaken for **Byron Shire Council** on the effects of Local Network Credits and Local Electricity Trading on the viability of a proposed solar energy project.

The trial is part of a one year research project, *Facilitating Local Network Charges and Virtual Net Metering.* The project is led by the Institute for Sustainable Futures (ISF) and funded by the Australian Renewable Energy Agency (ARENA) and other partners, and is investigating two measures aimed at making local energy more economically viable:

- Local Network Charges for partial use of the electricity network; these are implemented as a credit paid to the generator, or Local Network Credit.
- Local Electricity Trading (LET) (previously referred to as Virtual Net Metering or VNM) between associated customers and generators in the same local distribution area.

The project includes five 'virtual trials' of the two measures in New South Wales, Victoria and Queensland.

Local Network Charges/ Credits

Local Network Charges

Local network charges are reduced network tariffs for electricity generation used within a defined local network area. This recognises that the generator is using only part of the electricity network and may reduce the network charge according to the calculated long-term benefit to the network. The rationale is to address some aspects of inequitable network charges levied on a generator/consumer pair; dis-incentivise duplication of infrastructure (private wires) set up to avoid network charges altogether; and maintain use of the electricity network. Following previous work on the practicality of applying a reduced network charge for electricity sourced locally or paying a network credit to local generators, the latter was recommended as a means to deliver reduced network charges for local electricity[1], and was the mechanism investigated in this project.

Local Electricity Trading (LET)

Local Electricity Trading

LET is an arrangement whereby generation at one site is "netted off" at another site on a time-of-use basis, so that Site 1 can 'sell' or transfer generation to nearby Site 2. The exported electricity is sold or assigned to another site for billing purposes. LET can be applied in a number of different ways:

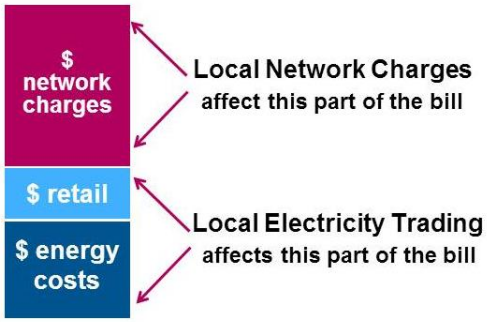
- A single generator-customer can transfer generation to another meter(s) owned by the same entity (e.g. a Council has space for solar PV at one site and demand for renewable energy at a nearby facility);
- A generator-customer can transfer or sell exported generation to another nearby site;
- Community-owned renewable energy generators can transfer generation to local community member shareholders; and

[1] Rutovitz, J., Langham, E. & Downes, J., 2014. Issues Paper: A Level Playing Field for Local Energy, Prepared for the City of Sydney

- Community retailers can aggregate exported electricity generation from generator-customers within a local area and resell it to local customers.

The interaction of Local Network Credits and local electricity trading

Local Network Credits and LET are independent but complementary concepts with different effects on a consumer's energy bills. In most cases, the LNC will reduce the network charge portion of electricity bills, while Local Electricity Trading may reduce the combined energy and retail portion of bills for local generation.



About the project and trials

The objective of the project is to create a level playing field for local energy, by facilitating the introduction of local network charges and Local Electricity Trading. The key outputs are:

a. Improved stakeholder understanding of the concepts of Local Network Credits and Local Electricity Trading;

b. Five 'virtual trials' of Local Network Credits and Local Electricity Trading in New South Wales, Victoria, and Queensland (see Figure 1);

c. Economic modelling of the benefits and impacts of local network credits and Local Electricity Trading;

d. A recommended methodology for calculating Local Network Credits;

e. An assessment of the metering requirements and indicative costs for the introduction of Local Electricity Trading, and consideration of whether a second rule change proposal is required to facilitate its introduction; and

f. Support for the rule change proposal for the introduction of a Local Generation Network Credit submitted by the City of Sydney, the Total Environment Centre, and the Property Council of Australia.

The virtual trials aim to test the impact of Local Network Credit and Local Electricity Trading on local distributed energy projects, particularly the economic impacts, and to assess the real-world requirements for the measures to operate.

Figure 1 The virtual trials

2 BYRON SHIRE COUNCIL TRIAL – KEY FACTS

Table 2 Trial description

Proponent	Byron Shire Council
Network service provider	Essential Energy
Electricity retailer	Origin Energy
Generator	150kW new Solar PV
Location	Cavanbah sports centre (generation site) and the West Byron Sewage Treatment Plant (netting off site)
Generation/customer model	Single entity, 1-to-1 transfer between two Byron Shire Council sites. The Cavanbah sports centre with low consumption and good roof space transfers energy to the nearby sewage treatment works which has high consumption but little space.
Project status at time of trial	25 kW installed, with very small amount of export. Council is investigating adding 150kW at the Sports Centre, with a significant proportion of the generation exported to supply the West Byron Sewage Treatment Plant.

Table 3 Key financial and market inputs

Technology		Solar PV
Electrical capacity	kW	150
Generator cost/ kW	$/kW	1,888
Generator cost (total)	$	283,161
Generator O&M Cost (fixed)	$/a	1,500
Interest rate	%/a	6.0%
Discount rate	%/a	6.0%
Inflation rate	%/a	2.43%
Private wire capital costs	$	200,000
Private wire O&M cost	$/a	2000
CO2 equivalent - replaced power	kgCO2/kWh	0.97
Other charges (AEMO, RET, SRES, NSW EES)	c/kWh	1.20
Large Scale Generation Certificates (LGCs)	$/MWh	50
LGC's credited until	Year	2030
Retailer buy back rate	c/kWh	calculated from Pool price [1]
Retailer margin	%	7.0%
Network connection level		1 (Low Voltage network)

Note 1: The retailer buyback rate was calculated on a daily basis as the average daily price accessed from AEMO's historical record less $5/MWh as an administration fee identified by Origin Energy.

Note 2: The retailer margin is based on information from the Queensland Competition Authority 2015-2016 retail price determination, and is not based on information from Origin Energy. Note that it is 7% of the energy volume charge, not of overall energy and network charges

3 METHODOLOGY

This section gives a brief summary of the methodology used across all five trial sites. For a full description of the methodology, please see the Trials Summary Report[2].

An excel business case model was constructed to compare local generation projects under the current market conditions with the same generator installed with the two measures under investigation in the trials, namely Local Electricity Trading (LET) and a Local Network Credit (LNC) using two methodologies. The measures are considered together and separately. In order to see the effect of these measures, eight different scenarios were defined.

The model calculates the changes in costs for the proponent sites as a result of the new generation, including the local generation site (LG site) and whatever trading sites are included in the trial (called the LET sites). The model also calculates the financial impact on the network business and the retailer (this does not include implementation costs).

The projects were at various stages of development, but all the installations are under serious consideration by the proponents, and it was expected that the trial would assist with decisions on whether to go ahead, as well as with project sizing. Table 2 gives summary information for the Byron trial, including the project status.

3.1 The model

In the excel business case model, all input data for the local generation side (LG) was arranged in one sheet, so specific parameters such as payback time or interest rate could be changed easily to test the influence on trial results.

Both the generation profile(s) and all demand profiles – from the local generation site (LG) as well as the LET "netting off" sites were uploaded in hourly steps. The netting off step includes a cascade which can include up to 10 different demand profiles.

The third step of the calculation involved detailed input of consumption tariffs and the Local Network Credit (LNC) tariff. The LNC tariffs were calculated from each network partner's data, using the methodology developed for this project. The consumption tariffs include times for shoulder, peak and off peak, and the energy and network charges, including capacity, volume, and fixed charges where applicable.

Due to "time-of-use" dependent tariffs and LNCs, the shape of generation and demand profiles have a significant impact on the trial results and whether or not a project is profitable.

Steps four and five processed all inputs of LG and LET sites in sub calculations, which are summarized in a comprehensive result overview for each scenario. Each calculation step can be traced and checked separately and assumptions can be changed. A specific module for cash flow calculations is included to produce a range of economic indicators..

Finally, a standardised report sheet provides an overview to key results in the form of tables, texts and figures.

[2] Rutovitz, J., Langham, E., Teske, S., Atherton, A. & McIntosh, L. (2016) *Virtual trials of Local Network Charges and Local Electricity Trading: Summary Report*. Institute for Sustainable Futures, UTS.

3.2 The scenarios

The trial compares the business case for the new generation in current conditions, and with and without the new measures. Costs are calculated for the generation site and any netting off sites included in the trial in all scenarios. All scenarios except BAU include the new local generation.

The different scenarios are:

- **BAU**: business as usual – current electricity and network charges, without any new generation.
- **Current market**: installation of new generation, with the market as it is now. (exported electricity is valued according to the retailer buy-back rate).
- **LET only**: Local Electricity Trading in place for the exported electricity, but no LNC paid. Exports from the generation site are netted off at whatever LET sites are included, and any remaining residual exports are valued according to the retailer buy-back rate.
- **LNC (M1)**: includes new generation, with payment of a Local Network Credit using methodology 1 (volumetric only).
- **LNC (M2)**: includes new generation, with payment of a Local Network Credit using methodology 2 (combined volumetric and capacity payment)
- **LET and LNC (M1)**: new generation with both measures in place, using the LNC methodology 1.
- **LET and LNC (M2)**: new generation with both measures in place, using the LNC methodology 2
- **Private wire**: some of the project sites could be connected via a private wire, so that all generation would be 'behind-the-meter' on a single metering point.

The Local Network Credit methodology was developed as part of this project. The Trials Summary Report[3] describes in detail the LNC methodology and the calculations we performed for the various scenarios. All calculations were performed using the excel model.

Briefly, the calculation of the LNC has two parts:

1. Value setting (the base value of the LNC). We used the same value setting methodology that network businesses use for regular tariffs i.e. the Long Run Marginal Cost (LRMC) of the network.
2. Tariff setting (the application of a tariff structure to the base LRMC value). We applied two different tariffs:
    - Volumetric tariff (methodology 1)
    - Combined volumetric and capacity tariff (methodology 2)

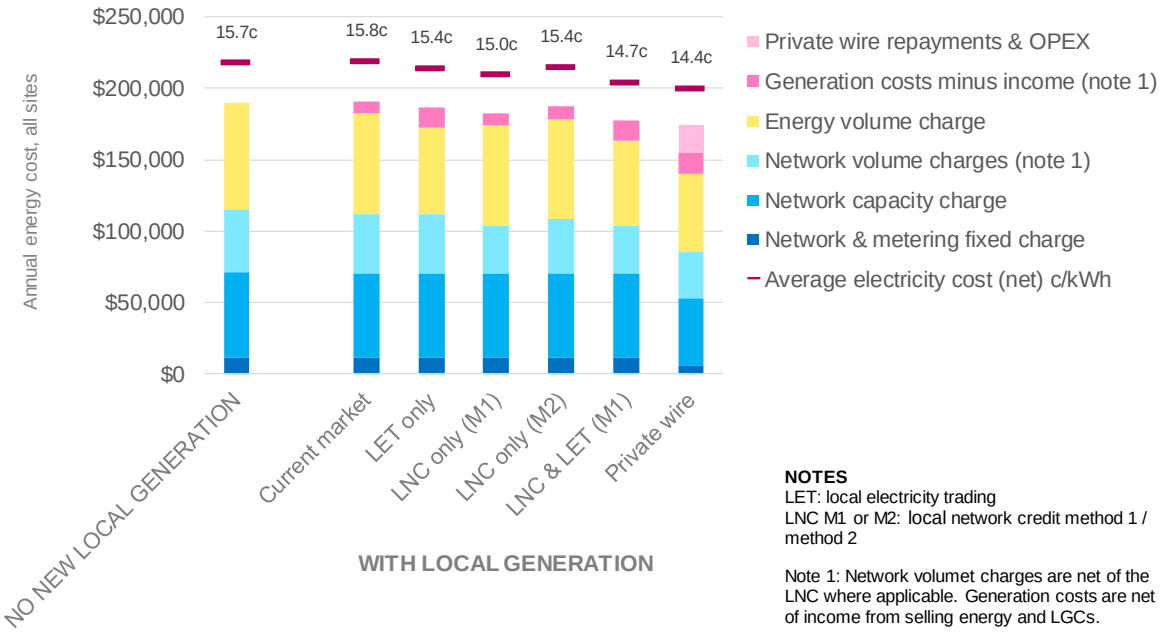
[3] Rutovitz, J., Langham, E., Teske, S., Atherton, A. & McIntosh, L. (2016) *Virtual trials of Local Network Charges and Local Electricity Trading: Summary Report*. Institute for Sustainable Futures, UTS.

4 RESULTS

The net energy cost for the two Byron Shire Council sites is shown in Figure 2 for each scenario. This includes the energy and network charges, capital repayments on any new infrastructure, such as the solar panels and the private wire, and any income the generator may receive. Income includes renewable energy credits, the new LNC, and any buy back income from electricity which is exported and not used at the netting off site. Detailed costs are given in Table 5.

All scenarios except the current market conditions result in a saving compared to business as usual, so the project would have a cost benefit with either of the new measures in place, or with a private wire, with the assumptions used.

Figure 2 Byron Shire Council: Cavanbah Sports Centre & West Byron STP annual energy cost by scenario



Note that costs are modelled, and may be different from actual project outcomes.

Table 4 gives the annual savings, the lifetime benefit, and the Internal Rate of Return for the project in each scenario. The private wire results in the greatest benefit, with estimated annual saving of $15,400. The next most advantageous is the scenario with both the new measures, the Local Network Credit and Local Electricity Trading.

Network charges are the most significantly affected in the private wire case, with a loss of $29,400, compared to $2,700 in the LNC case. This is 2.6 times worse than the next best scenario from the network's point of view.

The current market scenario still appears to have a small lifetime benefit, despite showing a loss in the annual savings. This is because annual savings are for the first year, and include the capital repayment on the solar system. The lifetime benefit includes the effect of inflation,

and over time the capital repayments remain the same while energy and network costs increase as a result of inflation.

Table 4 Summary effect on Byron Shire energy costs by scenario (both sites combined)

	Current market	LET only	LNC only (M1)	LNC only (M2)	LNC[1] and LET	Private wire
Annual savings (1ST year)	-$1,200	$3,300	$7,400	$2,700	$9,500	$15,400
Lifetime benefit	$12,000	$126,000	$230,000	$110,000	$284,000	$578,000
IRR	6.5%	9.0%	11.1%	8.7%	12.1%	12.7%

Table 5 Detailed effect on Byron Shire energy costs by scenario (both sites combined)

	BAU	Current market	LET only	LNC only (M1)	LNC only (M2)	LNC[1] & LET	Private wire
Network volume charges	$43,532	$42,087	$42,087	$42,087	$42,087	$42,087	$32,529
Network capacity charge	$59,728	$58,482	$58,482	$58,482	$58,482	$58,482	$47,162
Network fixed charge	$11,649	$11,649	$11,649	$11,649	$11,649	$11,649	$5,825
Local Network Credict	-	-	-	*-$8,603*	*-$3,876*	*-$6,240*	-
AEMO, RET, Other	$14,287	$13,927	$13,548	$13,927	$13,927	$13,548	$9,434
Energy volume charge	$60,564	$56,251	$46,277	$56,251	$56,251	$46,277	$45,527
TOTAL ENERGY BILL	**$189,761**	**$182,397**	**$172,044**	**$173,794**	**$178,521**	**$165,804**	**$140,477**
Private wire repayments & O&M	-	-	-	-	-	-	$19,437
Generator repayments	-	$24,687	$24,687	$24,687	$24,687	$24,687	$24,687
Variable O&M	-	*$1,500*	*$1,500*	*$1,500*	*$1,500*	*$1,500*	*$1,500*
LGCs	-	*-$11,791*	*-$11,791*	*-$11,791*	*-$11,791*	*-$11,791*	*-$11,791*
Buy back [2]	*-$106*	*-$5,914*	*-$55*	*-$5,914*	*-$5,914*	*-$55*	*-$55*
Average electricity cost (net) c/kWh	15.7c	15.8c	15.4c	15.0c	15.4c	14.9c	14.4c
Total supply costs	**189,655**	**190,880**	**186,386**	**182,276**	**187,004**	**177,782**	**174,255**

Note 1 Average of LNC method 1 and LNC method 2

Note 2 The $106 buy back in the BAU case is from the existing solar, and the $55 buy back in the LET cases and the private wire case is from the small amount of export remaining

Table 5 shows the details of how energy charges and generator costs vary in each scenario. Network volume and capacity charges go down when local generation is installed as a result of behind the meter consumption at the administration centre. They stay the same through all the scenarios with LET and an LNC as network charges do not change at the LET site – the reduction in network charges is achieved via the payment of the credit to the generator. The

only further change to network charges is in the private wire case, when most of the generation is behind the meter.

4.1 LNC outcomes and effects on network businesses

Table 6 shows the impact on the charges Byron Shire would pay to the network business in each scenario; the LET only scenario is not shown as it is exactly the same as the current market scenario from the network business point of view, and the LNC plus LET scenarios are not shown as they are identical to LNC (M1) or LNC (M2).

The current market shows a small reduction in network charges, as some of the output from the solar system is used at the leisure centre (behind the meter). This effect remains, and is amplified in the private wire scenario, as most of the export from the system becomes "behind the meter" in effect.

As soon as an LNC is paid, the LNC payment is added to the reduced charges, with a combined impact of $11,300 in the LNC (method 1), and $6,600 in the LNC (method 2) scenario. The private wire results in a reduction in network charges of $29,400, more than double the effect using either LNC method.

Table 6 Distribution and transmission network business - net impact (annual)

	Current market [1]	LNC only (M1)	LNC only (M2)	Private wire
Revenue effect (excluding LNC)	-$2,700	-$2,700	-$2,700	-$29,400
Local network credit	-	**-$8,600**	**-$3,900**	-
Net effect on NSP revenue	**-$2,700**	**-$11,300**	**-$6,600**	**-$29,400**

Note 1 The LET only scenario is not included here, as LET has no impact on the network business, so "LET only" is identical to "Current Market". The LET plus LNC scenarios are not included as they are identical to the LNC only scenarios for the same reason.

LNC (method 2) results in a significantly lower payment than LNC (method 1). This is driven by two factors. Firstly, the volumetric method was intended to be used with quite narrowly defined peak periods, to act as an 'availability adjustment' on the credit value. However, all network businesses selected quite broad peak periods, which effectively meant this adjustment was not applied. Thus the volumetric method LNC payment calculations may be higher than the true value of variable distributed generation to the network. Secondly, the settings on the capacity payment meant if local generation was *ever* not available during a very broadly defined period, it received no credit. However, there is evidence to suggest variable solar PV generation has an impact on network peak demand, for example, from a portfolio of generators located in commercially dominated distribution zones with air-conditioning driven peaks, or upstream in transmission networks[4]. This means that the combined volume-capacity method as used in the trials probably under-rewarded the value of DG. In practice, the true value of variable DG may be somewhere in between the results for Methods 1 and 2.

[4] APVI (2015), APVI Discussion Paper on SA Power Network's Pricing Proposal, working paper for the Australian PV Institute.

4.2 Impact on retailer

Table 7 shows the effects on the retailer. The impact in current market conditions is close to $3,000 annually, as a result of the increase in behind the meter consumption. This almost doubles if netting off is in place, and increases somewhat more if there is a private wire installed. It should be noted that the retail margin is charged on netted off electricity, but an assumed percentage of 7% was used for the margin as this is commercially confidential information.

Table 7 Impact on retailer (annual)

	Current market	LET only	Private wire
Energy volume charges (change)	-$4,300	-$14,300	-$15,000
Estimated savings energy purchase	$1,500	$8,200	$8,200
Net effect on retailer revenue	**-$2,800**	**-$6,100**	**-$6,900**

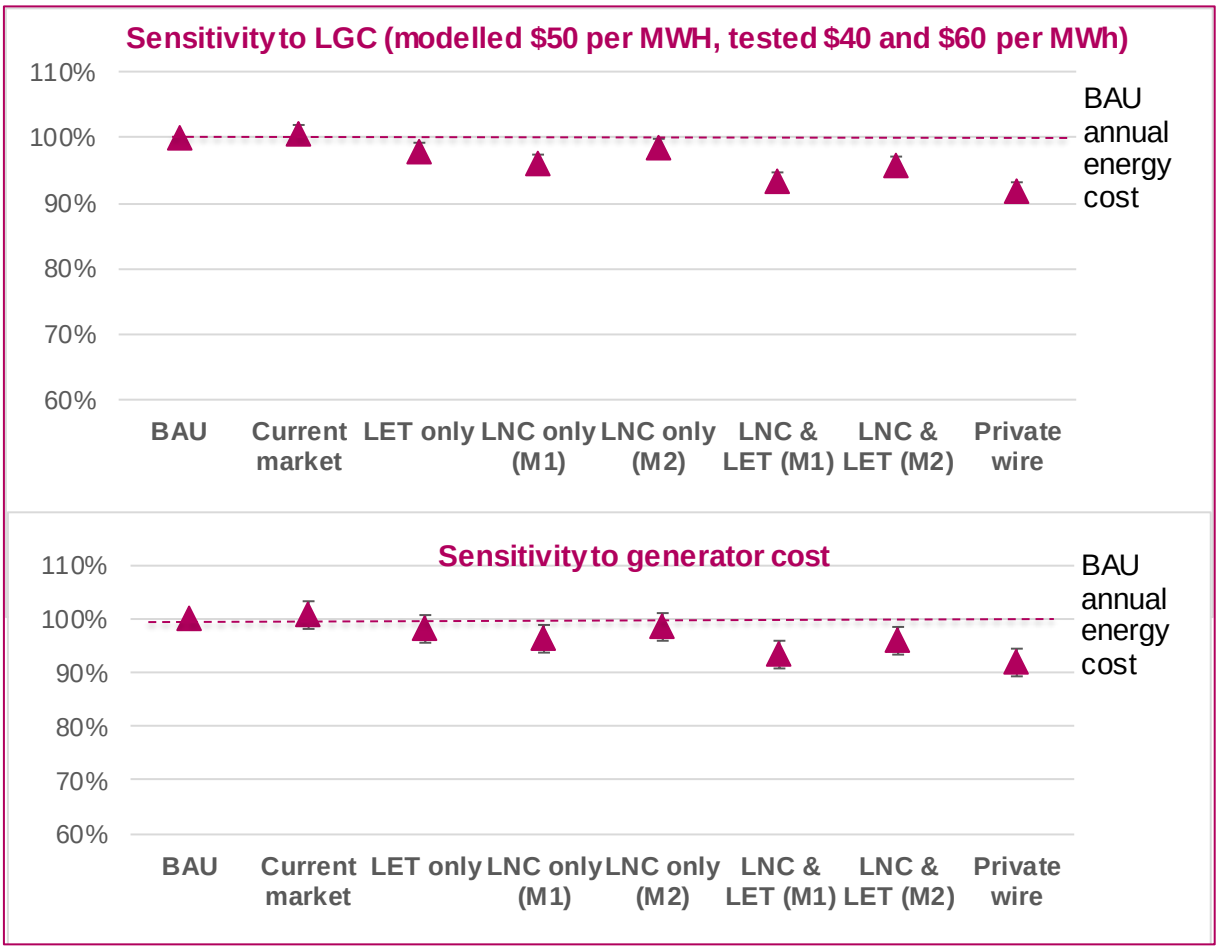
4.3 Sensitivity

Sensitivity testing was undertaken on the results for generator cost, LGC price, retailer buy back rate, the LNC value, and the LRMC value. The most significant input to the Byron outcomes is the cost of the solar system, as shown in Table 8. It was not possible to test for the effects of different consumption tariffs, but these would have a significant effect as well. Figure 3 shows the effects of the LGC price and the generator cost.

Table 8 Sensitivity testing results, Byron Shire Council trial

	Variation tested	Effect on outcome
Generator cost	80% and 120% of modelled cost	2.6%
Large Scale Generation Certificates (LGCs)	Modelled rate $50/MWh; tested $40 & $60	1.2%
Retailer buy back rate	80% and 120% of modelled cost	0.6%
LNC	80% and 120% of modelled cost	0.4% - 0.9%
LRMC variation from modelled rate	0.94	-0.1% to -0.3%

Figure 3 Sensitivity to LGC price and generator cost: Byron trial



5 DISCUSSION AND RECOMMENDATIONS

All scenarios **except** the current market conditions result in a saving compared to business as usual, so the project has a cost benefit with the assumptions used and with either LET or an LNC, or with a private wire. However, neither of the two measures are available to Byron Shire Council at the present time. The availability of an LNC is dependent on the outcome of the rule change proposal for the introduction of a Local Generation Network Credit submitted to the AEMC by the City of Sydney, the Total Environment Centre, and the Property Council of Australia, and currently under consideration at the time of writing.

The private wire scenario results in the greatest benefit, with an estimated annual saving of $15,400. The next most advantageous is the scenario with both the new measures, the Local Network Credit and Local Electricity Trading.

The private wire scenario, however, is the least advantageous scenario for both the other stakeholders, and in particular, the network business (Essential Energy). The scenario results in the greatest reduction in network charges, with a reduction of $29,400. This is 2.6 times worse than the next best scenario from the network's point of view. However, the effects for Byron Shire Council are very similar in the two scenarios. The retailer also loses the most income in the private wire scenario.

There are a number of factors that would render the project profitable, including a reduction in the generator cost, that is, a lower price for the PV system, the availability of a LET arrangement, an LNC or similar payment from the network, and the installation of a private wire. Byron Shire Council would prefer not to install a private wire, as it is in effect a duplication of public infrastructure. However, it would be useful to gain firmer information on the cost of this option, in order to determine whether it is practical.

In the short term, we recommend that Byron Shire Council:

1) Investigates the private wire option further, in order to determine whether this is a feasible alternative to allow the project to go ahead;

2) Explores the possibility of a LET arrangement with their retailer, and

3) Actively supports the rule change to introduce an LGNC. The rule change process is underway at the moment, and Byron Shire Council should ensure that they engage with the consultation process.

In the longer term, the project would become viable with either a lower cost PV system, or in the event that an LNC or similar became available from Essential Energy.

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