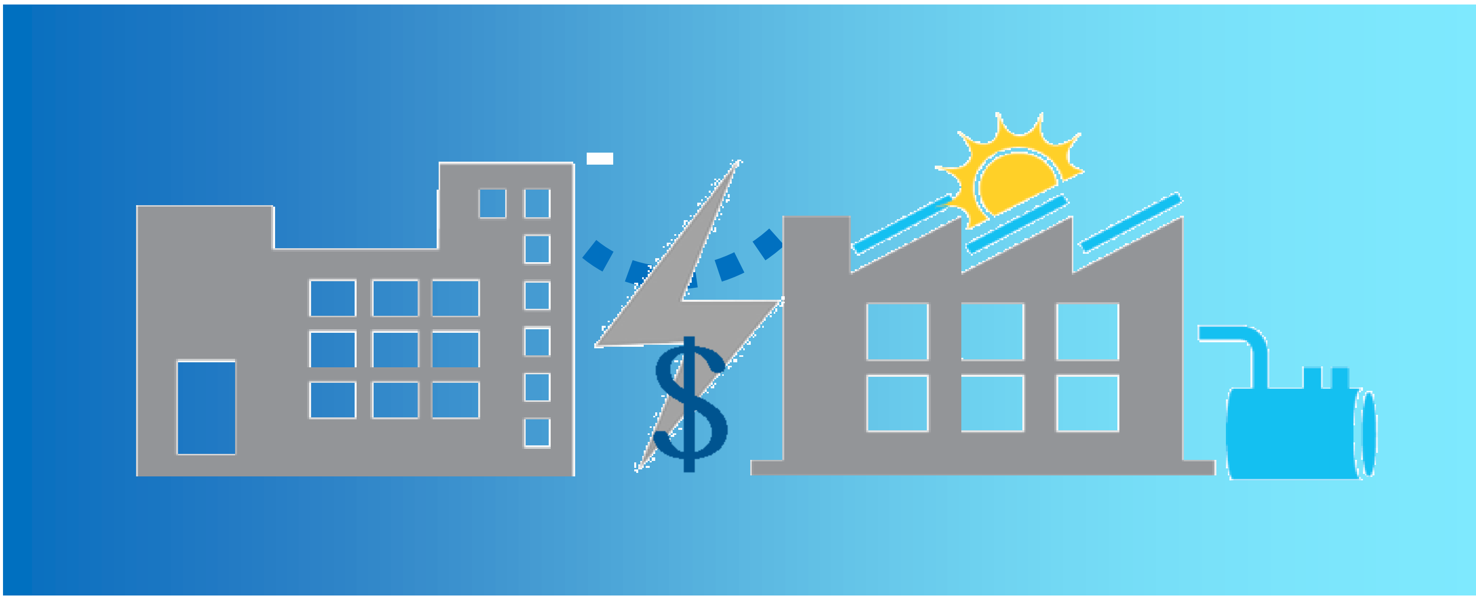

UTS: INSTITUTE FOR SUSTAINABLE FUTURES

Renewable power options enabled by Local Electricity Trading

Advisory report for Moira Shire and Swan Hill Rural City Councils

Briefing Paper 4: October 2015

2015

SWAN HILL
Rural City Council

MOIRA SHIRE
ON THE MURRAY

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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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Authors: Lawrence McIntosh, Jay Rutovitz, Ed Langham,

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DISCLAIMER

Institute for Sustainable Futures
University of Technology, Sydney
PO Box 123
Broadway, NSW, 2007
www.isf.edu.au

CONTENTS

1 EXECUTIVE SUMMARY 5

2 INTRODUCTION 5

2.1 Concepts: LET, LNC, many-to-one, and one-to-many 8

2.2 The research project 9

3 EXAMPLES & PRECEDENTS 11

3.1 One-to-many: Solar gardens 11

3.1.1 US Examples: Ownership and Subscription Solar Gardens 11

3.2 Many-to-one: Virtual Power Station (VPS) 11

3.2.1 Bornholm virtual power station 12

3.2.2 REPOSIT Power & Velocity Energy 12

3.2.3 Kombikraftverk 13

4 ASSESSMENT FRAMEWORK 14

5 ASSESSMENT OF OPTIONS 15

5.1 Many-to-one 15

5.1.1 Stakeholders 16

5.1.2 Financial aspects 16

5.1.3 Competition 18

5.1.4 Legal and Contractual Considerations 18

5.1.5 Regulatory environment 18

5.1.6 Technical assesment 19

5.1.7 Unresolved issues 19

5.2 One-to-many 21

5.2.1 Stakeholders 21

5.2.2 Siting 22

5.2.3 Financial aspects 22

5.2.4 Regulatory environment 23

5.2.5 Competition 23

5.2.6 Technical assesment 23

6 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS 26

6.1 Comparison of options 26

6.1.1 Economic & Empowerment comparison 27

6.1.2 Ease of implementation 27

6.1.3 Liability and Risk 28

6.2 Recommendations 28

References 30

TABLES AND FIGURES

Figure 1 Local Network Charges and Local Electricity Trading 9
Figure 2 The virtual trials 10
Figure 3 Upper and lower bounds for energy sales (many-to-one arrangement).................. 17

Table 1 Risk and benefit comparison – many-to-one and one-to-many................................. 7
Table 2 Assessment framework... 14
Table 3 Comparison of energy export rates by state and retailer 15
Table 4 Benefits and risks: many-to-one model 20
Table 5 Benefits and risks: one-to-many model 24
Table 6 Risk and benefit comparison – many-to-one and one-to-many............................... 26

1 EXECUTIVE SUMMARY

The paper is prepared as part of an Australian Renewable Energy Agency (ARENA) funded research project led by the Institute for Sustainable Futures (ISF) at the University of Technology Sydney (UTS), *Facilitating Local Network Charges and Virtual Net Metering* and a project funded by the Victorian Government Department of Environment, Land, Water and Planning (DELWP), *Virtual Renewable Power Stations*. A key task in the ISF project is to run five virtual trials of Local Electricity Trading (LET)[1] and local network charges, one of which will take place in the Moira Shire and Swan Hill Rural City Council areas in regional Victoria.

The Moira and Swan Hill trial will examine either the business model for a one-to-many (Community Power Station) or for a many-to-one (also called a Virtual Power Station, or VPS). Both of these models are likely to be enabled if Local Electricity Trading becomes commonly available. The primary interest of the Councils is to improve the resilience of the local economy by retaining energy spending within the area, to increase the capacity of local renewable energy generation and to enable local residents and businesses to participate in the renewable energy generation.

The purpose of this paper is to assist the Councils to choose which model to take forward into a trial.

1.1 Concepts: LET, LNC, many-to-one and one-to-many

Key concepts used in the report are:

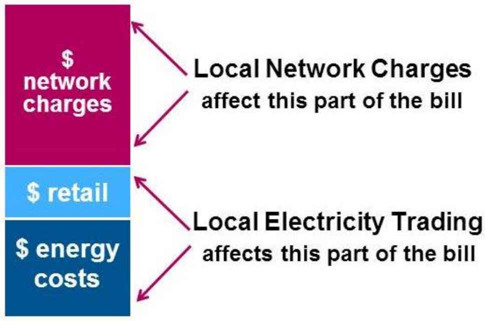
- **Local Electricity Trading** is an arrangement whereby generation at one site is "netted off" at another site on a time-of-use basis, so that Site 1 can 'sell' or assign generation to nearby Site 2. Local electricity trading (the term used in this report) has frequently been referred to as Virtual Net Metering or VNM.

- **Many-to-one (Virtual Power Station):** in this model many individual, separately located generators generate energy that is aggregated and transferred to a single site, or a small number of sites. If this model were to be applied in the Council's trial, export from residents' or business' PV systems, would be netted off against the Council's usage (and potentially other business users).
- **One-to-many:** A single generator's energy output is virtually 'split' and transferred to many individual sites. This could either be a council owned power station or a community owned facility **(Solar garden or Community Solar Farm).** If the latter model were to be applied in the Council's trial, the business case would be established for a community owned facility supplying its members via a LET arrangement.
- **Local network charges** are reduced network tariffs for electricity generation that are used within a defined local network area. In most circumstances, the tariff will reduce the network charge portion of electricity bills for local generators. This recognises that the generator is using only part of the electricity network, and reduces the

[1] Local Electricity Trading is the term adopted for virtual net metering in this paper

network charge accordingly.

- **The relationship between Local Electricity Trading and local network charges**: the two measures are complementary but independent. Each will have different effects on a consumer' energy bills, with local network charges affecting the network charge of the bill and LET affecting the energy cost and retailer portion of the bill.



1.2 Comparison of options

The choice between the 'many-to-one' and 'one-to-many' model are considered in the context of the Councils' aims. An assessment framework was devised for this report, with all factors shown in Table 6 and the most important factors of differentiation discussed below.

- ***Economic & Empowerment comparison:*** Both options provide a unique way for the local community to be involved in the economic activity associated with energy generation. However, there are differences:
  - A **many-to-one** power station will be limited to the size of the energy user(s), most likely the Councils. Additionally, the economic activity will only be accessible to those homes or businesses able to host a renewable generation system.
  - A **one-to-many** virtual power station is likely to be limited by the size of available sites and the total electricity demand of the community. However, Local Electricity Trading creates considerably more opportunities for siting than the status quo.
  - It is assumed that **'one-to-many'** power stations will be newly built infrastructure and therefore have the added benefit of the economic activity associated with installation.
  - The benefits of a **community solar garden** are likely to be greater than both the many-to-one option and the one-to-many council owned power station, as the scale of a project is limited only by the electricity demand of the entire local community.
- ***Ease of implementation:*** the selected option must be practical for the Councils to implement. The primary challenges in a **Many-to-one** VPS are the large number of contractual agreements that the Councils will need to manage. A **One-to-many** model has a quite distinct set of challenges: retailer complexity, finding a suitable site and establishing governance for community ownership being the chief challenges. While the last of these can be avoided if the Council is the owner, this significantly detracts from the potential community empowerment outcomes. However, the challenges associated with the community ownership model have been addressed in an Australian context, and there are toolkits available to assist with implementation.
- ***Liability and Risk:*** Risks and liabilities are important to identify and manage early in the project. A **Many-to-one** VPS contains few legal or financial liabilities for the Councils. Political or perceptual risks are also manageable providing the Councils are not offering excessively high rates for the energy. By contrast, a community owned **One-to-many** facility may require significant risk management. Should community investors lose their money there could be significant backlash. Despite this, governance and risk management frameworks exist for community owned solar and can be readily applied to this project. It would be prudent for council to encourage and empower a governance board separate from the council itself to administer the investment scheme required. A well-run community solar project can be supported by the Council but ultimately will need to be led by community members.
- ***Accessibility*****:** the one-to-many (community owned) solar garden brings the greatest benefit, as all residents who are able to invest in renewable energy may participate. In

contrast, the many-to-one option has ownership of a suitable roof as a pre-requisite, and one-to-many (Council-owned) does not allow increased community ownership of generation.

- ***Community empowerment*** is further improved by the community solar garden as the community has the opportunity for capability and skills development in renewable energy at a level beyond the scale of domestic solar.
- ***Replicability*** is greatest for the community solar garden as there are over 60 communities across Australia considering community solar projects. The business case for these projects is likely to be considerably enhanced if Local Electricity Trading was demonstrated to be feasible for selling electricity. This represents a significant opportunity for lessons learned to be applied to other projects
- ***Ease of implementation*****:** a community solar garden is considered to be an easier path than a ‘many-to-one’ VPS in the absence of a third party willing to play an aggregator role

1.3 Recommendations

ISF recommends a ‘one-to-many’ solar garden (community owned) be implemented for the Local Electricity Trading trials conducted in the Moira and Swan Hill Councils.

The risk benefit comparison conducted for this report (as summarised in Table 1) has found that the **‘one-to-many’ solar garden** outperforms the many-to-one option in six of eleven cases and is only rated worse in two cases. This option is similarly rated to the one-to-many council owned power station; the solar garden is rated higher in four cases (economic development, access to renewable energy, community empowerment, and replicability), but rated less highly on ease of implementation, legal and financial liabilities and political risk. The overall scores are close, with 33 rather than 27.

The areas where the solar garden performs less well are ease of implementation (compared to the Council owned option) and liabilities and risks. As there are clear strategies available to reduce these risks, they are considered less important than the potential benefits.

Table 1 Risk and benefit comparison – many-to-one and one-to-many

Factor	Many-to-one	One-to-many (Community owned “solar garden”)	One-to-many (Council owned)
Ease of implementation	★?	★★	★★★
Council electricity cost	★★	★★	★★
Economic development	★★★	★★★★★	★★★★
Access to renewable energy	★★★	★★★★	★★★
Greenhouse Gas Reductions	★★★	★★★★	★★★★
Community empowerment	★★★	★★★★	★
Replicability	★	★★★	★★
Legal liabilities	★★★	★★	★★★
Prudent management of resources and funds	★★★★	★★★★	★★★★
Political and perception risks	★★	★	★★
Financial Liabilities	★★	★★	★★★
TOTAL	27	33	31

2 INTRODUCTION

The paper is prepared as part of an ARENA funded research project led by the Institute for Sustainable Futures (ISF) at the University of Technology Sydney (UTS), *Facilitating Local Network Charges and Virtual Net Metering* (the ISF project), and the Virtual Renewable Power Stations project (the VPRS project) funded by the Victorian Department of Environment, Land, Water and Planning (DELWP).

A key task in the ISF project is to run five virtual trials of Local Electricity Trading (LET)[2] and local network charges, one of which will take place in the local government areas of Moira Shire and Swan Hill Rural City Council (the Councils) in regional Victoria.

The VRPS project aims to generate the knowledge to support municipal governments to spend their energy budgets locally and encourage further distributed renewable energy generation uptake in their communities.

There are many new business cases made possible by the introduction of Local Electricity Trading. The Moira and Swan Hill trial will examine the business model for a one-to-many (Community Power Station) or for a many-to-one (also called a Virtual Power Station, or VPS). Both of these models are likely to be enabled if Local Electricity Trading becomes commonly available. The primary interest of the Councils is to improve the resilience of the local economy by retaining energy spending within the area and to enable local residents and businesses to participate in renewable energy generation.

The purpose of this paper is to investigate the relative merits of the one-to-many and many-to-one model and assist the Councils to choose which model to take forward into a trial. .

2.1 Concepts: LET, LNC, many-to-one, and one-to-many

Key concepts used in the report are:

- **Local Electricity Trading** 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 assign generation to nearby Site 2. This will reduce the combined energy and retail portion of electricity bills for local generation. Local electricity trading (the term used in this report) has frequently been referred to as Virtual Net Metering or VNM.
- **Many-to-one (Virtual Power Station):** in this model many individual, separately located generators generate energy that is aggregated and transferred to a single site, or a small number of sites. As with all electricity sales, the physical electricity may not reach the buyer's site, but the generation is reconciled against their usage for billing purposes. If this model were to be applied in the Councils trial, export from residents' or business' PV systems, would be netted off against the Council's usage (and potentially other business users).
- **One-to-many:** A single generator's energy output is virtually 'split' and transferred to many individual sites. As with all electricity sales, the physical electricity may not reach

[2] Local Electricity Trading is the term adopted for virtual net metering in this paper

the buyer's site, but is reconciled against their usage for billing purposes. This could either be a council owned power station or a community owned facility **(Solar garden or Community Solar Farm).** If the latter model were to be applied in the Councils trial, the business case would be established for a community owned facility supplying its members via a LET arrangement.

- **Local network charges** are reduced network tariffs for electricity generation that is used within a defined local network area. In most circumstances, the tariff will reduce the network charge portion of electricity bills for local generators. This recognises that the generator is using only part of the electricity network, and reduces the network charge accordingly. To date reduced network tariffs have been applied systematically in the UK and Minnesota.

- **The relationship between Local Electricity Trading and local network charges**: the two measures are complementary, but independent. Each will have different effects on a consumer' energy bills, with local network charges affecting the network charge of the bill, and LET affecting the energy cost and retailer portion of the bill.

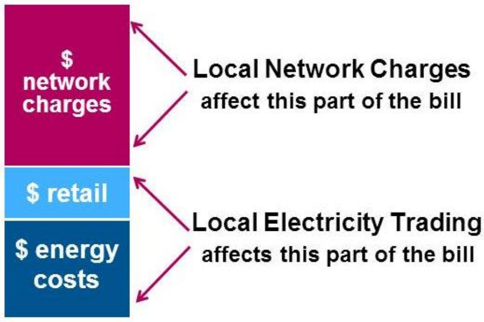


Figure 1 Local Network Charges and Local Electricity Trading

2.2 The VRPS research project

The two year project to investigate Virtual Renewable Power Stations is a partnership between Moira Shire Council and Swan Hill Rural City Council, funded by DELWP. VRPS aims to support local generation and consumption of renewable electricity within municipal areas. Municipal governments spend tens of millions of dollars on electricity annually, with even small rural shires spending in excess of a million dollars annually. Many aim to spend their budgets within the local community and encourage their communities to embrace environmentally sustainable behaviours.

The VRPS project has the overall aim "to investigate the concept of using regional community owned assets to host renewable energy generation infrastructure to create a virtual renewable power station and drive adaptation to, and investment in, decentralised electricity generation infrastructure.' Related objectives are:

- Retaining a greater proportion of Council energy expenditure in the local economy;
- increasing local renewable energy generation capacity; and
- engaging the local community in the value of local renewable distributed generation.

Involvement by the Moira Shire and Swan Hill Rural City Councils in the ISF research project is enabled by the VRPS project, and recognises that partnering brings mutual benefits for each project.

2.3 The ISF research project

The one year ISF project started in June 2015 and investigates two measures aimed at making local energy generation more economically viable: Local network charges for partial use of the electricity network and Local Electricity Trading (also called Virtual Net Metering) between associated customers and generators in the same local distribution area. The project brings together a partnership of consumers, researchers, electricity providers and government to help level the playing field for local energy and prepare for the electricity grid of the future.

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

ISF will publish reports and briefing papers and an open-source 'Business Case' spreadsheet tool that will be freely available for use by anyone who wants to see how local network charges and Local Electricity Trading affect the economics of their projects.

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 charges and Local Electricity Trading;

b. Five 'virtual trials' of local network charges and Local Electricity Trading;

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

d. A recommended methodology for calculating local network charges;

e. An assessment of the metering requirements and indicative costs for the introduction of Local Electricity Trading,

f. Consideration of whether a second rule change proposal is required to facilitate widespread introduction; and

g. 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 (see Section 6).

Figure 2 The virtual trials

3 EXAMPLES & PRECEDENTS

3.1 One-to-many: Solar gardens

Solar Gardens is a term used in the USA for community owned solar farms whose energy generation is directly 'netted off' the electricity bills of individual community owner investors. Legislation passed in 2011 in Colorado applies where beneficial use of the renewable energy generated by the [community solar project] belongs to the subscribers of the project.

Under Colorado legislation, a Solar Garden is "deemed to be located on the site of each subscribing customer's facilities for the purpose of crediting the subscribers' bills". In effect this is local electricity trading with the full retail rate (which includes the full network charge) of the electricity being attributed to the local customer.

A solar garden is an example of a One-to-Many virtual power station. Some notable solar gardens in operation in the USA are detailed below.

3.1.1 US EXAMPLES: OWNERSHIP AND SUBSCRIPTION SOLAR GARDENS

There are many examples of shared solar in the US (Interstate Renewable Energy Council 2015). The two examples chosen here show the difference between an owner and a subscription model.

Ownership model Examples: Community Sun SolarCondos in Texas has a program whereby participants can purchase 'SolarCondos' that are small sections of a larger facility. This project has received confirmation from the US Securities and Exchange Commission (SEC) that the program is not considered to be a security (Feldman et al. 2015). This is advantageous to community members as securities regulation can be challenging to navigate.

Clean Energy Collective (CEC) owns and operates 39 projects across 9 states. These projects take advantage of virtual net metering legislation to enable 'roofless solar' for people in the community to purchase electricity from these projects. Clean energy collective is one of the largest community solar developers in the world. Customers are able to purchase individual panels which are then operated by the CEC (Clean Energy Collective 2015).

Subscriber model: City Utilities' solar farm is a utility owned project that allows the customers of the utility to purchase the output of the solar farm at a fixed rate for up to 20 years. Customers to City Utility are able to subscribe for up to 100% of their bill to be sourced from the solar project. Solar energy can be 'banked' from one billing period to the next (City Utilities 2015).

3.2 Many-to-one: Virtual Power Station (VPS)

The definition of a virtual power station is somewhat flexible and there are a number of virtual power station examples around the world with significantly different characteristics. The appropriate VPS for the Moira and Swan Hill Councils is a specific case of VPS whereby energy goes directly to a single customer, or small number of customers. This definition, as compared with the broader VPS definition are presented below:

VPS definition for Moira and Swan Hill

> *An aggregation of distributed energy generators in the local area that act together to provide for the energy needs of a central facility or facilities.*

Broader Literature definition

> *An aggregation of distributed resources acting together for commercial or technical benefit.*

The broader definition of a VPS generally means combining the resources into a large enough generation capacity to effectively provide network support to utilities and/or bid into the electricity market. This may be the actual electricity market or (more likely) the ancillary services (FCAS) market.

While most commercial VPSs in operation aggregate generation for bidding into the national electricity market, this is not a prerequisite. It would be equally possible for the aggregate output to serve the needs of a large single energy customer. The examples below are beyond the scope of what is proposed for Moira and Swan Hill, however it is likely that building blocks of these projects will resemble potential solutions for the Moira & Swan Hill VPS.

3.2.1 BORNHOLM VIRTUAL POWER STATION

Bornholm is an island in the Baltic sea (Østergaard & Nielsen 2010) with 52 coordinated generators serving over 28,000 local customers. Generation is managed via a fibre optic communication system which also can control capacitor banks and transformer tap changers. This is made possible through ownership of local electricity grid as well as the generation infrastructure.

The VPS scoping study conducted by Moreland Energy Foundation for the Councils (Moreland Energy Foundation 2015) notes that a VPS is possible through the municipalisation of a local section of the distribution network. Such is the case with the Bornholm VPS. This allows the local section of the network to be operated as a coordinated unit with internal loads and energy resources acting to reduce reliance on the wider electricity network.

It should be noted however that there are significant hurdles involved in establishing ownership over a local distribution network, even without consideration of how the network would then be maintained. In the case of Moira and Swan Hill the purchase would need to be negotiated from Powercor. Alternatively, a substitute network would need to be constructed privately as was done in Feldheim, Germany (Guevera-Stone 2015). Due to these challenges this type of VPS has not been considered further in this report.

Nonetheless this example shows the potential technical challenges (of coordinating generation and load) to address within a relatively small distribution area.

3.2.2 REPOSIT POWER & VELOCITY ENERGY

Australian organisations such as Reposit Power (Reposit Power 2015) and Velocity Energy are aggregators of privately owned energy generation, providing an interface to the broader electricity market. These organisations have the ability to participate in reserve markets (Velocity Energy n.d.) and in doing so are operating a Virtual Power Station. However this is not a ‘many-to-one’ scenario as envisaged by the Councils as the VPS has been created to sell ancillary services to the network, rather than to sell energy.

While these companies are not supplying energy to a third party, they demonstrate that the legal, contractual and customer relationship management of many generators is possible. There is nothing to prevent energy sales being included in this type of arrangement however.

The capacity to manage many generator contractual relationships is a crucial building block of the VPS considered for Moira and Swan Hill in this report.

3.2.3 KOMBIKRAFTVERK

Kombikraftverk is a VPS example in Germany combining the renewable energy resources of 12 solar PV installations, two wind farms and four biogas plants (German Renewable Energies Agency n.d.). The purpose of the plant is primarily to show that power stability is achievable despite constituent generators having varying output. A secondary outcome of the project, however, is that contractual relationships for all the constituent generators are manageable but this role is taken by the Fruanhofer Institute in the case of Kombikraftwerk.

4 ASSESSMENT FRAMEWORK

This report sets out to determine whether the one-to-many or the many-to-one model of Local Electricity Trading is most beneficial for Moira and Swan Hill Councils. The result will assist the Councils to investigate further through trials. The following are taken as the primary criteria for consideration: the overall ease of implementation, the potential benefits and the potential risks.

Table 2 Assessment framework

Factor	Description
EASE OF IMPLEMENTATION	What is the likelihood of the project going ahead? Is a regulatory change needed prior to implementation? What is the likely timescale to implementation?
POTENTIAL BENEFITS	
Council electricity cost	What are the impacts on council's electricity cost?
Economic development	Will energy spending in the local economy increase as a result of the project? What scale?
Access to renewable energy	Will the project increase the access to renewable energy for a broad range of community segments?
Greenhouse Gas Reductions	What are the impacts on Greenhouse Gas reductions for the Council and/or Council area?
Community empowerment	What are the impacts for a broad range of segments?
Replicability	How easily can the model be replicated?
POTENTIAL RISKS	
Legal liability	How might the project affect Council's legal liability?
Prudent management of resources and funds	Does the project fit within an expectation of prudent management?
Political and perception risks	What risks is the project likely to bring?
Financial Liability	How might the project affect Council's financial liability?

5 ASSESSMENT OF OPTIONS

5.1 Many-to-one

The 'Many-to-one' option is characterised by many generators supplying energy to a single energy user. In the context of Moira and Swan Hill the generators are likely to be individual households with small solar PV units. This version of a virtual power station was defined in previous work conducted by Moreland Energy Foundation (Moreland Energy Foundation 2015). The single energy user would be the Council premises, or sales may be arranged to a small number of large users.

Energy from the virtual power station is sent to a user using a Local Electricity Trading (LET) mechanism. The energy (kWh) from the generator(s) is attributed to a 'beneficial account' of the electricity user. This beneficial account would show a reduction in energy usage and costs due to the virtual power station.

This trade is likely to occur when the energy (per kWh) costs of the beneficial account are higher than the price that the generator would otherwise receive from generating and exporting the power to the retailer. Retailer export tariffs differ from state to state and retailer to retailer. Currently in Victoria the most attractive rate is offered by Click Energy at 10c per kWh as seen in Table 3, and retailers generally offer between 6 and 8 cents. It is important to note however that these offers are at the retailer's discretion and therefore do not necessarily provide a generation proponent with the certainty to make a business case.

Table 3 Comparison of energy export rates by state and retailer

Retailer	ACT	NSW	QLD	SA	TAS	VIC
ActewAGL Retail	7.5					
AGL Sales		5.1	8	5.3		8
Alinta Energy Retail Sales Pty Ltd				9.6		8
Aurora Energy					5.5	
Click Energy		10	6			10
Cova U Pty Ltd						
Diamond Energy		8	8	8		
Dodo Power & Gas		0	4	6		8
EnergyAustralia		5.1	6	5.3		6.2
Ergon Energy Queensland						
GloBird Energy						
Horizon Power						
Lumo Energy Australia		5	6	6		6.5
Momentum Energy		0		5.3		6.2
Neighbourhood Energy						
OC Energy Pty Ltd						
Origin Energy Electricity	6	6	6	5.3		6.2
Pacific Hydro Retail Pty Ltd						
People Energy						
Powerdirect		7.7	6	8		8
Powershop Australia		6.4				6.4
Red Energy						6.5
Simply Energy				6.2		6.2

Note: greyed out squares indicate retailer does not operate in that state

5.1.1 STAKEHOLDERS

For the purposes of this section the proponent could be considered to be the combination of the generator owner and energy customer who wish to enter into a Local Electricity Trading arrangement with each other. Under a 'Many-to-one' scenario the proponents will need to engage with the following stakeholders.

Proponents

- **Energy customer**: The energy customer is the 'One' in 'Many-to-one'. This is likely to be a large user of energy and, for the purpose of the trials, would be a Council building or other public premises.
- **Generators**: The generators are the 'Many' in 'Many-to-one'. In the case of Moira and Swan Hill this would predominantly be residential solar customers. However, it should be noted that all generation technologies are considered equal under Local Electricity Trading. The energy customer, however, will be able to select at its sole discretion any particular generation technology that is preferred.

Other parties

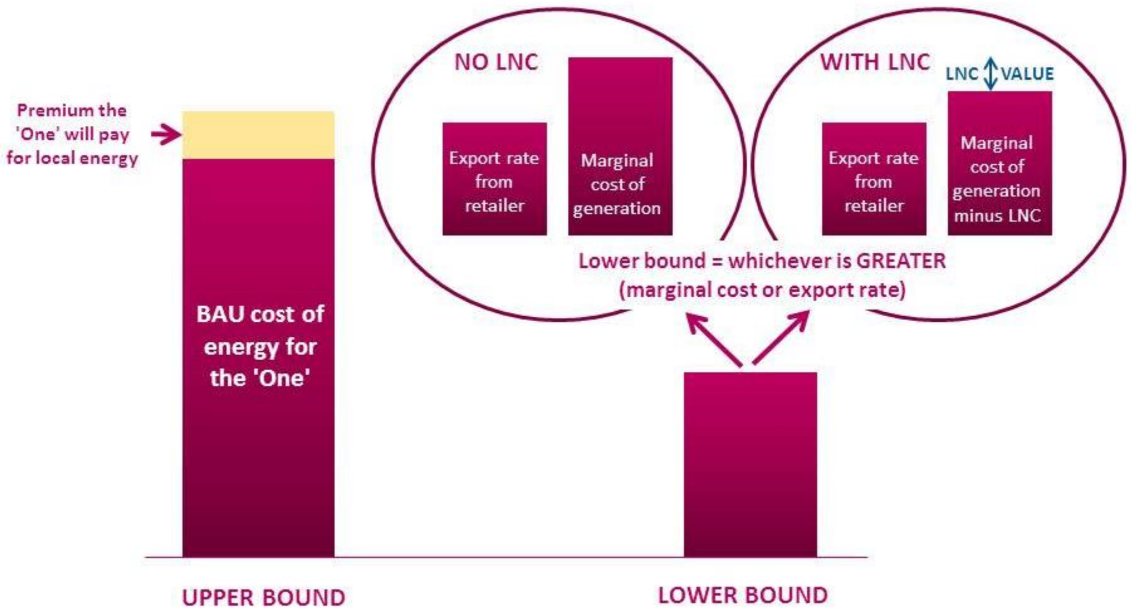
- **Retailer**: The electricity retailer performing the 'netting off' of generation at one site to use at another
- **AER**: The AER will not be required to make a ruling for the purpose of the trials, as no sale is taking place. However, if a 'Many-to-one' Virtual Power Station were to be implemented beyond the trial stage it would be necessary to consult with the AER to determine what exemptions or licences would need to be held by the different parties
- **Aggregator**: [optional] Each individual generator will require a contract to specify the terms by which it sells energy to the end customer. These contractual matters are likely to be handled by an aggregator more easily than by the Council itself.
- **Australian Taxation Office** (ATO): As the generator is making a sale of energy, the ATO may consider this as additional income for the generators. However, as solar feed in payments are not currently taxable income it is not expected that the ATO would view this transaction any differently.

5.1.2 FINANCIAL ASPECTS

Under a 'Many-to-one' arrangement each generator will opt in as to whether it sells energy to the 'One' customer. In return, the beneficial account holder (i.e. the Council) would pay each of the generators for the electricity received. In this manner the council would be able to ensure that its energy is sourced from the local area. This also guarantees money from the Council is being re-circulated in the community. This payment may be direct to each energy generator, or perhaps more realistically through an aggregator who has business systems in place for managing financial transactions with many small generation units.

If Local Electricity Trading is in place without the LNC, the transaction is only likely to occur if the 'One Customer' is prepared to offer a higher amount for the electricity than the retailer offers the generator for exports. How much higher the 'One Customer' will offer will be limited by the price that it will otherwise have to pay for energy use plus any additional margin it is prepared to pay for the benefit of 'buying locally'. A second constraint is that the transaction will only occur if the marginal cost of generation is less than this sale price. Note that for solar PV the marginal cost of generation is zero. These two constraints set the upper and lower bound for the transaction.

Figure 3 Upper and lower bounds for energy sales (many-to-one arrangement)



Where Local Electricity Trading is in operation with the LNC the 'One Customer' may be able to negotiate a lower price with the generators, as each unit exported and sold to the 'One Customer' will result in LNC accruing to the generator. This credit would assist them in recouping their generation costs and allow them to potentially offer a lower sale price to the 'One Customer'. However they would not offer a price lower than that which they could receive from the retailer plus the value of the LNC. As the generators are to be Solar PV, the marginal cost of generation for this case will be zero.

Worked example: Solar PV and Cogeneration at Swan Hill
For the case of the Swan Hill Council, with a virtual power station comprised of local solar PV and gas Cogen the following figures indicate the range of the likely sale price:

- Export rate from retailer for solar (AGL): 8 ¢ / kWh
- Export rate from retailer for Cogen (AGL): 0 ¢ / kWh
- Marginal (operating) cost of generation (Solar): nil
- *Marginal (operating) cost of gas cogen: 9.5¢ / kWh
- Business as usual cost of energy for council: 8.7 ¢ / kWh
- *Hypothetical LNC value: 2¢ / kWh
- *Hypothetical premium the council may pay for buying local: 1¢ / kWh

Without an LNC in place the potential sale price for solar would likely fall between 8 ¢ (best alternative) and 9.7 cents (Council's highest offer). For the cogeneration unit it will fall between 9.5¢ and 9.7¢ due to the higher operating cost of the cogen unit.

With an LNC in place, the likely sale price for solar would not change. However ,the Council may have less appetite to pay a premium for local energy given that the solar PV is receiving a local credit from the network. The LNC does however have the effect of helping the gas cogen recover some of its operating costs and thus it will be willing to switch on at an offer from the council as low as 7.5¢.

** Values are based on dummy data*

5.1.3 COMPETITION

During the trials, only one possible Local Electricity Trading customer will exist (the Council). For this reason the Council will have significant negotiating power in setting the commercial terms for any energy transferred. It should be noted that if and when Local Electricity Trading becomes more widespread, the Council would face competition from other potential customers. Businesses or consumers with the highest electricity cost (per kWh) could be expected to bid the highest for receiving electricity from a local generator. This could be considered advantageous from the point of view of the Council in encouraging local transactions. A consequence of this however is the Council may not be the one to actually receive the benefit of the locally generated electricity, as it may be outbid by another customer. The competitive nature of bidding for prosumer energy and the resulting behaviours of prosumers are considered by Rathanayka (Rathnayaka et al. 2011), but are not detailed further in this paper. The resulting behaviour of the local energy market-place, sale price level and competitive efficiency are unclear at this time.

5.1.4 LEGAL AND CONTRACTUAL CONSIDERATIONS

Each generator would require a contract regarding the supply of energy it makes. This would typically be handled by an 'aggregator'; an organisation which combines the generators so that they appear to operate as a single generation unit. This role could be performed by the Council(s) via a purpose built entity, as identified by the Moreland Energy foundation scoping study. This entity would be an Electricity Services Company (ESCO) capable of managing the multiple generator relationships. There are no known precedents of a Council in Australia forming such an entity.

As an alternative to creating a purpose built entity the Councils may find it more suitable to engage an organisation already involved in generator aggregation such as Sunverge (Sunverge Energy Australia 2015), Reposit Power (Reposit Power 2015) or Velocity Energy (Velocity Energy n.d.). Each of these organisations has existing infrastructure for managing many sites on both a technical and contractual basis and may be willing to play this role for the Councils.

Finally, it may be such that the Council's retailer is interested and willing to fill the aggregation role.

5.1.5 REGULATORY ENVIRONMENT

The regulation of electricity sales of this nature is the domain of the Australian Energy Regulator. A determination would be required from the AER under the exempt selling guideline and it is possible that the generators would require a 'registrable exemption' as a person or business selling energy to large customer(s) (Australian Energy Regulator 2011). As the customer is a large one the AER is unlikely to demand stringent consumer protection conditions as it will consider that the customer (i.e. the Councils) will only choose to take part in the transaction if fair terms are negotiated.

The introduction of a pre-existing aggregator as discussed in section 5.1.4 is likely to considerably decrease the regulatory burden as it can be expected that the aggregator will have all sufficient licenses and exemptions to provide this service.

The legal complexities of billing means that the operation of a 'Many-to-one' Virtual Power Station would either require the involvement of an aggregator with billing systems and technical knowledge of the energy market to mediate transactions, or that generators would need to share the same electricity retailer as the Council.

5.1.6 TECHNICAL ASSESMENT

Individual small scale solar PV systems are a well understood technology and installation technicalities will be specific to each property owner wishing to install a system. Despite individual situations it is likely that technical barriers of installation will be minimal.

Virtual power stations of an aggregate nature will typically have a communications and control system that gives visibility to the operator of the total output of the generation fleet and enables the control required to respond to the customer's needs. In the case of Moira and Swan Hill it is possible that this additional layer of control will not be necessary as there is no market place that the VPS intends to participate in. However, it may be advantageous to take the opportunity to perform ancillary services in order to maximise revenue, provided the total aggregated generation is large enough.

5.1.7 UNRESOLVED ISSUES

Over supply of energy

As the size of the VPS grows there is an increasing likelihood that there will be points in time in the day or year that the aggregate energy generation is in excess of what is being used at the customer site.

When this over supply occurs there needs to be clear agreements in place with the generators as to whose energy will be sold and who will miss out. If this is difficult to predict it will be a risky business case for generators who are relying on the customer site usage for revenue. A fair and transparent mechanism is very important for this.

Aggregation

A scalable and cost effective method of aggregating the contractual and generator-relationship will be highly important in implementing the 'Many-to-one' scheme.

Table 4 Benefits and risks: many-to-one model

Factor	Description	Score
Overall ease of implementation	The primary barriers to implementation are the contract management and aggregation roles. The potential creation of a purpose built Electricity Services Company represents a significant difficulty in implementation. However, If a partnership were developed with an aggregator of suitable capability then this option would be significantly easier.	★?
POTENTIAL BENEFITS		
Council electricity cost	Electricity costs may be reduced by a small amount. However the retail offer for exports places a floor on how much cost reduction the council can achieve	★★
Economic development	Significant portions of Council electricity could be sourced locally in this manner resulting in more council money being recirculated into the local community. The economic development benefit will however be limited by the size of the Councils' electricity spend.	★★★
Access to renewable energy	Some additional community segments may find it worthwhile to install a generator, particularly those with a good site but low energy use. However, only people with houses or businesses capable of accommodating a generator will be able to participate.	★★★
Greenhouse Gas (GHG) Reductions	Greenhouse gas emissions are likely to be reduced to the extent that Virtual Power Station encourages additional generation capacity to be installed and operated. The attractiveness of the Council's offer in driving this must be made in comparison to other export offers. As other offers are likely to be comparable to the Council's it is difficult to mount a case for significant additional generation being installed due to the Many-to-one VPS in this particular context	★★★
Community empowerment	A greater market place would exist for sale of energy from local generators, representing a greater level of community participation in energy generation.	★★★
Scalability	Scaling the 'Many-to-one' type VPS would be dependent on how successfully the barriers to implementation and addressed in a replicable way. This will be most affected by the method chosen to manage the aggregation of generator relationships A second barrier to applicability to other sites and councils is the change in financial case due to 'grid price' of electricity for other sites possibly being significantly lower than the tariffs Moira and Swan hill pay.	★
POTENTIAL RISKS		
Legal liabilities	No significant legal liabilities would exist for the council as compared with business as usual.	★★★
Prudent management of resources & funds	Providing the council is not offering an excessive premium for local generation it would be difficult to fault the council on due prudence	★★★★
Political and perception risks	The council would have to manage any perception/communications risks regarding the fact that only homeowners/business owners with a suitable site would be able to participate	★★
Financial Liabilities	The Councils would be liable to pay for all electricity transferred to it. The Councils may also be liable to pay any required management fee to an entity taking the role of aggregator	★★

5.2 One-to-many

The 'one-to-many' considered by this report consists of a single generator that sends energy directly to people in the council's local area.

It is likely, although not absolutely necessary, that the generator would also be owned in a community ownership structure where the people receiving the energy credits are also the owners of the VPS. This is called a community solar farm, or solar garden.

The output of the generator (the 'One') would be 'netted off' from a large number of beneficial accounts holders (the 'Many') who would receive a lower energy consumption charge on their bills.

The beneficial account holders may be required to pay for the energy, or alternatively it may already be rightfully theirs due to a capital investment they make in setting up and constructing the generator.

For the purposes of this report the generator examined will be a centrally located solar farm.

Two cases will be considered:

1. **Community owned:** Local community members through a community ownership structure own the solar farm and are also beneficial account holders.
2. **Separately owned:** The beneficial account holders and the solar farm owners are separate. For example the council would own the solar farm and the local residents would receive the energy credit on their bills.

5.2.1 STAKEHOLDERS

Under a many-to-one model the proponents will need to engage with the following stakeholders. For the purposes of this section the proponent could be considered to be the combination of the generator owner and the energy customer who wish to enter into a Local Electricity Trading arrangement with each other.

Proponents

- **Energy customers**: The energy customers are the 'Many' in 'One-to-many'. This is likely to be a large range of energy users in the local community
- **Generator**: The generator is the 'One' in 'One-to-many'. In the case of Moira and Swan hill this is considered to be a centrally located solar PV array.

Other parties

- **Retailer**: The electricity retailer performing the 'netting off' of generation at one site to use at another.
- **AER**: The AER will not be required to make a ruling for the purpose of the trials, as no sale is taking place. However if a 'One-to-many' Virtual Power Station were to be implemented beyond the trial stage it would be necessary to consult with the AER to determine what exemptions / licences would need to be held by the different parties
- **Australian Taxation Office** (ATO). As the generator is likely to be making a sale of energy the ATO may consider this as additional income for the generators. If the generator distributes this income to local owner-investors there will be tax implications for those owner-investors.

5.2.2 SITING

Solar projects are commonly sited in a manner to directly feed electricity load on the same site. This is often referred to as ‘behind the meter’. A high value for the energy can be realised due to avoiding use of power coming via the electricity meter from the grid.

A Local Electricity Trading approach becomes worthwhile where this ‘high value’ electricity load is not present or if the beneficial account holders have a higher energy cost than the energy cost of load on site. If such a site with high and consistent electricity use is available and technically suitable it would be advantageous to install a solar array on this site, rather than using Local Electricity Trading to send the energy elsewhere.

There is also a hybrid approach if a Council site exists that can have more solar installed than the on-site load, in which case part of the generation is exported via a Local Electricity Trading arrangement.

As the context of this report is to recommend a Local Electricity Trading trial, it is assumed that such a site would only consume a small amount of the solar generation and the rest would need to be exported.

The introduction of Local Electricity Trading has the effect of opening up siting opportunities to other locations which are technically feasible for an installation but do not have the demand for electricity on site, and to energy consumers who do not themselves have suitable sites. This represents a significant expansion in the number of feasible sites, and an expansion of the opportunity for self generation.

5.2.3 FINANCIAL ASPECTS

Construction for the solar farm will require an initial capital outlay. This report will consider the capital investment coming from two possible places:

1. **From local community owner-investors**: This type of community investment project allows any member of the community to take part in local energy generation. In return for their capital investment the investor could receive benefit in the following ways:

    a. Directly receiving energy from the plant in proportion to the investor’s share of ownership in the plant.

    b. Dividends from profits earned by plant in selling its energy to members in the community via Local Electricity Trading.

    Where Local Electricity Trading is offered by the retailer option a) would be the easier to implement. However if the owner-investor is not using electricity at this time the benefit may be forfeited.

    It should also be noted that where energy is sold and profits returned as dividends there would be tax implications for the income received by the owner investors. Electricity transferred directly is less likely to have tax implications for owner investors. However a definitive ruling on this has not been made by the ATO at the time of writing.

    A combination of a) and b) is likely to be the most desirable structure for a community owned solar farm. However, this will involve more administration from the community investment vehicle in keeping track of where energy and dividends are used and earned.

2. **From a separate institution such as the Councils:** Where the entity making the capital expenditure is a different entity to the beneficial account holders there will need to be payment for the energy transferred. The Councils (or other entity) would need to manage a number of energy sales contracts with the local residents purchasing the energy, or have those sales moderated via a retailer or aggregator.

Either of these models will result in greater local economic activity and a greater amount of electricity spending occurring locally.

Any model involving sale of energy, i.e., any option other than purely 1a) is likely to require a retailer exemption from the AER. This is covered further in the regulatory section below.

5.2.4 REGULATORY ENVIRONMENT

Regulation of Energy Sales

As per the Many-to-one discussion, the regulatory body for energy sales is the Australian Energy Regulator (AER). As the solar farm will have relationships with many individual energy consumers the AER is likely to require a license or exemption be held by the solar farm. As each consumer will also have an electricity retail account with a licensed retailer it is possible the retailer’s license is all that will be required.

Some aspects of the transfer of energy, notably the consumers retaining the ability to source electricity from a retailer of their choice, would steer the AER away from onerous exemption conditions. On the other hand the fact that energy is provided to small residential customers may cause the AER to take a greater interest (AER 2013).

Regulation of Investment

Where a community owned solar farm is progressed there will also be a body regulating the community investment entity. This could be:

- The Australian Securities and Investment Commission (ASIC) if a community owned company is the investment entity.
- The Registrar of Cooperatives if a cooperative is chosen as the investment entity

The consumer protections in place for managing an investment scheme are not insignificant. In order to conduct capital raising for a community owned solar project a disclosure document is required. The contents of this document are strictly regulated and will require careful consideration and understanding.

5.2.5 COMPETITION

The market situation and process by which an energy customer selects an energy source is already well understood. The generator will need to offer a more attractive price of energy to the receiver of the energy than the receiver would otherwise pay. Part of this attraction may be non-monetary, such as the ‘feel good’ factor of buying local. The lower bound of the transaction would not be lower than the Levelised Cost Of Energy (LCOE) of the solar generation. Depending on the required rate of return for the investors this could be as low as 8.4¢/kWh to achieve return rates of 5% (Parkinson 2014).

5.2.6 TECHNICAL ASSESEMENT

Locating and securing a site for a central solar plant can present a significant technical challenge. Some of the key aspects to consider include:

- Is the project more suited to land (green field) or rooftop?
- What is the aspect of the site (north facing preferred)?
- What electricity connection infrastructure is nearby?
- Is the owner amenable to hosting a solar array?
- Is there good access for vehicles and workmen to the site?

- Is there any shading cast from nearby trees, buildings and/or mountains?
- For greenfield sites:
    - What are the planning overlays/constraints in zoning, flood level, heritage and biodiversity?
    - What is the soil type and depth to rock? (Geotechnical suitability)
    - Is the land suitably flat and clear of vegetation?
- For rooftop sites (a solar installer can usually assist with these points)
    - Is there easy access for lifting equipment onto the roof?
    - Is there a clear route for cabling to the main connection point?
    - Is the roof construction easy for mounting and structurally sufficient?

Beyond the technicalities of siting the generator there are technical considerations in its operation and transferring energy to the beneficial accounts. Questions to consider are:

- Will it be possible for customers who do not share a retailer with the generator to receive the energy via Local Electricity Trading? How?
- How will it be determined which customers receive energy from the power plant at which times? How will this impact the retailers billing systems?
- Where a customer's bill is not already split into energy and network charges, how will the retailer determine the energy value to be 'netted off'?

Table 5 Benefits and risks: one-to-many model

Factor	Description	Community owned	Council owned
Overall ease of implementation	The primary barriers to implementation are: • Locating and securing a suitable site • The regulatory environment in creating a community investment vehicle (if applicable) • The complexity for the retailer in attributing the generation to multiple sites These are not insurmountable and in the case of the first two there are numerous precedents to draw from	★★	★★★
POTENTIAL BENEFITS			
Council electricity cost	This model will provide more cost effective energy if the councils are members of the community solar project, as they would share in the output of the farm. Another option is for Councils to purchase electricity from a community owned project at a reduced rate due to LET. Finally, the council may secure cheaper electricity if the solar generator is sited on a council building that uses some of the generation before the balance is exported.	★★	★★
Economic development	Significant portions of local residents' and businesses' energy use could be sourced from the VPS under this model. The scale of local transactions occurring would be limited by the size of the plant. As profits from this activity	★★★★★	★★★★

Factor	Description	Community owned	Council owned
	would be recirculated in the local community (either directly or via the council) the 'One-to-many' will enhance local economic activity		
Access to renewable energy	The only limit on access to the renewable energy would be any voluntary constraints the VPS choose to place on its customers. If a community investment model is used, access to renewable energy investment will be increased for people who have had unsuitable circumstances for owning their own solar power.	★★★★	★★★
Greenhouse Gas (GHG) Reductions	Greenhouse gas emissions will be reduced if the generator was not otherwise going to be constructed. As 'One-to-many' VMN unlocks significantly more siting opportunities for solar plants than the status quo, any additional project represent GHG reductions.	★★★★	★★★★
Community empowerment	The level of community empowerment is dependent on whether a community investment model is used for the capital fundraising, which would significantly enhance community empowerment outcomes.	★★★★	★
Replicability	A successful trial of LET for a One-to-many generator would provide other communities a template to use for their projects, Many communities and councils are currently exploring opportunities for community owned renewables and would benefit strongly from the ability to transfer electricity directly to their members	★★★	★★
POTENTIAL RISKS			
Legal liabilities	The legal responsibilities of the board of directors managing a community investment scheme are not to be taken lightly. This would need to be a different body from the Council and as such the Council's legal exposure would be significantly reduced	★★	★★★
Prudent management of resources and funds	A prudent business case can be established for both a council owned and/or a community owned 'One-to-many'.	★★★★	★★★★
Political and perception risks	A council led community investment model can result in political risk if investors were to lose their money.	★	★★
Financial Liabilities	If the generator is owned by the community but located on council property the council would be liable for damage to the array if it were caused by the council.	★★	★★★

6 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Comparison of options

The 'Many-to-one' / 'One-to-many' choice of project for Moira and Swan Hill needs to be considered in the context of the Councils' aims. The chief points of comparisons are summarised in Table 6, with key issues discussed further below.

Table 6 Risk and benefit comparison – many-to-one and one-to-many

Factor	Many-to-one	One-to-many (Community owned)	One-to-many (Council owned)
Ease of implementation	★?	★★	★★★
Council electricity cost	★★	★★ (see note)	★★ (see note)
Economic development	★★★	★★★★★	★★★★
Access to renewable energy	★★★	★★★★	★★★
Greenhouse Gas Reductions	★★★	★★★★	★★★★
Community empowerment	★★★	★★★★	★
Replicability	★	★★★	★★
Legal liabilities	★★★	★★	★★★
Prudent management of resources and funds	★★★★	★★★★	★★★★
Political and perception risks	★★	★	★★
Financial Liabilities	★★	★★	★★★
TOTAL	27	33	31

Note: Council electricity cost is assumed to be affected to a similar degree by both 'many-to-one' (VPS) and 'one-to-many' (solar garden). The solar garden does have the potential to realise greater benefits for a council building if energy is used on-site behind the meter. However as this paper is focussed on a trial for Local Electricity Trading it is assumed that behind the meter usage at a Council site is small

6.1.1 ECONOMIC & EMPOWERMENT COMPARISON

ISF understands a primary aim of the project is to increase the amount of energy services sourced locally as a means of increasing local economic activity. Both options provide a unique way for the local community to be involved in the economic activity associated with energy generation. The National Renewable Energy Laboratory and the Institute for Local Self-Reliance have both reported that local ownership of renewable energy increases local economic activity (Farrell 2014; Lantz & Tegen 2009)

While both 'many-to-one' and 'one-to-many' will have these effects, each option does have certain limitations however:

- A **Many-to-one** power station will be limited to the size of the energy user(s), most likely the Councils. Additionally, the economic activity will only be accessible to those with suitable homes or businesses to host a constituent generator.

  It is likely that not all of the solar generators would be newly built for the program, unless the Council mandates this. Pre-existing generators are likely to already bring money into the community through receiving payments (feed in tariffs) from the external energy company. If these generators were to switch to receiving payments from Council instead, the net change in money flows in and out of the community is likely to be small. This is because the Councils decreased spend on energy from external sources would be offset by the local generators decreased income from external sources (the external energy retailer)
- A **One-to-many** virtual power station is likely to be limited by the size of available sites and the total electricity demand of the community. It should be noted that local electricity trading creates considerably more opportunities for siting the power station than the current status quo. This option increases access to renewable energy for the most number of people, as there are no barriers to participating due to not owning a suitable property.

In addition to energy transactions occurring locally (via LET) the program will stimulate economic activity through encouraging new solar PV to be constructed, which is likely to involve local electricians, installers and suppliers

It is assumed that any 'one-to-many' power stations, whether community owned or council owned will be newly built infrastructure. This variation therefore has the potential to have a larger impact on local energy transactions than the 'many-to-one' alternative

6.1.2 EASE OF IMPLEMENTATION

The selected option must be practical for the Councils to implement. There are number of aspects of each option that are challenges to implementation:

- The primary challenges in a **Many-to-one** VPS are the large number of contractual agreements that the Councils will need to manage either directly, or indirectly via an aggregator or purpose created Electricity Services Company.
- A **One-to-many** has a quite distinct set of challenges: retailer complexity, finding a suitable site and establishing governance for community ownership being the chief challenges. While the last of these can be avoided if the Council is the owner, this significantly detracts from the potential community empowerment outcomes. The challenges associated with the community ownership model have been addressed before in an Australian context, and there are toolkits and other resources available for to assist with implementation.

6.1.3 LIABILITY AND RISK

Risks and liabilities are important to identify and manage early in the project.

- A **Many-to-one** VPS contains few legal liabilities for the Councils. The financial liabilities involved under this option are simply the requirement to pay for electricity sourced from the VPS. Political or perceptual risks are also manageable providing the Councils are not offering excessively high rates for the energy.
- By contrast, a community owned **One-to-many** facility does require significant risk management and governance capabilities. Should community investors lose their money there will be significant backlash. Additionally if the system is on Council property, the Council will need to ensure that any maintenance of nearby Council equipment (for example roof mounted air conditioning units) do not affect the solar array. Despite this, governance and risk management frameworks exist for community owned solar and can be readily applied to this project.

6.2 Recommendations

ISF recommends a 'one-to-many' solar garden (community owned solar farm) be implemented for the Local Electricity Trading trials conducted in the Moira and Swan Hill Councils.

In summary, the **'one-to-many' solar garden** outperforms the many-to-one option in six of eleven cases and is only rated worse in two cases. This option is similarly rated to the one-to-many Council owned power station; the solar garden is rated higher in four cases (economic development, access to renewable energy, community empowerment, and replicability), but rated less highly on ease of implementation, legal and financial liabilities and political risk. The overall scores are close, with 33 rather than 27.

The areas where the solar garden performs less well are in ease of implementation (compared to the Council owned option) and on liability and risk issues. As there are clear strategies available to reduce these risks, they are considered less important than the increase in benefits noted in the comparison.

The main criteria where the alternatives have a different rating are discussed below with regard to main option.

- **Economic development:** the benefits of a community solar garden are likely to be greater than either of the alternative options. This is because:
  - The scale of a community solar farm project is limited only by the electricity demand of the entire local community and by available sites for community solar plants. This is a significantly higher upper limit than for a 'many-to-one' project, which is limited by Council consumption.
  - Local Electricity Trading under the many-to-one model is likely to include local generators switching from a feed in tariff to a local sale, so the additional income coming into the area may only be the increment, which is likely to be small.
  - All power participating in Local Electricity Trading is likely to be new generation capacity if it is community solar, leading to greater construction activity as compared to 'many-to-one'. It should also be noted that the local electricity trading scheme opens up many more opportunities for sites than would otherwise be available for community solar projects. This is because sites without significant and consistent load required for 'behind the meter' projects can now be considered.
- **Accessibility:** the community solar garden brings the greatest benefit, as all residents who are able to invest in renewable energy may participate. In contrast, the many-to-one

option has ownership of a suitable roof as a pre-requisite, and council owned does not allow increased community ownership of generation.

- **Community empowerment** is improved by the community solar garden as the community has the opportunity for capability and skills development in renewable energy at a level beyond the domestic solar scale.
- **Replicability** is greatest for the community solar garden as there are over 60 communities across Australia considering community solar projects. The business case for these projects is likely to be considerably enhanced if Local Electricity Trading was demonstrated to be feasible for selling electricity. This represents a significant opportunity for lessons learned to be applied to other projects
- **Ease of implementation:** a community solar garden is considered to be an easier path than a 'many-to-one' VPS in the absence of an third party willing to play an aggregator role
- **The risks** of a community solar garden are chiefly around proper management of community investor funds. It would be prudent for council to encourage and empower a governance board separate from the council itself to administer the investment scheme required. A well-run community solar project can be supported by the Council but ultimately will need to be lead by community members.

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