THE NETWORK VALUE OF DISTRIBUTED GENERATION

Distributed Generation Inquiry Stage 2 Discussion Paper

June 2016

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GLOSSARY

Co-generation	A type of distributed generation system designed to generate electricity and heat jointly.
Distributed generation	Refer to section 2.4.1.
Flicker	Changes to the output of lighting caused by voltage fluctuations.
Gross output	The total electricity generated by a distributed generation system
Harmonics	Currents or voltages in the electricity grid with frequencies different to an ideal electrical waveform, which can be associated with power quality problems. Frequencies within the electricity grid associated with power quality problems.
Inverter	Apparatus that converts the direct current (DC) output of solar photovoltaic panels into alternating current (AC). Inverters used in conjunction with solar panels may also have additional functionality.
Islanding capability	The capability for distributed generation to maintain power to a location when grid supply of electricity is cut.

Net output	The amount of electricity generated by a distributed generation system exported to the grid.
Output profile	The pattern of electricity produced across time by a distribution generation technology.
Third party aggregator	An entity that aggregates the supply from a number of distributed generators and transacts through the wholesale market on their behalf.
Tri-generation	A type of distributed generation system designed to generate heat, cooling and electricity jointly.

ACRONYMS

AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
ARENA	Australian Renewable Energy Agency
CEC	Clean Energy Council
CESS	Capital Expenditure Sharing Scheme
DG	Distributed Generation
DMIA	Demand Management Investment Allowance
DMIS	Demand Management Investment Scheme
DNSP	Distribution Network Service Provider
DuOS	Distribution Use of System
ENA	Energy Network Association
EIA	Electricity Industry Act
EBBS	Efficiency Benefit Sharing Scheme
FIT	Feed-in Tariff
IPART	Independent Pricing and Regulatory Tribunal

kVA	Kilovolt Amp
kW	Kilowatt
kWh	Kilowatt Hour
LGC	Large-scale Generation Certificate
LGNC	Local Generation Network Credit
LRET	Large-scale Renewable Energy Target
LRMC	Long Run Marginal Cost
MLF	Marginal Loss Factor
MW	Megawatt
MWh	Megawatt Hour
NEM	National Electricity Market
NER	National Electricity Rules
NPV	Net Present Value
PFIT	Premium Feed-in Tariff
PV	Photovoltaic
RET	Renewable Energy Target
RIT-D	Regulatory Investment Test – Distribution
RMI	Rocky Mountain Institute
SFIT	Standard Feed-in Tariff
TOU	Time of Use
ToUS	Transmission Use of Service

TSS	Tariff Structure Statement
VCEC	Victorian Competition and Efficiency Commission

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SUMMARY

Introduction

In September 2015, we received a terms of reference under section 41 of the Essential Services Commission Act 2001, to carry out an inquiry into the true value of distributed generation (the Inquiry). In December 2015 we published a paper outlining our proposed approach to the Inquiry which was accepted by the Government.

The Inquiry involves two separate but related stages. The first is looking at the energy value of distributed generation, and the second is looking at the network value. In both stages, we are looking at the economic, social and environmental benefits that arise from distributed generation.

This Discussion Paper is the first of three reports to be published in the second stage of the Inquiry. Its purpose is to propose a framework for examining the network value of distributed generation. We are seeking feedback on both the framework itself, and a range of questions that we believe need to be answered in order to:

- identify and quantify the network value of distributed generation
- assess the extent to which the current regulatory framework takes this value into account, and
- recommend any changes to the regulatory framework necessary to better account for the network value of distributed generation.

The Proposed Framework

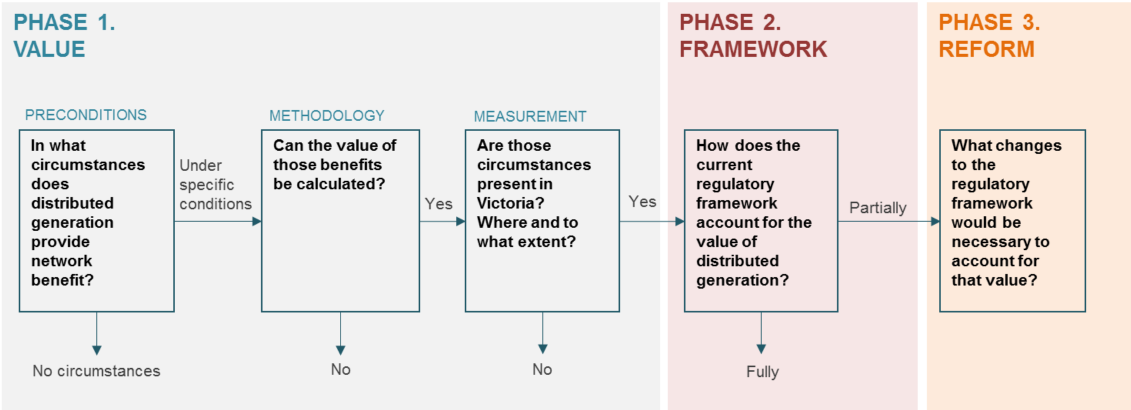
Under certain circumstances, private investment in distributed generation can produce economic value by reducing the cost of building, maintaining and operating Victoria's electricity network. These direct benefits accrue in the first instance to the businesses that own the electricity networks. To the extent that these benefits are fully factored into the pricing decisions of the Australian Energy Regulator (AER), they result in lower network prices paid by consumers.

However, whether the private investors in distributed generation obtain any financial compensation for the external benefits their investment creates may depend on the design of the regulatory framework.

We propose to examine these issues in three phases. Phase one will involve looking at whether the network benefits can be identified, quantified and monetised. If they can, we will proceed to a second stage involving an examination of whether the current regulatory framework allows private investors of distributed generation to receive compensation for some or all of the value created. If we identify any barriers, gaps or disincentives for private investors in receiving appropriate compensation, a third phase will look at whether there are any changes that should be made to the regulatory framework.

These three phases are illustrated in figure 1 below.

FIGURE 1 NETWORK VALUE OF DISTRIBUTED GENERATION
Framework for Stage 2 of the Distributed Generation Inquiry



Source: ESC

Circumstances under which distributed generation can provide network benefit

Understanding the circumstances in which distributed generation can provide potential network value involves several steps, starting with the identification of benefit categories. Our research to date has identified the following broad categories:

- **Network Capacity** – the effect of distributed generation on the need to build or replace network infrastructure.
- **Grid Support Services** – the effect of distributed generation on services required to enable reliable operation of the grid, including voltage regulation, frequency regulation, energy balancing, operating reserves, and market operation (usage of the network).
- **Electricity Supply Risk** – the effect of distributed generation in improving the reliability and resilience of the grid.
- **Environmental and Social** – the extent to which changed operation of the grid resulting from distributed generation leads on to environmental and social benefits.

Having identified these benefit categories, the capability of distributed generation to produce value depends on five main criteria related to the characteristics of the distributed generation system:

- **Location** – the location of distributed generation system within the network, including its proximity to points of network congestion.
- **Time** – the time at which the distributed generation system produces electricity.
- **Controllability** – the extent to which the electricity output or network support capacities of the distributed generation system can be relied upon, or controlled ('firmness').
- **Size** – the output capacity of the distributed generation system.

Methodology and measurement of value

If circumstances under which distributed generation can provide benefits can be identified, a methodology is required to measure them and assess their value. Through this report we propose the building blocks of such a methodology for application in Victoria. To the extent the economic benefits of distributed generation arise through avoided capital expenditure, the methodology seeks to establish the net present value

(NPV) of avoided capital. This value is then added to the value of any environmental and social benefits.

Developing a methodology involves settling a range of questions about design, granularity, and data availability. Through the consultation process, we seek stakeholder input on the components of the methodology and the availability of required data and make the following observations about the steps required to establish a methodology.

- **Define the unit of analysis.** That is, it is necessary to define the appropriate level of granularity – expressed in terms of a network infrastructure hierarchy[1] – at which identification and measurement of benefit should occur.
- **Accommodate each benefit category**. Within each unit of analysis, the methodology must be capable of measuring the benefit provided by distributed generation across each of the benefit categories.
- **Develop a method for identifying the impact of distributed generation.** In order to measure the scope of the benefit and its value, the methodology would be geared towards conducting a counterfactual that compares the technical requirements (and therefore costs) of managing the network with and without the existence of distributed generation.
- **Define time parameters.** The identification of the benefit and its value must occur within defined time parameters. Because the Commission is required to set feed-in tariffs (FiT) each year, the Commission proposes any methodology be geared towards calculating the benefits that are caused by distributed generation within a given year.

The design of the methodology will dictate the data needs of the evaluation exercise. In developing our initial thinking, we have identified preliminary approaches for exploring the assessment approaches and associated data requirements for performing those assessments.

[1] By a 'network infrastructure hierarchy' we mean the elements of the electricity supply system, from central generator through to consumer. This includes the broad categories of transmission and distribution network, and also the specific sub categories, such as terminal stations, zone substations, transformers, and the various types of feeders that connect them.

Operation of the current regulatory framework

The National Electricity Rules contains a number of mechanisms aimed at making it easier for distributed generation to access the National Electricity Market (NEM) and to allow for certain types of distributed generation to be rewarded for any identified network benefit it provides. Some mechanisms are designed primarily to accommodate distributed generation that is 'network-led' while others also account for 'proponent-led' systems.

Network-led distributed generation refers to generation which is installed and controlled by a network business or procured by a network business from a third party. Proponent-led distributed generation refers to systems that are installed by third parties. The majority of rooftop solar PV installed in Victoria is proponent-led.

A number of the mechanisms with the NER are targeted towards distributed generation that is larger than 5 MW in capacity. Because this inquiry is focused on systems under this capacity threshold, those mechanisms are not the focus of this paper.[2]

The mechanisms relating to network-led investment in distributed generation and which apply to systems of less than 5 MW in capacity include:

- **Regulatory Investment Test for Distribution (RIT-D) –** The RIT-D is a framework that requires electricity distribution businesses to consider a range of non-network options where network investment is required above $5 million.
- **Demand Management Incentive Scheme (DMIS) and Innovation Allowance (DMIA) –** The AER is required to develop and publish the incentive scheme and set an innovation allowance to fund innovative projects that have the potential to deliver ongoing reductions in demand or peak demand.
- **Capital Expenditure Sharing Scheme (CESS) and the Efficiency Benefit Sharing Scheme (EBSS) –** These schemes provide incentives for network businesses to further invest and operate in networks more efficiently.

[2] These include requirements on network business to pass through any Transmission Use of System (TUoS) costs avoided as a result of distributed generation, and also the Network Support Payment mechanism, through which distributed generators can negotiate payments by network and transmission businesses for providing specific network support services. Both of these mechanisms are described in more detail in chapter 4.

The existing mechanisms relating to both network-led and proponent-led investment in distributed generation include:

- **Small Generation Aggregator Framework –** This framework establishes a Small Generation Aggregator as a new category participant within the NEM, reducing the barriers for a third party aggregator in offering solutions for network businesses for operating or investing in the grid. A 'third party aggregator' is an entity who aggregates the supply from a number of distributed generators and transacts through the wholesale market on their behalf.

Two other developments within the national energy rules that may have an impact on the value of distributed generation are:

- **Cost-reflective distribution network tariffs –** This will require network businesses to develop prices that reflect to consumers the costs to the network at different times.
- **Local Generation Network Credit (LGNC) –** Currently being considered by the AEMC this mechanism would require network operators to calculate and credit distributed generators for any network benefit they provide. See section 4.2.1 for further details.

In examining the operation of these mechanisms, we propose to explore the following questions:

- **Identification and realisation of value** – How does the regulatory framework facilitate the identification and realisation of the potential value of distributed generation?
- **Current allocation of any identified value** – To the extent that the framework identifies and realises the network value of distributed generation, how is that value allocated between the distributed generator, the network business, and consumers at large? Is this allocation appropriate? How should the monetary value of the benefits provided by distributed generation be allocated?

The outcomes of this analysis will guide the Commission in its assessment of whether any reform to the current regulatory frameworks is necessary, and what the nature of that reform should be.

Reform

Concurrently with this inquiry, jurisdictions around Australia and internationally have sought to identify and measure the possible network benefit provided by distributed generation, and examined the means by which distributed generators might be remunerated for this value. Beyond the analysis presented in this paper, the Commission invites stakeholders to bring forward examples of methodologies and regulatory mechanisms under consideration in other jurisdictions that may be relevant to the Victorian context.

Approach, concepts and definitions

Q1. Are there any other aspects of our definition of distributed generation that we should consider, in this stage of the inquiry?

Q2. What data and evidence is available about the potential network benefits of battery storage?

Q3. On what basis should the network benefit from distributed generation be assessed – on the total output or on the total exports of the distributed generation system?

Q4. What do you see as the main differences between network-led and proponent-led DG in terms of the network benefits they deliver?

Q5. Are there any other aspects of our definition of value that we should consider, in this stage of the inquiry?

Q6. Are there any other aspects to our proposed framework for assessing network value that we should consider?

Q7. Do you agree with the Commission's proposed framework for the network value stage of the inquiry? Are there alternative approaches?

Economic benefits

Q8. Beyond those identified in the paper, are the other examples of applied methodologies for calculating network benefit that the Commission

should consider?

Q9. Can you suggest any alternative or additional categories of network benefits regarding distributed generation?

Q10. Can you suggest alternative or additional characteristics of distributed generation (that effect the capacity of distributed generation to provide network benefits)?

Q11. Are there circumstances in which a fleet or 'portfolio' of passive distributed generation systems can provide suitably firm generation capacity to create circumstances in which network benefit is created?

Economic value methodological approach

Q12. What alternative or additional building blocks of a methodology should be considered for determining the network benefit of distributed generation?

Q13. What do you see as the most appropriate unit of analysis and level of granularity is for the assessment of network benefits?

Q14. What publicly available data sources can be accessed to apply the methodology, particularly with respect to network constraint and demand?

Q15. What are the appropriate time parameters of a study into the potential network benefits of distributed generation?

Environmental and social benefits

Q16. Can you suggest or provide evidence that supports those environmental or social benefits attributed to distributed generation listed in this discussion paper?

Q17. Outside those potential benefits listed, are you able to provide (and support with evidence) of how distributed generation reduces the environmental impact of the transportation of electricity?

Q18. Outside those potential benefits listed, are you able to provide (and support with evidence) examples of how distributed generation provides social benefit, as it relates to the transportation of electricity?

Operation of the current regulatory framework

Q19. Are there other aspects of the current regulatory framework outlined in this paper that the Commission should consider?

Q20. Can you provide specific examples of payments made to distributed generators under the regulatory mechanisms listed in this discussion paper? What size of distributed generation systems received the payments? Were payments made to small-scale systems?

Q21. Are you able to provide data/evidence about the operation of the small scale generation aggregator framework as a mechanism by which network benefits of small scale distributed generation can be identified, valued and compensated?

Q22. To what extent do the Tariff Structure Statements published by Victorian distribution businesses provide an indication of the benefit distributed generation can provide through reducing peak network demand?

Q23. Are there are alternative conceptual frameworks that could be used to examine the benefits provided by proponent-led distributed generation? In particular, are there conceptual frameworks for considering potential benefits that were not anticipated in the planning forecasts associated with the five yearly pricing determination process?

Alternative mechanisms

Q24. How should the Commission consider the scope of the LGNC Rule Change Proposal with this current inquiry?

Q25. Are there methodologies for calculating network value and/or regulatory mechanisms from any other jurisdiction that are suitable for consideration in the context of this inquiry?

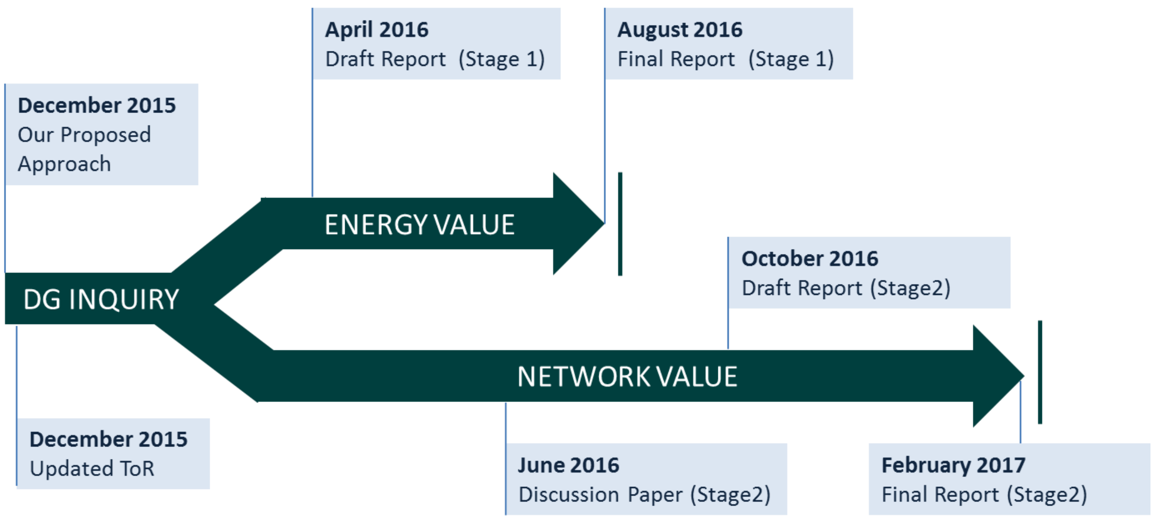
1 INTRODUCTION

1.1 BACKGROUND

In September 2015, we received a terms of reference under section 41 of the Essential Services Commission Act 2001, to carry out an inquiry into the true value of distributed generation (the Inquiry). In December 2015 we published a paper outlining our proposed approach to the Inquiry, which was accepted by the Government.

The Inquiry involves two separate but related stages. The first is looking at the energy value of distributed generation, and the second is looking at the network value (figure 1.1). In both stages, we are looking at the economic, social and environmental benefits that may arise from distributed generation.

FIGURE 1.1 INQUIRY STRUCTURE



1.2 PURPOSE

This Discussion Paper is the first of three reports to be published in the second stage of the Inquiry. Its purpose is to propose a framework for examining the network value of distributed generation. We are seeking feedback on both the framework itself, and a range of questions that we believe need to be answered in order to:

- identify and quantify the network value of distributed generation
- assess the extent to which the current regulatory framework takes this value into account, and
- recommend any changes to the regulatory framework necessary to better account for the network value of distributed generation.

1.3 STRUCTURE OF THIS REPORT

This Discussion Paper is divided into the following chapters:

- Chapter 1 contains the introduction
- Chapter 2 sets out the context and approach of the inquiry, including its scope, and the role of this Discussion Paper
- Chapter 3 sets out the Commission's initial views on the network benefits of distributed generation
- Chapter 4 presents the Commission's initial views on the operation of the regulatory framework
- Chapter 5 sets out the next steps for the inquiry including public consultation.

2 CONTEXT & APPROACH

2.1 CONTEXT TO THE INQUIRY

Distributed generation is a growing segment of the market for the supply of electricity. Current small-scale distributed generation capacity in Victoria is estimated to be over 880 megawatts (MW).[1] By way of comparison, total electricity generation capacity in Victoria is estimated at 13,169 MW.[2]

Most distributed generation that is currently installed in Victoria is small-scale solar photovoltaic (PV) generation, but distributed generation can come in a range of sizes and be powered by a variety of sources, including wind, biomass and natural gas.

Distributed generation typically supplies the electricity demand at the place it is installed, with excess electricity exported to the grid. In 2015, electricity generation in Victoria from small-scale solar (PV) was estimated to be 1,043,000 megawatt hours (MWh),[3] with a further 188 MWh[4] from small-scale wind power.

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1 Small scale distributed generation refers to systems with a capacity of less than 100 kilowatts (kW). Data is ESC estimation, based on Victorian data for eligible small-scale solar PV, wind and hydro under the Small-scale Renewable Energy Scheme from the Clean Energy Regulator (CER) 2016, *Postcode data for small-scale installations*, 1 March 2016. There is less publicly available data on the amount of distributed generation currently deployed in Victoria in the 100kW-5 megawatt (MW) range. However data from the Australian Energy regulator (AER) suggest the amount of deployed capacity in this range is small relative to that deployed in the small-scale category.

2 ESC estimation, based existing in service scheduled, semi-scheduled and non-scheduled generation nameplate capacity in Victoria from Australian Energy Market Operator (AEMO) 2016, *Regional generation information pages: Victorian Summary,* 10 March 2016, data from the Clean Energy Regulator 2016 for small-scale systems, and data on 100kW-1MW solar systems from Sunwiz 2016, *Database of Australian Commercial Solar Power Projects, http://solardatabase.sunwiz.com.au/*, accessed 31 March.

3 ESC estimation, based on data from CER 2016, *Postcode data for small-scale installations,* 1 March 2016, and estimated yearly Victorian solar PV electricity production from ACIL Allen Consulting.

4 ESC estimation, based on data from CER 2016, *Postcode data for small-scale installations,* 1 March 2016, and estimated yearly Victorian wind power electricity production from ACIL Allen Consulting.

2.2 SCOPE OF INQUIRY

The terms of reference state that the inquiry will:

1. Examine the value of distributed generation including: the value of distributed generation for the wholesale electricity market; the value of distributed generation for the planning, investment and operation of the electricity network; and the environmental and social value of distributed generation.
2. Assess the adequacy of the current policy and regulatory frameworks governing the remuneration of distributed generation for the identified value it provides.
3. Make recommendations for any policy and or regulatory reform required to ensure effective compensation of the value of distributed generation in Victoria. These recommendations should have regard to the most appropriate policy and regulatory mechanisms for compensating different benefits of distributed generation, including considering their practicality and costs.

The terms of reference also state that the inquiry will not consider the policy and regulatory frameworks governing the costs of connecting distributed generation to the network. This is taken to mean that the terms of reference exclude consideration of all costs associated with initiating and maintaining connection between distributed generation and the network (i.e. encompassing maintenance and augmentation costs associated with having distributed generation connected to the network), meaning the inquiry is focused on understanding the potential benefits produced by distributed generation.

Although the terms of reference exclude consideration of the elements of the regulatory framework governing costs of connection, for the purposes of the inquiry is important that the Commission understands how the costs of connecting distributed generation to networks are accounted for. We understand that these costs comprise two elements:

- Individual connection costs – the costs of connecting a specific distributed generator to the network. This process, including the contribution that individual distributed generators should make to the cost of connecting, is underpinned by elements of the National Electricity Rules (NER) and Victoria specific guidelines.[5]

- Aggregate connection costs – costs associated with modifying the infrastructure and operation of the network to accommodate distributed generation.

Network businesses make forecasts for the level of aggregate connection costs during the process of developing their five yearly regulatory determination proposals. These forecasts are based on their assessment of the amount of distributed generation that will be connected to their networks during the regulatory period. These costs, once approved by the Australian Energy Regulator (AER), are recovered from all electricity consumers.

Based on this understanding of the how the costs of connecting distributed generation are dealt with, the Commission will assume, for the purposes of this inquiry, that the costs to distribution businesses of connecting distributed generation and using the network are already accounted for.

The Commission's task in this inquiry is to identify the various direct and indirect benefits that may be attributed to distributed generation and, to the extent possible, place a monetary value on those benefits. Its task is then to provide advice to Government on how those monetary values might be reflected in an appropriately designed payment mechanism.

Electricity generated by distributed generation and used by the host reduces the demand to transport centrally dispatched electricity.[6] To the extent that some electricity from a distributed generator is exported, it can also affect the demand for network services by supplementing the supply of electricity to consumers in its local area and thereby relieving demand on upstream sections of the network. We discuss how both the locally consumed and the exported electricity interacts with the network in chapter 3.

[5] See chapter 4 for a discussion of these mechanisms.

[6] Centrally dispatched electricity is also referred to as 'large scale generation' or 'centralised generation'.

The network effects caused by distributed generation may also have indirect effects. In chapter 3 we also discuss some indirect effects and their potential to produce social or environmental benefits.

The calculation of monetary value undertaken in this inquiry is limited to the direct and indirect benefits that may be associated with investment in distributed generation. The inquiry does not extend to examining:

- an expansion of the feed-in tariff (FiT) to cover other actions customers may take to reduce their energy consumption
- other strategies that may be implemented to reduce the emissions intensity of energy supply, and
- other steps that may be taken to reduce demands on the network.

The terms of reference do not anticipate the Commission assessing alternative policy options for promoting investment in distributed generation or assessing alternative policy options for achieving the indirect effects that were identified as having been derived from investment in distributed generation.

2.3 STAKEHOLDER RESPONSES

In our approach paper we outlined our initial views on the potential network benefit of distributed generation. We proposed that distributed generation could produce benefits through its impact on the operation of the distribution network, with this impact being highly location and time specific. Based on our initial analysis, it was less apparent whether any environmental or social benefits arose as a result of the changed operation of the network caused by investment in distributed generation.

The majority of submissions supported our initial view that distributed generation could produce benefits in relation to the operation of the distribution network, and that these benefits were highly time and location specific. In chapter 3 we set out our initial views of the circumstances under which distributed generation may produce network value, based on stakeholder submissions and our own analysis, as well as the building blocks of a methodology for exploring this question.

Many submissions highlighted that the Australian Energy Market Commission (AEMC) is currently investigating similar issues through the Local Generation Network Credit (LGNC) rule change and urged us to align our investigation of network value with this inquiry. We have aligned our investigation to the extent possible. A more thorough explanation of the LGNC rule change application and its relevance to this inquiry is provided in box 4.2.

A number of submissions proposed environmental and social benefits that may arise because of changed network operations caused by distributed generation. We set out these proposed benefits in chapter 3**Error! Reference source not found.** and seek stakeholder input on what evidence may be available to better understand the monetary value of these potential benefits.

2.3.1 GUIDING PRINCIPLES OF THE INQUIRY

We have adopted three broad principles to guide our work in identifying value through this inquiry. These principles are:

- **Simplicity.** The benefits must be readily convertible into a mechanism that is simple to understand (and administer) by all relevant market participants.
- **Behavioural response.** Any mechanism for rewarding distributed generation for any network benefit it provides, must align signals for investment in, and use of, distributed generation with the benefits (direct and indirect) identified in this inquiry.
- **Materiality.** The benefits being investigated must be large enough to have a material impact on payments made to the distributed generator.

In conducting the inquiry, the Commission also has regard to its objectives under the *Essential Services Commission Act 2001*, which are to promote the long term interests of Victorian consumers with regard to the price, quality and reliability of essential services.[7]

[7] *Essential Services Commission Act 2001* (Vic.) *http://www.esc.vic.gov.au/getattachment/d6250f4c-a1cc-44de-a756-5a2d634842b7/Essential-Services-Commission-Act-2001-incorporati.pdf*

2.4 OUR APPROACH

This section outlines our overarching approach to the inquiry. It sets out our definition of distributed generation and a high level method for identifying and quantifying its potential network benefits.

We take the following approach to the inquiry:

- Define distributed generation for the purposes of the inquiry.
- Identify the values that can be attributed to distributed generation and whether methodologies exist to enable the quantification of these values. For this report, which focuses on network value, the terms of reference requires us to focus on two distinct areas in which distributed generators may produce effects:
  - the value that distributed generation produces in respect of the planning, investment and operation of the electricity network, and
  - the value of any environmental and social benefits caused by changes in the way the grid is managed because of distributed generation.
- Understand how the regulatory framework already accommodates the value of distributed generation.
- Identify any regulatory changes needed to amend the framework for valuing and remunerating distributed generation.

2.4.1 DEFINITION OF DISTRIBUTED GENERATION

In our draft report on energy value we confirmed our proposal to define ‘distributed generation’ for the purpose of the inquiry as:

- **Distributed generation below 5 MW capacity.**[8] It is generally understood that distributed generators of this size are not stand-alone generators; they are normally installed in or on a host’s property and supply electricity to the host’s site.[9]

[8] The Australian Energy Market Operator (AEMO) defines larger generators also as distributed generation, ranging from non-scheduled generators between 5-30MW. AEMO also considers some generators that deliver electricity to transmission customers as distributed generation.

- **Distributed electricity generation from any source or fuel type.** Electricity from distributed generation can be generated from a range of sources including wind, solar, biomass, hydro and natural gas. Solar and wind are the most common. A further discussion on distributed generation technology types (and its particular characteristics and interaction with the network) is provided in section 3.2 of this report.
- **Battery storage.** In our draft report on energy value we concluded that battery storage did not have a material impact on the question of energy value. With regard to energy value, the primary opportunity they provide is in the realm of 'private value' insofar as they enable the distributed generator to avoid retail tariffs by storing any excess energy for later use. Conversely, when assessing network value batteries become more significant. We intend to revisit the role, and value, of battery storage in this stage of the inquiry.

Through submissions we did not encounter evidence that regulatory mechanisms for remunerating distributed generation were inadequate for generators with capacity in excess of 5 MW and so have not considered raising the capacity threshold above this amount.

We welcome submissions on our proposals to focus our examination of network value on all forms of distributed generation up to 5MW in capacity and to include battery storage.

NETWORK-LED AND PROPONENT-LED DISTRIBUTED GENERATION

When defining distributed generation for this stage of the inquiry, we make the distinction between distributed generation that is procured by a network business, which we term 'network-led', and that which is installed independently of the decision making of the network business, or which is 'proponent-led'. Network-led distributed generation could be installed and owned by a network business, or it may be refer to supply of electricity that a network business procures from a third party distributed generator via a contract for service. Proponent-led distributed generation refers to

[9] These include those distributed generators that are; connected via an inverter prescribed by AS4777 (the Australian Standard for the Grid Connection of Energy Systems via Inverters, which sets out the technical standards that must be met when connecting a generator to the grid via an inverter), and systems larger than those connected via an inverter, but no more than 5 MW in size (and are exempt from the need to register as a generator with AEMO).

systems that are installed by third parties. This includes the majority of rooftop solar PV installed in Victoria.

The Commission seeks to examine how network-led or proponent-led distributed generation may provide network benefit, and how these different categories of generation are accommodated within the regulatory framework.

CONSIDERATION OF TOTAL OUTPUT OF DISTRIBUTED GENERATION

This stage of the inquiry seeks to understand the potential for distributed generation to provide value for the planning, investment and operation of the electricity network, as well as its potential to provide environmental and social benefits through changes to the way the grid is managed. We take the entire output of a distributed generation system to be relevant to the calculation of this value.

Distributed generation electricity that is consumed ‘on site’ reduces the amount of electricity that needs to be ‘delivered’ to that customer through the network. Distributed generation electricity that is exported and used to supply local demand changes the way the network is used (less electricity has to be transported long distances to meet consumers’ demand).

2.4.2 CONCEPT OF VALUE

Our Stage 1 Draft Report we set out the concept of value that we are using in this inquiry.[10] This section describes this concept in the context of the network value stage of the inquiry.

FOCUS ON ‘EXTERNAL’ EFFECTS

The first distinction we make is between the ‘internal’ and ‘external’ effects of distributed generation. The term ‘internal effects’ refers to anything that only affects the investor in distributed generation, without any intervention from government. This could include the benefit that the distributed generation owner gets from reduced power bills, or the enhanced wellbeing they experience as a result of having taken steps to help the

[10] ESC, The Energy Value of Distributed Generation, Distributed Generation Inquiry Stage 1 Draft Report, p27.

environment. Because the benefits of internal effects accrue directly to the investor, they are excluded from our analysis in this inquiry.

‘External effects’ of distributed generation are those that are experienced by parties other than the investor in distributed generation. These other parties could include other people, communities, firms or the physical environment in which the distributed generation unit operates.

DIRECT AND INDIRECT EXTERNAL EFFECTS

There are two types of external effects. The first are ‘direct external effects’. Direct external effects are those that manifest in the electricity network when, for example, a distributed generator produces electricity or when they export their surplus electricity into the grid.[11]

The second type is ‘indirect external effects’. Indirect effects are those that flow on from the direct effects. If those effects enhance the wellbeing of someone or something, then those effects can be said to generate benefits. By definition, benefits have positive value. For example, if distributed generation leads to a reduction in expenditure on network infrastructure, then this could produce a benefit to network business. To the extent the reduction in costs is reflected in network tariffs, this can produce a benefit to society through reduced network prices paid by electricity consumers.

How that value is measured is not straightforward. However, because this review is focussed on identifying how value (or ‘true value’) might be reflected in a payment to distributer generators, and such a payment is self-evidently a monetary mechanism, then we confine our approach to defining value in monetary terms only. Alternatively stated, in this review we are seeking to identify direct and indirect effects that produce benefits that can be valued in monetary terms.

We set out this typology of effects in figure 2.1.

Typically, an investor in distributed generation cannot, all things being equal, gain a return on the benefits enjoyed by other parties via the indirect effects of that

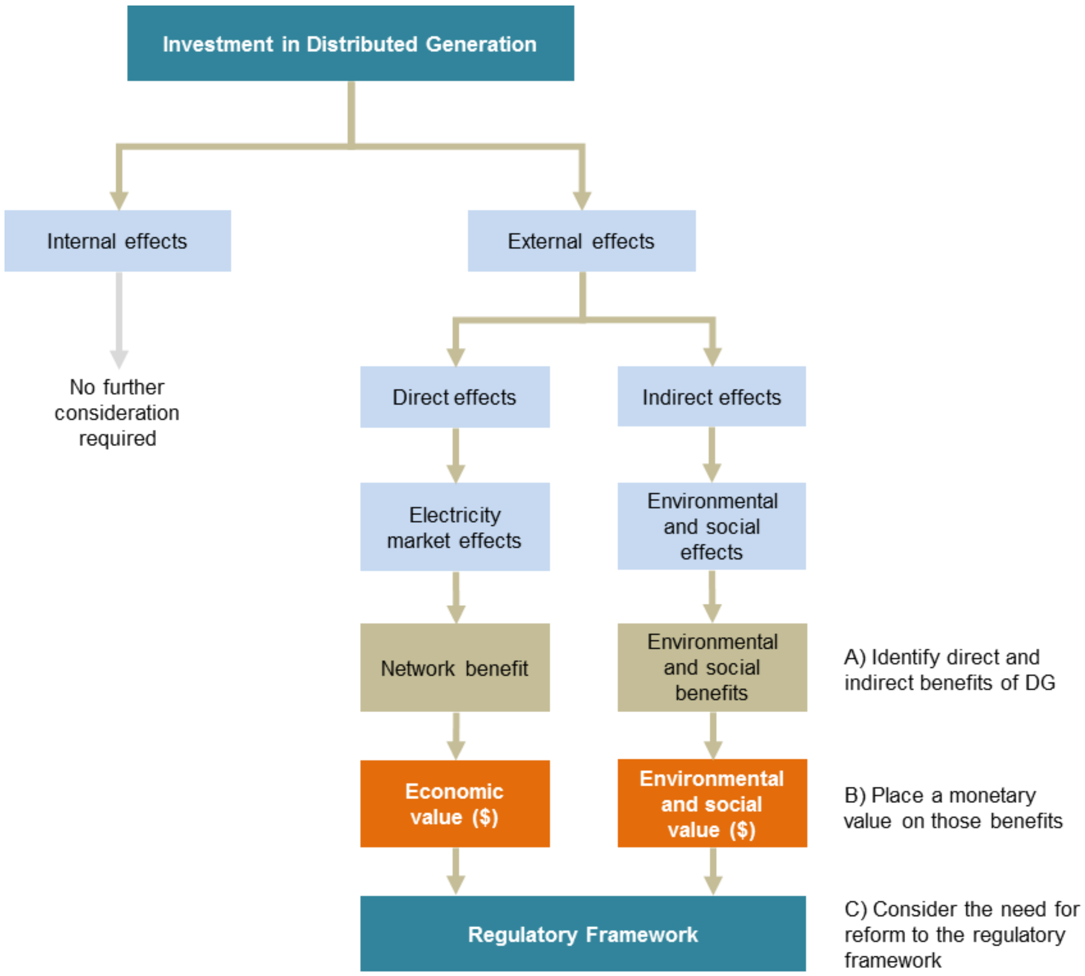
[11] A separate series of Commission reports examines the external effects of distributed generation electricity.

investment. (Economists usually refer to situations such as these as: public benefits deriving from externalities or spill-overs.) One of the purposes of this review is to identify and then quantify the value of the indirect benefits that arise from investment in distributed generation. Specifically, the terms of reference for this inquiry request that we identify and evaluate the environmental and social value derived from distributed generation.

At a conceptual level, identifying the environmental benefits of distributed generation is the more straightforward exercise. We define environmental benefits to be those benefits that manifest themselves in the natural environment. Following further discussions with the department[12], and for the purposes of this inquiry, we have defined the term ‘social' to cover benefits that manifest themselves in domains such as: health, justice, safety and amenity. These all pertain to the well-being of individuals and communities (and potentially their productivity).

[12] Department of Economic Development, Jobs Transport and Resources, Victorian Government

FIGURE 2.1 TREATMENT OF VALUE IN THIS INQUIRY



Source: ESC

Importantly, in our role in assessing the 'true value' of distributed generation we do not examine matters such as: the optimal profile for future investment in distributed generation; how the benefits of that investment might be maximised; or whether those benefits could be delivered by alternative means.

2.4.3 APPROACH TO IDENTIFYING NETWORK VALUE OF DISTRIBUTED GENERATION

Under certain circumstances, private investment in distributed generation can produce economic value for network businesses by reducing the cost of building, maintaining and operating Victoria's electricity network. These potential direct benefits accrue in the first instance to the businesses that own the electricity networks. To the extent that these benefits are fully factored into the pricing decisions of the Australian Energy Regulator (AER), they result in lower network prices paid by consumers.

However, whether the private investors in distributed generation obtain any financial compensation for the external benefits their investment creates depends on the regulatory framework.

We propose to examine these issues in three phases. Phase one will involve looking at whether the network benefits can the identified, quantified and monetised. If they can, we will proceed to a second stage involving an examination of whether the current regulatory framework allows private investors in distributed generation to receive compensation for some or all of the value created. If we identify any barriers, gaps or disincentives that mean that private investors are not able to receive appropriate compensation, a third phase will look at whether there are any changes that should be made to the regulatory framework.

PHASE 1 - VALUE

- Preconditions of value – Identify the circumstances under which distributed generation of less than 5 MW capacity can provide network, environmental or social benefits. This encompasses both of the characteristics of the network and the characteristics of the distributed generation needed for benefit to be provided.
- Methodology – Establish a methodology for calculating the scope of the benefits and the value of any identified benefits. Specifically when reviewing the environmental and social benefits, we adopt the same three part test used during the energy value stage of the inquiry.
- Measurement – Examine whether the circumstances under which distributed generation can provide network benefit pertain in Victoria, including where and to what extent those circumstances exist.

PHASE 2 - FRAMEWORK

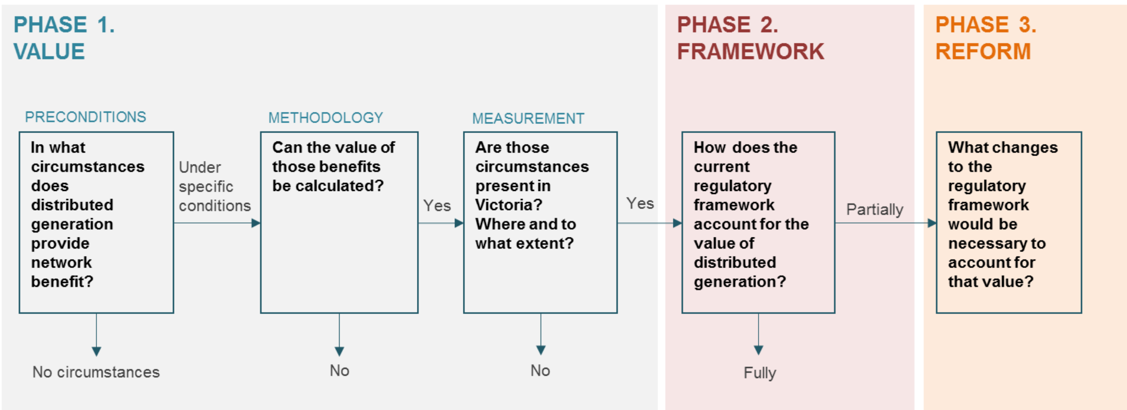
- Assess how the current regulatory framework accommodates the network value of distributed generation, including consideration of whether the framework allows for that value to be captured and also how it presently allocates that value between distributed generators, network businesses and consumers at large.

PHASE 3 - REFORM

- Identify any changes needed to amend existing regulatory frameworks or alternative frameworks for remunerating distributed generation.

The framework is summarised in figure 2.2.

FIGURE 2.2 NETWORK VALUE OF DISTRIBUTED GENERATION
Framework for Stage 2 of the Distributed Generation Inquiry



QUESTIONS FOR CONSULTATION

Approach, concepts and definitions

Q1. Are there any other aspects of our definition of distributed generation that we should consider, in this stage of the inquiry?

Q2. What data and evidence is available about the potential network benefits of battery storage?

Q3. On what basis should the network benefit from distributed generation be assessed – on the total output or on the total exports of the distributed generation system?

Q4. What do you see as the main differences between network-led and proponent-led DG in terms of the network benefits they deliver?

Q5. Are there any other aspects to our definition of value that we should consider, in this stage of the inquiry?

Q6. Are there any other aspects of our proposed framework for assessing network value that we should consider?

Q7. Do you agree with the Commission's proposed framework for the network value stage of the inquiry? Are there alternative approaches?

3 NETWORK VALUE OF DISTRIBUTED GENERATION

3.1 INTRODUCTION

In certain circumstances, distributed generation can provide a benefit to electricity networks by changing the way network businesses build and maintain their electricity networks. To the extent that any cost savings for network businesses are fully reflected in network tariffs, this represents a reduction in network charges to energy consumers.

Where distributed generation leads to changes in the way the network is managed, this may also cause flow-on, or indirect, social and environmental benefits. Through consultation on our approach paper, stakeholders proposed a number of such social and environmental benefits, including bushfire risk mitigation and improved amenity through a reduction in poles and wires.

This chapter sets out our framework for examining these benefits and their value.

3.1.1 BENEFIT CATEGORIES

Distributed generation affects the network by primarily altering patterns of demand for electricity. Distributed generation electricity that is consumed 'on site' reduces the amount of electricity that needs to be 'delivered' to that customer through the network. Distributed generation electricity that is exported and used to supply local demand changes the way the network is used (less electricity has to be transported long distances to meet consumers' demand).

Under certain circumstances, these changes can create a network benefit, primarily by reducing peak demands on the network and thereby deferring or avoiding the need for network businesses to invest in augmentation or maintenance of the network.

Recent work from a number of sources examine this issue, including:

- The methodology being developed to support the Local Generation Network Credit (LGNC) rule change proposal currently under consideration by the Australian Energy Market Commission (AEMC).[1]
- Analysis conducted by Frontier Economics on behalf of the Energy Networks Association (ENA) in support of the ENA's submission to the AMEC's LGNC consultation paper.[2]
- Analysis conducted by Ernst & Young (EY) as part of the Future Proofing in Australia's Electricity Distribution Industry project undertaken by the Clean Energy Council (CEC).[3]
- Analysis conducted by the Rocky Mountain Institute (RMI) into cost benefit studies of distributed energy resources.[4]

We have developed our proposed framework by drawing upon work completed by others, including those listed above, and propose carrying it forward to application in the Victorian context. Our research to date has identified four distinct network benefit categories:

- **Network Capacity** – the effect of distributed generation on the need to build or replace network infrastructure.
- **Grid Support Services** – the effect of distributed generation on services required to enable reliable operation of the grid, including voltage regulation, frequency regulation, energy balancing, operating reserves, and market operation (usage of the network).
- **Electricity Supply Risk** – the effect of distributed generation in improving the reliability and resilience of the grid.

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[1] See discussion in Chapter 4 for further details.

[2] Frontier Economics (2015) *Valuing the impact of local generation on electricity networks,* Energy Networks Association, February 2015.

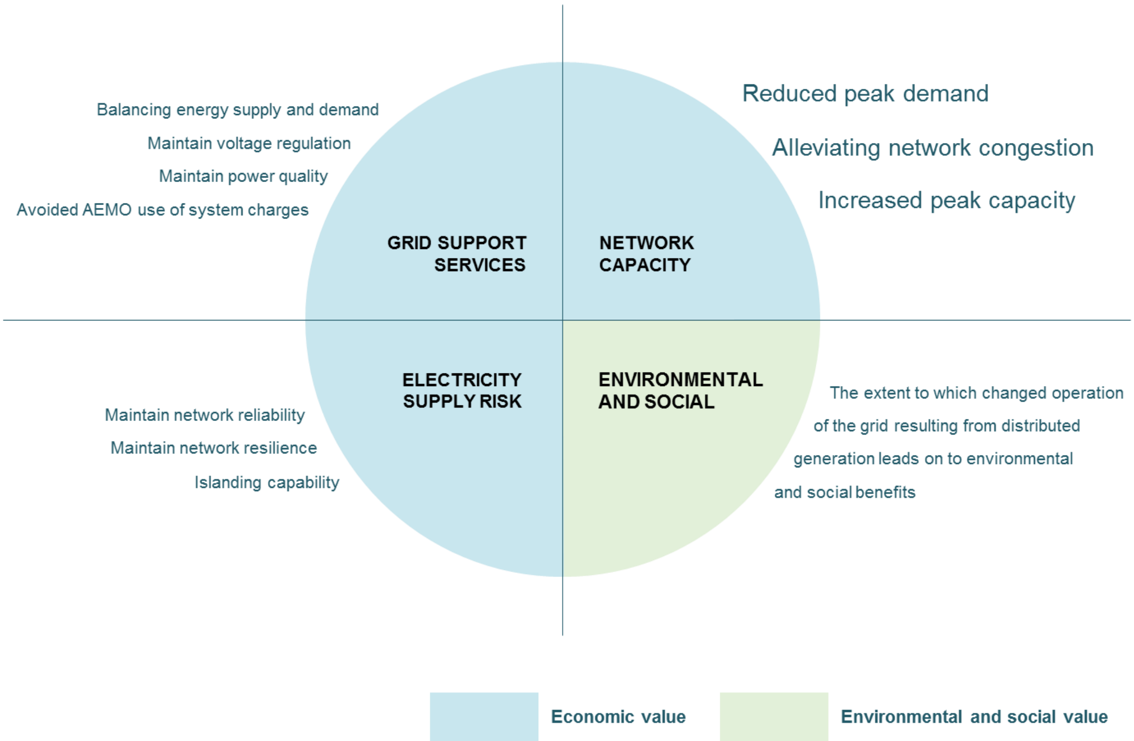
[3] Ernst & Young (2015) *Evaluation Methodology of the Value of Small Scale Embedded Generation and Storage to Networks,* Clean Energy Council, July 2015.

[4] Rocky Mountain Institute (2013) *A Review of Solar PV Benefit & Costs Studies.*

- **Environmental and Social –** the extent to which changed operation of the grid resulting from distributed generation leads on to environmental and social benefits.

Our research to date indicates that the network capacity category is the most material in terms of the potential network benefits caused by distributed generation. Accordingly, examining this category will be a key focus of our work. A summary of these benefit categories is shown in figure 3.1.

FIGURE 3.1 BENEFIT CATEGORIES
Including identified potential network benefits



Source: ESC analysis of ENA, EY, RMI

The following sections sets out two frameworks for examining these benefits and potential value by category. Under 'economic value' the categories of network capacity, grid support services, and electricity supply risk are considered. 'Environmental and social value' is considered under a separate framework.

Distribution businesses are also recognising that there are network benefits associated with certain distributed generation technologies. A number of Victorian distribution businesses have conducted residential trials of distributed generation installations, such as:

- CitiPower, which is currently installing 20 residential batteries into the network as a three-year trial.[5]
- Powercor, which has installed a 2 MW battery system on a property in Buninyong, to increase the capacity of the local network on peak days.[6]
- AusNet Services, which is currently trialling a 1 MW battery and diesel generation system installed into the network to support peak demand periods.[7]

One trial by AusNet Services in 2011 has recently been completed, with findings presented in a case-study. The main findings from the case-study are described in box 3.1.

BOX 3.1 CASE-STUDY: RESIDENTIAL BATTERY STORAGE TRIAL RESULTS

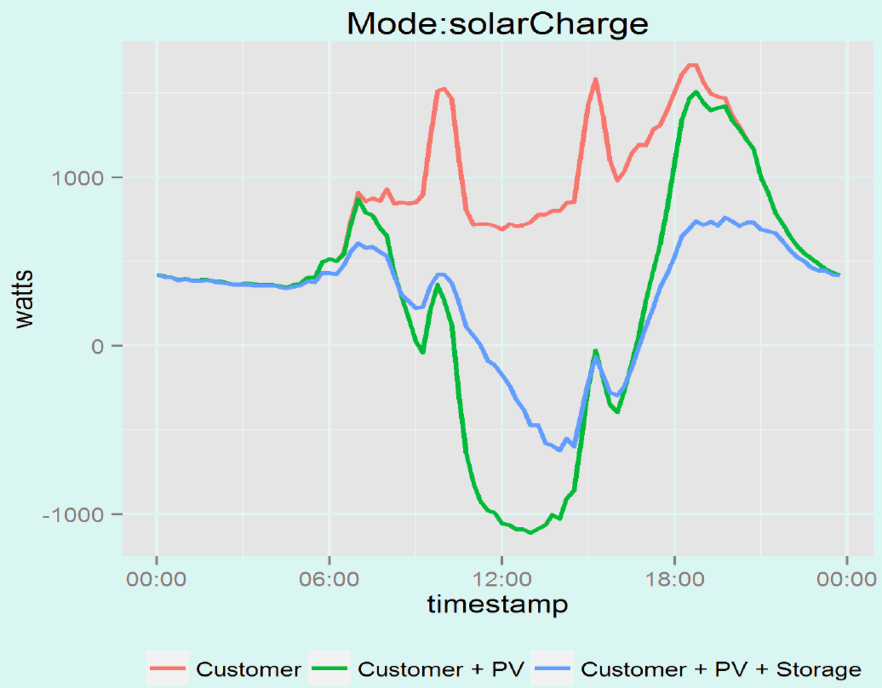
In 2011, AusNet Services began a trial to understand the potential value of residential energy storage for the network and the consumer. The trial installed residential battery storage units on ten homes with rooftop solar PV.

The trial found that distributed generation in the form of solar PV and a battery can decrease grid peak demand specifically during a typical peak period. The following figure shows results of average peak grid electricity demand across a day comparing a customer with and without distributed generation.

[5] CitiPower (2016) *Residential battery storage,* accessed on 6 June 2016 at https://www.powercor.com.au/future-thinking/harnessing-new-technologies/residential-battery-storage/

[6] Powercor (2015) *Powercor installs Australia's largest battery in Ballarat South,* 20 August 2015, accessed on 6 June 2016 at https://www.powercor.com.au/news-and-media/latest-news/powercor-installs-australias-largest-battery-in-ballarat-south/

[7] AusNet Services (2015) *AusNet Services' Australian-first network battery trial,* 6 January 2015, accessed on 6 June 2016 at http://www.ausnetservices.com.au/CA257D1D007678E1/Lookup/MediaReleases2015/$file/150106%20GESS.pdf



In 2011, the high capital costs of the storage system would not make the system a financially feasible investment for the individual consumer (in electricity bill savings).

The results did show that there was value to the network from the residential battery system. AusNet Services stated that “the main quantifiable benefit of storage to the network is in peak demand management”. However, the value of this benefit is dependent on the level of capacity constraint in the network where such residential storage systems could be applied. In a network constrained area, residential storage systems applied at scale could potentially defer traditional network upgrade solutions.

Source: Adapted from AusNet Services case-study[8]

[8] AusNet Services (2016) *Demand Management Case-Study: Residential Battery Storage Trial,* March

3.2 ECONOMIC VALUE

The following section sets out our framework for assessing 'economic value' derived from distributed generation.

As described in section 3.1.1, under certain circumstances, distributed generation can cause benefits that provide value to network businesses through reducing the cost of operating and maintaining their networks – we describe this as the 'economic value'. Economic value can be broken in to the following categories:

- **Reduced need to build or replace network capacity (capital expenditure (CAPEX) and replacement expenditure (REPEX)).**

  This may occur where distribution businesses avoid the need to invest in new equipment for the network. Similarly it may occur where distribution businesses avoid the need to replace like-for-like equipment in a network area.

- **Reduced need for operation and maintenance work (operational expenditure (OPEX)).**

  This may occur where distributed generation provides network support that reduces the time and resources otherwise spent by a distribution business to manage a part of the network.

The potential of reducing network costs within CAPEX, REPEX and OPEX are based on a number of technical benefits that may arise from distributed generation in the network. The technical benefits are closely associated with the objectives of network operation of providing reliable and secure electricity for customers connected to the grid. These technical benefits are described further in table 3.1 and classified by category.

TABLE 3.1 ECONOMIC VALUE TYPOLOGY

Benefit category	Technical benefits	Description of potential technical benefit from distributed generation	CAPEX or REPEX	OPEX
Network capacity	Alleviation of network congestion through reducing peak demand or increasing network capacity	Congestion refers to the extent to which a network, or a section of a network such as a feeder, is approaching the limits of its capacity to supply sufficient electricity during periods of peak demand. When a network becomes congested, it becomes necessary to spend money to relieve that congestion. This can include either building entirely new 'poles and wires' or replacing existing infrastructure.	✓	
Grid support services	Balancing energy supply and demand	Services and resources are required to operate the network on an on-going basis. A crucial part of network operation is balancing energy supply and demand at any time and in specific parts of the network. Dispatchable distributed generation can be contracted by a network business to control the amount of exported electricity in a local area.		✓
	Managing voltage regulation (or correcting voltage levels locally)	The network must be operated within an allowable voltage range. Network businesses operate equipment and conduct maintenance to regulate voltage levels through the network. This includes through adjusting taps on transformers or upgrading them entirely, which requires expenditure. Distributed generation may have an effect on the management of voltage regulation, either because of the export of power into the grid or through the operation of its network interfacing equipment (ie inverter).		✓
	Maintaining power quality	The network must be operated to meet a range of power quality requirements, which protects electrical network equipment. Power quality can be impacted by fluctuations in voltage and harmonics faced by a distribution system. Certain technologies of distributed generation could provide benefit by working with the network to manage power quality levels, such as managing harmonics and flicker experienced in a local network.		✓
	Avoiding AEMO use of system charges	AEMO recovers costs for its operations from a variety of means, one being a charge for the use of the system by distribution and transmission networks. These charges are known as Distribution Use of System (DUOS) and Transmission Use of System (TUOS) charges. These charges are passed through to consumers by network businesses. To the extent that distributed generation reduces the need to transport electricity through the network it may lead to a reduction in these charges.		✓
Electricity Supply Risk	Maintaining network reliability and resilience	To meet service standards, the network must be able to deliver power with certain levels of reliability, including under adverse conditions (resilience). In practice, this means ensuring that consumers do not experience unacceptable levels of interruptions. To the extent any factor can contribute to meeting the network's need for reliability, it may produce a benefit by reducing expenditure that would otherwise have been required to ensure that reliability. Distributed generation can provide islanding capability for consumers (or a group of consumers) to provide further assurance for reliability.	✓	✓

CHARACTERISTICS OF DISTRIBUTED GENERATION RELEVANT TO NETWORK BENEFIT

The capacity of distributed generation to deliver the benefits outlined in table 3.1 depends on the characteristics of the distributed generation system. The focus of network planning is on ensuring the network is capable of delivering electricity to the right places during periods of peak demand. The planning process therefore involves making judgements about the likelihood of different demand scenarios in locations across the network and making expenditure decisions accordingly. That is, it involves making an assessment of the risk of the network being incapable of servicing peak demand across Victoria.

The capacity of distributed generation to provide network benefit therefore depends on four main characteristics:

- **Location of installation.** This considers the location in the network where distributed generation is installed. This is important as not all parts of the Victorian electricity network are the same, in that some substations may be nearing capacity while others may have sufficient capacity for years to come. Location can also have a bearing on the capability of distributed generation to provide other sorts of network benefit, such as voltage regulation on long rural feeders.
- **Time of electricity generation**. This considers the time when distributed generated electricity is being generated. This is important as some forms of distributed generation can generate electricity at any time (being operator-controlled) whilst other forms can only generate depending on availability of a given resource (such as standalone solar PV and the availability of sunlight). The potential of distributed generation to provide network benefit is driven by its capacity to produce electricity coincident with peak demand within the network.
- **Controllability of electricity generation and other capacities of the distributed generation system.** This encompasses 'firmness'; that is, how reliably a generator can provide a certain amount of electricity at a given time. Reliability is an important consideration for distribution businesses in planning investments into the network. For example, in a highly constrained network, distribution businesses will need high confidence that electricity generated from distributed generation will occur at the right place at the right time to reduce peak demand.

The nature of the generation can either be constant, intermittent, or ‘controllable’, that is, it can be dispatched upon command from either the distributed generator or a third party. The more reliable or ‘controllable’ the dispatch of a distributed generation system, the more potential it holds to provide network benefit.

‘Controllability’ also encompasses specifications of the distributed generation’s network interfacing equipment (i.e. inverter). Some distributed generation technologies have been designed to interface with the network under certain conditions and regulations (such as co-generation plants). Other technologies have specific equipment that allows for an interface with the network, such as inverters on solar PV. Network benefits may depend on the design or attributes of such network interfacing equipment in distributed generation.

- **Capacity size –** The output of distributed generation systems in each part of the network, which determines the scale of their effect on the network.

In carrying forward our analysis we will review different forms of distributed generation technology for their characteristics in terms of these categories. A list of distributed generation technologies under considered as part of this inquiry is provided in table 3.2.

TABLE 3.2 DISTRIBUTED GENERATION TECHNOLOGY TYPES
Characteristics and interaction with the network

Generation type	Technology type	Source of fuel
Weather dependent (intermittent)	In-line hydro	Renewable
	Wind turbines	Renewable
	Solar photovoltaic (PV)	Renewable
Operator-controlled (dispatchable)	Co- and tri-generation	Natural gas, biofuel
	Reciprocating engine	Diesel, biodiesel
	Hydrogen fuel cell	Natural gas, biofuel
	Hydro with storage (reservoir)	Renewable
	Batteries (standalone)	Grid electricity
	Batteries (connected with other generation technologies)	Various

Source: ESC

QUESTIONS FOR CONSULTATION

Economic benefits

Q8. Beyond those identified in the paper, are there other examples of applied methodologies for calculating network benefit that the Commission should consider?

Q9. Can you suggest any alternative or additional categories of network benefits regarding distributed generation?

Q10. Can you suggest alternative or additional characteristics of distributed generation that effect the capacity of distributed generation to provide network benefits?

Q11. Are there circumstances in which a fleet or 'portfolio' of passive distributed generation systems can provide suitably firm generation capacity to create circumstances in which network benefit is created?

TRENDS IN DISTRIBUTED GENERATION AND THEIR RELEVANCE TO THIS INQUIRY

The small scale electricity generation sector has experienced substantial changes in recent years, including the emergence of innovations around battery storage, improved electrical integration with the grid, more sophisticated metering and measurement, and operator control via software to the home or network business.

One emerging trend is the ability for small-scale generation technologies to be dispatched and controlled remotely, individually or at-scale. This form of 'smart' distributed generation offers potential value for both consumers and the network beyond that provided by 'traditional' solar PV. This has been evidenced by recent work done by the Australian Government as part of the *Smart Grid, Smart City* project, which tested and trialled the potential cost and benefits from innovative distributed generation technologies.[1]

In taking forward this stage of the inquiry, we are focused on understanding how these emerging trends influence the circumstances under which distributed generation can provide network benefit and as a result make the following distinction for the purposes of our analyses:

- **'Traditional' distributed generation**. This denotes the current installed type of small-scale distributed generation, which predominantly features rooftop solar PV, the output of which cannot be controlled by the owner (unless through the owner's own energy demand management). This also includes some dispatchable distributed generation (such as diesel generators and co-generation), which are rarely installed in an average Victorian residential home.
- **'Smart' distributed generation**. This denotes innovative small-scale distributed generation, which enables household-scale distributed generation to be measured accurately and controlled remotely. Smart distributed generation is typically linked to software that can allow dispatch of electricity controlled by either the owner or a network business. One example of the application of such technologies is described in box 3.2.

There are also innovative solutions that propose to aggregate distributed generation to improve reliability of energy supply from distributed generation. Case-studies of these and other examples are described in the following text boxes.

BOX 3.2 EMERGING TREND: INTELLIGENT STORAGE

Globally, the battery storage sector continues to pursue innovations to both lower the cost of equipment and to improve the interaction between a household and the electricity grid. The most recent innovation is the concept of 'intelligent storage', where generated electricity can be stored for the purposes of maximising payoff to a household (either through its own consumption of exporting to the grid), and providing

[1] Department of Industry, Innovation and Science (2016) *Smart Grid, Smart City,* Australian government, accessed on 6 June 2016 at http://www.industry.gov.au/ENERGY/PROGRAMMES/SMARTGRIDSMARTCITY/Pages/default.aspx

network benefits in the form of stabilising energy demand and supply in a local area. Intelligent storage technology has already been piloted in Australia.

In 2015, an Australian company, Reposit Power, developed a control module (named the GridCredits system) for battery storage systems that automatically manages the energy supply and demand of a household with distributed generation (via solar PV and a battery system in this case-study). The control module automatically determines an optimal balance of supply and demand to increase financial return for the householder, and creating network benefits by smoothing the output from solar PV.

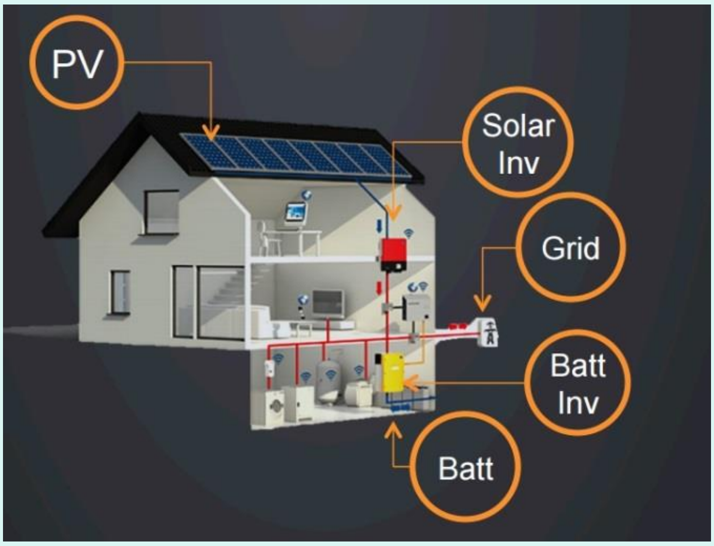
Reposit Power's GridCredits system combined with the Tesla Powerwall Home Battery received funding from the Australian Federal Government's Australian Renewable Energy Agency (ARENA) to trial the systems in Canberra.

Source: Adapted from ARENA case-study[2]

[2] ARENA (2016) *Intelligent storage for Australia's grid,* Australian government, accessed on 3 June 2016 at http://arena.gov.au/project/intelligent-storage-for-australias-grid/

BOX 3.3 EMERGING TREND: VIRTUAL POWER PLANTS

Distribution businesses have also been exploring potential options for using distributed generation as an alternative to the traditional solutions of purchasing new or replacement network infrastructure. One solution is a Virtual Power Plant (VPP).



Source: Yong, Zhou (2015) *Virtual Power Plant Web Application*, United Energy, Monash University

VPP is the concept of installing distributed generation and storage equipment for a number of consumers, and aggregating the combined capacity of this equipment as a "virtual" power plant. VPP requires sophisticated software, advanced metering, and automated control capabilities for use by a distribution business. The solution gives distribution business the ability to manage energy supply and demand. In 2014, United Energy received funding from the AER's 2011-2015 allocation of Demand Management Incentive Scheme (DMIS) to develop a VPP in Victoria. A 50kW Residential Pilot Project was developed, with successful installation of thirteen VPP units involving solar PV and batteries on residential properties. United Energy stated that the VPP "aims to address specific network constraints by reducing demand on the network at the location and time of the constraint. […] This is likely to be in areas where there are significant distribution transformer constraints".

Source: Adapted from United Energy case-study[3]

[3] United Energy (2013) *Demand Management Incentive Scheme Report 2013,* p. 5

BOX 3.4 EMERGING TREND: RURAL DISTRIBUTED GENERATION AND STORAGE

Distributed generation and storage systems are also being piloted in rural applications. In 2014, as part of the Australian Government Smart Grid, Smart City program, a system of eight wind turbines and twenty battery storage systems were installed in Gundy, NSW. The system was connected to a rural high voltage (HV) feeder to support approximately thirty rural customers.

The system aimed to improve the reliability of electricity supply to customers, who had previously experienced poor reliability from the grid. Whilst the system potentially provided reduced electricity bills, the relatively poor wind conditions in the trial area limited the benefits to the consumer. Additionally, the high installation cost of the wind turbines and battery storage outweighed the financial benefit created at the time.

Source: Adapted from Smart Grid, Smart City case-study[4]

3.2.2 METHODOLOGY: IDENTIFYING NETWORK BENEFIT IN VICTORIA AND CALCULATING ITS VALUE

MOVING FROM THEORETICAL TO MEASURED VALUE

At the start of this chapter we set out the categories of network benefit that under certain circumstances distributed generation can provide. We also outlined the characteristics of distributed generation that determine its capacity to provide these benefits. In order for the value of these benefits to be measured , a methodology is required to:

- identify whether the circumstances under which distributed generation can provide value exist in a given location and a given point in time,
- identify the characteristics of distributed generation that are required to give rise to benefits in that location and time, and

[4] Department of Industry (2014) *Smart Grid, Smart City Customer Applications Case Studies: Rural Distributed Generation and Distributed Storage,* Australian Government

- identify a way of calculating the value of any such benefits (or potential benefits) that are identified.

Through this section we present the building blocks of a methodology for application in the contemporary Victorian context. In essence, the methodology is focused on drawing a comparison between a range of scenarios through which the effect of various distributed generation portfolios can be assessed.

Because the capacity of distributed generation to provide value is highly locational, any methodology is necessarily granular and computational intensive. Drawing upon work conducted by EY for the Clean Energy Council, we understand such a methodology must cover the following:

- **Define the unit of analysis.** That is, it must define the appropriate level of granularity – expressed in terms of subdivisions of the network – at which identification and measurement of benefit should occur. For instance, EY proposes the appropriate unit of analysis is the medium voltage (e.g. 11 kV) feeder level.
- **Accommodate each benefit category**. Within the each unit of analysis, the methodology must be capable of measuring the benefit provided by distributed generation across each of the benefit categories. This may call for discrete methodologies where the method for calculating the benefit of deferred network augmentation is inappropriate for calculating, say, network support capacity.
- **Develop a method for identifying the effect of distributed generation.** In order to measure the scope of the benefit and its value, the methodology must identify the effect that distributed generation has on the network. The approach must be capable of identifying and valuing the benefit of the distributed generation systems that are installed during the measurement period. It must also be capable of evaluating the benefits caused, during the measurement period, of any distributed generation that was installed prior to the measurement period (which we refer to as 'pre-existing distributed generation').
- **Define time parameters.** The identification of the benefit and its value must occur within defined time parameters. The Commission proposes any methodology be geared towards calculating the benefits that are caused by distributed generation within a given year.

The design of the methodology will dictate the data needs of the evaluation exercise.

REGARDING DATA ASSOCIATED WITH NETWORK CONGESTION

In our initial analysis, it has been clearly expressed through recent studies and submissions that distributed generation potentially has a major role in alleviating network congestion. Given the prominence of this particular benefit, the Commission has further reviewed publicly-available data that may assist in determining the extent of network congestion alleviation caused by distributed generation. A preliminary approach for quantifying network congestion benefit is described in table 3.3.

TABLE 3.3 PRELIMINARY ASSESSMENT APPROACH FOR QUANTIFYING NETWORK CONGESTION BENEFIT

Step	Description	Potential data sources
1.	Determine current maximum peak-demand experienced at HV feeders and zone sub-stations across the Victorian network.	• Distribution Annual Planning Reports • Electricity Distribution Price Review Regulatory Proposals
2.	Determine current installed capacity of HV feeders and zone sub-stations across the Victorian network.	• Regulatory Impact Notices (RINs) – non-financial
3.	Estimate network congestion levels by matching maximum peak-demand and installed capacity. Present findings in tabulated and mapping format.	• *Compilation of data sources*
4.	Determine the current installed capacity of distributed generation systems across the Victorian network, by post-code.	• Clean Energy Regulator postcode data for small-scale installations
5.	Estimate the matching of installed distributed generation capacity with network congestion at HV feeders and zone sub-stations. Present findings in tabulated and mapping format.	• *Compilation of data sources*
6.	Estimate counterfactual levels of maximum peak-demand, i.e. if no distributed generation was installed across the network. Present counterfactual network congestion levels (at HV feeder and zone substations). Identify network areas where maximum peak-demand exceeds current installed capacity.	• *Calculation and compilation of data sources*
7.	Estimate cost of counterfactual traditional network infrastructure required to meet theoretical exceedances of current installed capacity.	• Electricity Distribution Price Review Regulatory Proposals • Regulatory Impact Notices (RINs) –financial, category analysis, economic benchmarking

QUESTIONS FOR CONSULTATION

Economic value methodological approach

Q12. What alternative or additional building blocks of a methodology should be considered for determining the network benefit of distributed generation?

Q13. What do you see as the most appropriate unit of analysis and level of granularity is for the assessment of network benefits?

Q14. What publicly available data sources can be accessed to apply the methodology, particularly with respect to network constraint and demand?

Q15. What are the appropriate time parameters of a study into the potential network benefits of distributed generation?

3.3 ENVIRONMENTAL AND SOCIAL VALUE

Where distributed generation leads to changes in the way the network is managed, this may cause flow-on, or indirect, social and environmental benefits. Through consultation on our approach paper stakeholders proposed a number of such social and environmental benefits, including bushfire risk mitigation and improved amenity through a reduction in poles and wires. We set out these proposed benefits below, following an explanation of how we will assess them for inclusion within true value.

3.3.1 PROPOSED SOCIAL AND ENVIRONMENTAL BENEFITS ARISING FROM THE EFFECT OF DISTRIBUTED GENERATION ON ELECTRICITY NETWORKS

This section lists the potential social and environmental benefits proposed in submissions to our approach paper.

BUSHFIRE RISK MITIGATION

The Melbourne Energy Institute stated that that given "the cost of network solutions to reduce bushfire risks in remote areas…it would be worthwhile to revisit the value of distributed generation in mitigating bushfire costs and risks".[5] Mr Alan Pears also recognised potential reductions in insurance costs for network providers as a result of reduced bushfire risk.[6]

AESTHETIC AND AMENITY BENEFITS

Amenity and aesthetic benefits were also suggested by the Clean Energy Council, as using distributed generation may reduce the need to build poles and wires. Some submissions also suggested that distributed generation can lead to increased customer empowerment and control where their generation system allow a consumer to operate independently of the grid thereby providing further reliability and safety for that consumer.

INCREASED CUSTOMER EMPOWERMENT (THROUGH REDUCED RELIANCE ON THE GRID)

Some forms of distributed generation also provide certain consumers the ability to go off-grid or reduce their reliance on the grid – this is particularly relevant to distributed generation with associated battery or storage systems. This type of capability is often referred to as 'islanding', where in the case of a brownout or loss of grid electricity supply, a consumer can utilise its own electricity generation or storage.[7]

For some consumers, particularly those in rural areas or in areas with lower network reliability standards, this can be highly beneficial. Environmental Justice Australia stated that "Victorians see benefit in using distributed energy to reduce their reliance on

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[5] Melbourne Energy Institute (MEI) 2016, *Submission to the Essential Services Commission Inquiry into the true value of distributed generation,* February, p. 12

[6] Alan Pears 2016, *Submission to the Essential Services Commission Inquiry into the true value of distributed generation,* February, p. 14

[7] Islanding is the ability for a consumer to operate off the electricity grid by relying on its own electricity generation sources

the grid, or go off grid all together" and the Institute for Sustainable Futures refers to this type of network benefit as being one of customer empowerment.[8]

3.3.2 APPROACH TO ASSESSING SOCIAL AND ENVIRONMENTAL BENEFITS

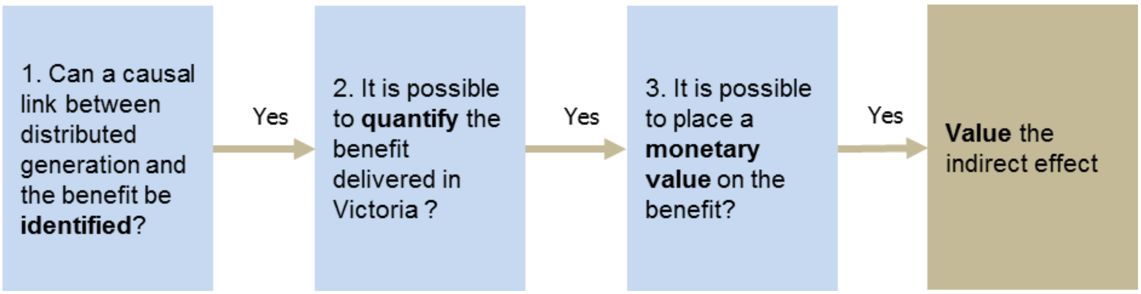
When examining the energy value of distributed generation in stage one of this inquiry, we assessed the associated environmental and social benefits of that energy. In this second stage, we propose the application of the same three-part process applied to environmental and social benefits. The three-part process was:

a. **Identification –** We will consider the potential benefits of distributed generation and whether it is possible to establish a causal link between that benefit and its association with the electricity network.
b. **Quantification –** We considered whether it is possible to measure the quantum of benefit delivered in Victoria by distributed generation in the context of networks.
c. **Valuation –** We considered whether it is possible to place a monetary value on the benefit.

Only where all three parts of the test can be completed, can a monetary value on that environmental and social benefit be determined (figure 3.2).

[8] Environmental Justice Australia 2016, *Submission to the Essential Services Commission Inquiry into the true value of distributed generation,* February, p. 7 and Institute for Sustainable Futures 2016, *Submission to the Essential Services Commission Inquiry into the true value of distributed generation - Proposed Approach Paper,* February, p. 2

FIGURE 3.2 THREE-PART INDIRECT EFFECT TEST
Method for considering environmental and social value



Data source: ESC

To support our assessment of these proposed benefits, we welcome submissions providing evidence related to these benefits of distributed generation. In particular, we would seek specific evidence in relation to how distributed generation directly leads to such benefits.

QUESTIONS FOR CONSULTATION

Environmental and social benefits

Q16. Can you suggest or provide evidence that supports those environmental or social benefits attributed to distributed generation listed in this discussion paper?

Q17. Outside those potential benefits listed, are you able to provide (and support with evidence) of how distributed generation reduces the environmental impact of the transportation of electricity?

Q18. Outside those potential benefits listed, are you able to provide (and support with evidence) examples of how distributed generation provides social benefit, as it relates to the transportation of electricity?

4 REGULATORY FRAMEWORK

The inquiry has been asked to assess the operation of the current regulatory framework governing the remuneration of distributed generation in Victoria. This chapter sets out the elements of the regulatory framework that relate the network effects of distributed generation.

4.1 REGULATORY FRAMEWORK

The current regulatory framework governing the valuation and remuneration of distributed generation for network benefits is a combination of state and national regulations.[31]

4.1.1 COMPONENTS OF THE VICTORIAN FRAMEWORK

Since this inquiry commenced, the Victorian regulatory framework as it relates to distributed generation has changed. The Victorian Government has amended relevant legislation to implement Chapter 5A of the National Energy Rules (NER) in Victoria, commencing 1 July 2016. Chapter 5A outlines the connection process for distributed generators with a capacity of 5 MW or less, providing a shorter and more flexible connection process for these generators.

The implementation of Chapter 5A provides an opportunity for the Commission to review two existing Victorian instruments, Victorian Electricity Industry Guidelines 14

[31] National in this context refers to the rules and regulations that govern the National Energy Market (NEM), which encompasses the eastern states and territories of Queensland, New South Wales, Victoria, South Australia, Australian Capital Territory and Tasmania.

and 15, which previously served similar purposes to Chapter 5A including through establishing the framework governing connections of small scale distributed generation. To the extent that Guideline 15 provided a mechanism to make payments to distributed generators for the value they provide in the form of avoided distribution system costs and avoided TUoS charges, the inquiry provides a natural avenue through which to review this function of the guideline.

THE OPERATION OF CHAPTER 5A

Chapter 5A of the National Electricity Rules will apply in Victoria from the 1st July 2016. Chapter 5A governs the connection of distributed generation[32] less than the standing exemption to register as a participant with AEMO (currently 5MW). It provides for three different connection options:

- Basic connection service. Provided to a typical retail customer and to a micro-embedded generator via a model standing offer.
- Standard connection service. For connections larger than for a micro-embedded generator, but for which there is a model standing offer
- Negotiated connection service. For connections not covered by either the basic or standard connection service.

Chapter 5A outlines the process and timelines that should be followed under each connection type.

Chapter 5A also provides the framework for determining the charges that network businesses can recover from a connecting customer. They allow, in certain circumstances, for a DNSP to recover extension and augmentation costs required to connect the distributed generator (or load customer) to the network.

The connection costs that will be recovered from a micro-embedded generator will be detailed in the relevant DNSPs model standing offer that will reflect the DNSPs connection policy. The DNSPs connection policy, which is approved by the AER, must

[32] Referred to in Chapter 5A as embedded generation.

comply with the AER's connection charge guidelines and with the connection charge principles outlined in Chapter 5A. These outline that micro-embedded generators:

- Can be required to make a contribution to the capital cost of an extension, which could arise when the distribution network is extended beyond the current boundary of the network
- Can be required to make a contribution to the capital cost of augmentation, but only if the service in question is not a basic connection service and a relevant DNSP threshold has been exceeded.

The AER guidelines indicate that these thresholds should be set so they prevent retail customers, including micro-embedded generators, making a contribution towards augmentation.

Distributed generators that are not classified as micro-embedded generators (but below the 5MW AEMO registration threshold), can be charged for both the extension and augmentation costs related to their connection.

Based on this understanding of the how the costs of connecting distributed generation are dealt with, the Commission will assume, for the purposes of this inquiry, that the individual connection costs to distribution businesses – meaning the costs of connecting a specific distributed generator to the network – are already accounted for.

4.1.2 COMPONENTS OF THE NATIONAL FRAMEWORK

The components of the national framework that are relevant to this stage of the inquiry are established by provisions of the (NER) relating to the operation of, and investment in, the electricity distribution network. The owners of these networks are known as Distribution Network Service Providers (DNSP) and are regulated by the Australian Energy Regulatory (AER).

Under Chapter 6 of the NER, all DNSPs operating in the NEM must submit proposals to the AER outlining the revenue and expenditure they believe is necessary to operate their networks during the upcoming five year regulatory period. The AER assesses these proposals against a range of criteria outlined in Chapter 6 and makes a decision (determination) as to how much revenue the distribution business can collect during the regulatory period.

In recent years, a number of processes have looked at the structure and design of the National Electricity Market (NEM), and the NER that govern its operation, to ensure they enable the continued deployment of distributed generation. Through these processes a wealth of analysis has been carried out into the network benefit of distributed generation, including by the Victorian Government[33] and at the national level through various rule changes progressed by the Australian Energy Market Commission (AEMC).

This has resulted in a number of mechanisms being introduced aimed at making it easier for distributed to access the NEM and to allow for certain types of distributed generation to be rewarded for any identified network benefit it provides.

The distinction between network-led and proponent-led distributed generation becomes significant in this setting. Certain elements of the national regulatory framework are targeted at ensuring that network-led distributed generation is commissioned by the network business where that constitutes the most efficient (that is, lowest cost) alternative to upgrading network infrastructure.

Other elements are focused on providing a mechanism by which distributed generation that is proponent-led – that is, installed and operated for and by parties other than the network business – can receive payments for benefits they provide to the network. Lastly, a number of mechanisms apply to both network-led and proponent-led distributed generation. The mechanisms are set out below.

The existing mechanisms that could support network-led investment in distributed generation include:

- **Regulatory Investment Test for Distribution (RIT-D)** – The RIT-D is a framework that requires electricity distribution businesses to consider a range of options where network investment is required above $5 million. The framework requires DNSPs to consider both credible network and non-network options, which might include demand-side management or specific distributed generation projects.

[33] Primarily through the Victorian Competition and Efficiency Commission (VCEC) 2012 report *Power from the People: Inquiry into distributed generation.*

- **Demand Management Incentive Scheme (DMIS) and Innovation Allowance (DMIA)** – The AER is required to develop and publish the incentive scheme and set an innovation allowance to fund innovative projects that have the potential to deliver ongoing reductions in demand or peak demand. The innovation allowance will provide DNSPs with funding for research and development in projects that have the potential to reduce long-term network costs. Projects may incorporate distributed generation solutions as part of this scheme.
- **Capital Expenditure Sharing Scheme (CESS) and the Efficiency Benefit Sharing Scheme (EBSS)** – These schemes provides incentives for network businesses to further invest and operate in networks more efficiently. Where a non-network solution, such as distributed generation, is more cost effective than a typical network investment, the scheme allows the network business to keep part of the cost savings.

The existing mechanisms that could support both network-led and proponent-led investment in distributed generation include:

- **Avoided Transmission Use of System costs** – DNSPs are required to pass through any Transmission Use of System (TUoS) costs that have been avoided as a result of distributed generation, i.e. where the energy supplied by distributed generation avoids energy supplied to the distribution network via the transmission network. Note that this is available for distributed generation with a capacity above 5MW, meaning that it would not apply to the scale of distributed generation that is the subject of this inquiry.
- **Network support payments** – Distributed generation with a capacity above 5MW can negotiate payments by DNSPs and transmission network service providers (TNSPs) for providing specific network support services. These payments may be made by DNSPs and TNSPs for services where distributed generation provides firm generation, deferring a specific shared transmission network asset, or for a service that contributes to reliability and security of a transmission network. Note that this is available for distributed generation with a capacity above 5MW, meaning that it would not apply to the scale of distributed generation that is the subject of this inquiry.
- **Small Generation Aggregator Framework –** This framework establishes a Small Generation Aggregator as a new category participant within the NEM. This reduces

the barriers for a third party aggregator in offering solutions for network businesses for operating or investing in the grid. A 'third party aggregator' is an entity that aggregates the supply from a number of distributed generators and transacts through the wholesale market on their behalf. This mechanism provides a framework for small-scale generators to participate in aggregation schemes and potentially obtain financial benefit.

Separately from components of the regulatory framework that are specifically designed to ensure appropriate remuneration of distributed generators for any value they provide to the network, a number of other developments within the national electricity rules that intersect with distributed generation. These include:

- **Cost-reflective distribution network tariffs –** This requires network businesses to develop prices that reflect to consumers the costs to the network of supplying demand at different times. Network tariff reform has the potential to shift patterns of demand, thereby changing patterns of congestion, and this has the potential to influence the value of distributed generation to both the private investor and the broader network. .
- **Connecting embedded generators rule change –** Since 2014, the NER has included two processes that reduce the barriers for connecting embedded generators (known in this inquiry as distributed generators) to electricity networks. These processes have resulted in changes to Chapters 5 and 5A of the NER to streamline and clarify the processes for connecting distributed generation. They also provide guidance as how the costs of connecting a distributed generator to the network can be recovered.

We will consider these frameworks in further detail in understanding whether the current regulatory framework is adequate to return the potential network value created by distributed generation.

4.1.3 HOW VALUE IS ACCOMODATED WITHIN THE NATIONAL FRAMEWORK

The method of determining the financial value of network benefits described in chapter 3 is closely linked to the way in which network businesses spend money to maintain and operate their networks and charge consumers.

As described in section 3.2, the potential network benefits from distributed generation may lead to financial value in the form of reduced or avoided CAPEX, REPEX or OPEX of traditional network infrastructure.

These financial benefits are captured within a regulated process, in particular the regulation of how distribution businesses invest in the network and ultimately charge consumers. An understanding of how network businesses are regulated is required to understand what value distributed generation may cause for the network. An overview of energy network regulation is provided in box 4.1.

BOX 4.1 ENERGY NETWORK REGULATION

Network infrastructure is operated by network businesses (private companies) across designated areas in Australia. There are five electricity distributors in Victoria. Victorian electricity distributors are private companies that are monopolies in their distribution areas. Regulation is required to prevent network businesses from excessively charging for network use (which increases consumer prices) or from underspending on the network (which impacts service quality).

The electricity network infrastructure is nationally regulated by the Australian Energy Regulator (AER). The AER describes their role as follows:

> *"The AER regulates electricity networks and natural gas pipelines by setting the maximum amount of revenue they can earn. Network businesses submit proposals to the AER on their required revenues. We review the proposals and make decisions with reference to factors including:*
>
> *a. projected demand for electricity and natural gas*
> *b. age of infrastructure*
> *c. operating and financial costs*
> *d. network reliability and safety standards.*
>
> *Decisions generally apply for five years, and network businesses adjust their prices annually during the five year period."*

The AER assess the maximum amount of revenues based on a number of costs that network businesses require to operate. Network business submit a proposal that include details of asset costs (depreciation), operational costs, tax liabilities, the cost of debt repayment and interest, and returns to equity holders.

Source: AER (2013) *Better Regulation Fact Sheet: Expenditure Forecast Assessment Guideline*

Source: AER (2016) *Our role,* accessed on 8 June 2016 at https://www.aer.gov.au/about-us/our-role, and AER (2013) *Better Regulation Fact Sheet: Expenditure Forecast Assessment Guideline*

Within the current regulatory framework described in box 4.1, distributed generation may create economic value by reducing (or avoiding) traditional investment in network infrastructure (as described in section 3.2 as being reduced CAPEX, REPEX, or OPEX). This inquiry aims to understand if such value is identified and realised.

To undertake this assessment, we propose to consider the following questions:

- **Identification and realisation of value**. How does the regulatory framework facilitate the identification and realisation of the value of distributed generation, including the avoided CAPEX, REPEX and OPEX? How does it do so for both network-led and proponent-led distributed generation?
- **Current allocation of any identified value.** How is potential economic value allocated between the distributed generator, the network business, and consumers at large?

4.1.4 ASSESSMENT OF THE REGULATORY FRAMEWORK

In our approach paper, we sought information from stakeholders on how the framework operated in practice and received initial feedback. Through this discussion paper we are seeking further detail on how these mechanisms operate, specifically for distributed generation of different capacity size and distributed generation that is classed as 'proponent-led'.

The outcomes of this analysis will guide the Commission in its assessment of whether any reform to the current regulatory frameworks is necessary, and what the nature of that reform should be.

4.2 ALTERNATIVE MECHANISMS

If our review of network benefits indicates that distributed generation may provide value but the current regulatory framework does not provide an adequate means for reimbursing distributed generators for that value, the inquiry is tasked with exploring alternative frameworks for achieving this objective. This section sets out one alternative framework currently under consideration in another Australian jurisdiction, and seeks input from stakeholders on further framework options.

4.2.1 LOCAL GENERATION NETWORK CREDITS

In addition to the mechanisms outlined above, the Australian Energy Market Commission (AEMC) is currently considering a rule change proposal that, if accepted, would introduce what is known as a Local Generation Network Credit (LGNC) into the NER (see box 4.2).

The proponents of the rule change contend that the current incentives for distributed generation in the NER do not provide adequate recognition of the benefits that distributed generation can provide, and/or may not be readily accessible to small-scale local generators. They argue that the current framework for network pricing (outlined above) only focusses on electricity consumption; it does not explicitly address the export of electricity from an end-use customer. They also argue that the current mechanisms in the NER for recognising the network benefits of distributed generation, specifically the Network Support Payment, Avoided TUOS and RIT-D mechanisms, are unlikely to be accessible to many small-scale distributed generators.

BOX 4.2 LOCAL GENERATION NETWORK CREDIT RULE CHANGE REQUEST

In July 2015 the Local Generation Network Credit (LGNC) Rule change was submitted to the AEMC. The rule change has been proposed by the City of Sydney, The Property Council of Australia and the Total Environment Centre. It is supported by analysis from the Institute of Sustainable Futures and Oakley Greenwood.[34]

Key features of the Rule change are:

- It seeks to reflect the long-term economic benefits (in the form of capacity support and avoided energy transportation costs) that the export of energy from a local generator provides to a distribution business, including reduced or avoided transmission costs that would otherwise be passed through to end users.

[34] The full Rule change proposal can be found on the AEMC website: http://www.aemc.gov.au/Rule-Changes/Local-Generation-Network-Credits

- The LGNC would be signalled to customers in the form of a posted credit that would be able to be adjusted yearly as part of the distribution businesses broader Annual Pricing Submission process.
- The detail of the credit would be developed by individual distribution businesses, based on guidelines to be prepared by the Australian Energy Regulator. The credit could vary by voltage level (and potentially by location) where the allocative efficiency benefits of that greater level of disaggregation exceed the administrative costs of developing and administering it.
- The credit would be available to local generators of any size (not just to larger local generators) as:
  - This overcomes the gap in the Rules whereby small-scale local generators are unable to monetise the benefits that they collectively provide to the grid, and
  - By not limiting size, the credit can assist in enabling localised groups of embedded generators of sufficient aggregate size and scale to be treated as a diversified portfolio, as opposed to being treated as individual generators (which in turn overcomes the need for an individual generator to provide a 'firm' guarantee of capacity support).
- The proposed LGNC does not allow distributed generators to be charged when the calculation shows that they impose a cost rather than a benefit on the network (ie where the cost of catering for bi-directional flows is deemed to exceed the benefits of the exported electricity to the network). This is based on the assumption that distribution businesses will use other means for managing this issue, should it arise. These include (a) disallowing any further connections in an area where this situation arises, or (b) smearing any such additional costs across all applicable tariff classes.

Source: ESC

Through submissions to our approach paper, network businesses broadly encouraged the Commission to align the inquiry, where possible, with the AEMC rule change process. In response to our approach paper AusNet Services wrote:

> *AusNet Services anticipates that the AEMC review will provide an authoritative assessment of the circumstances whereby distributed generation provides benefits to networks. The analysis provided throughout the AEMC process, and the AEMC's conclusions, should provide a primary source of guidance for the ESC… Any further analysis should address clearly identifiable gaps in the scope of the AEMC's review.* [35]

Where the scope of the AEMC's rule change process coincides directly with the scope of the current inquiry, and where the conclusions of the AEMC are equally applicable in the Victorian context as they are in the broader national energy market, we accept that the rule change process provides a useful source of guidance on the issues under consideration in this inquiry.

4.2.2 ALTERNATIVE APPROACHES

A number of jurisdictions around Australia and internationally are exploring the question of whether distributed generation can provide a network benefit and what regulatory mechanisms might be appropriate for rewarding distributed generators for that benefit. The Commission seeks stakeholder input on whether mechanisms under consideration in any other jurisdiction are suitable for consideration in the context of this inquiry.

QUESTIONS FOR CONSULTATION

Operation of the current regulatory framework

Q19. Are there other aspects of the current regulatory framework outlined in this paper that the Commission should consider?

Q20. Can you provide specific examples of payments made to distributed

[35] Ausnet Services, 2016, p.4.

generators under the regulatory mechanisms listed in this discussion paper? What size of distributed generation systems received the payments? Were payments made to small-scale systems?

Q21. Are you able to provide data/evidence about the operation of the small scale generation aggregator framework as a mechanism by which network benefits of small scale distributed generation can be identified, valued and compensated?

Q22. To what extent do the Tariff Structure Statements published by Victorian distribution businesses provide an indication of the benefit distributed generation can provide through reducing peak network demand?

Q23. Are there are alternative conceptual frameworks that could be used to examine the benefits provided by proponent-led distributed generation? In particular, are there conceptual frameworks for considering potential benefits that were not anticipated in the planning forecasts associated with the five yearly pricing determination process?

Alternative mechanisms

Q24. How should the Commission consider the scope of the LGNC Rule Change Proposal with this current inquiry?

Q25. Are there methodologies for calculating network value and/or regulatory mechanisms from any other jurisdiction that are suitable for consideration in the context of this inquiry?

5 NEXT STEPS

5.1 CONSULTATION

Readers are invited to makes submissions to this Discussion Paper. A full list of the questions being asked is below. Submissions do not have to address every question.

Submissions should be made by **5pm 29 July 2016**.

Submissions, preferably in electronic format, and marked Submission to True Value of Distributed Generation Inquiry should be sent

By email to: DGInquiry@esc.vic.gov.au

By mail to: Essential Services Commission

Level 37, 2 Lonsdale Street

Melbourne, Victoria 3000

Submissions will be made available on the Commission's website, except for any information that is commercially sensitive or confidential. Submissions should clearly identify which information is sensitive or confidential.

5.2 DRAFT AND FINAL REPORT

Our Draft Report into the network value of distributed generation will be completed in October 2016. The Final Report for network value will be completed in February 2017.

In the interim, we will conclude the energy value stream of the inquiry by completing our Final Report (energy value) in August 2016.

APPENDIX A - TERMS OF REFERENCE

TERMS OF REFERENCE – INQUIRY INTO THE TRUE VALUE OF DISTRIBUTED GENERATION TO VICTORIAN CONSUMERS

The Andrews Labor Government recognises the importance of renewable energy for Victoria. We acknowledge sustainable sources of energy can deliver economic, environmental and social benefits to the State, including jobs for regional Victoria.

The Labor Government is acting to support the growth of renewable energy in Victoria through a suite of policy measures. These include:

- Establishing a renewable energy target of no less than 20 per cent by 2020.
- Using the government's electricity purchasing power to support the creation of hundreds of renewable energy jobs.
- Ending unfair discrimination for solar customers.
- Helping communities to transition to a clean energy future.
- Improving access to the grid for solar customers.
- Developing a Renewable Energy Action Plan.

Supporting clean energy jobs through the $20 million New Energy Jobs Fund.

An important source of renewable energy for Victoria is distributed generation, such as household solar systems. In Victoria, there are over 245,000 solar systems installed across the State, with a total generation capacity of over 700 megawatts.

The Labor Government believes Victorians with small-scale renewable energy generation should be fairly compensated for the value their generation provides. In Opposition, we committed to undertake an inquiry into the true value of distributed generation. In Government, we are getting on with it, and asking the Essential Services Commission to commence this inquiry.

The inquiry will seek to ascertain the true value of distributed generation, including determining what value distributed generation provides to the electricity market and the network. The Essential Services Commission will also be asked to consider the environmental and social value of distributed generation.

The findings of the inquiry will help inform the design of the feed-in-tariff arrangements in Victoria and assess current frameworks for the compensation of network value of distributed generation by relevant Victorian Electricity Industry Guidelines and the National Electricity Rules.

SCOPE OF THE INQUIRY

The inquiry will:

1. Examine the value of distributed generation including: the value of distributed generation for the wholesale electricity market; the value of distributed generation for the planning, investment and operation of the electricity network; and the environmental and social value of distributed generation.
2. Assess the adequacy of the current policy and regulatory frameworks governing the remuneration of distributed generation for the identified value it provides.
3. Make recommendations for any policy and or regulatory reform required to ensure effective compensation of the value of distributed generation in Victoria. These recommendations should have regard to the most appropriate policy and regulatory mechanisms for compensating different benefits of distributed generation, including considering their practicality and costs.

The inquiry will not consider the policy and regulatory frameworks governing the costs of connecting distributed generation to the network. The inquiry will also not consider whether the feed-in-tariff should be deregulated.

The inquiry should have regard to reviews and reports completed in Victoria and other jurisdictions which may be relevant to the objectives of this inquiry.

The inquiry will involve extensive consultation with industry, environmental organisations and consumer advocacy groups.

STRUCTURE OF THE INQUIRY

PART 1. THE TRUE ENERGY VALUE OF DISTRIBUTED GENERATION

This part of the inquiry will examine the social, environmental, locational and temporal value of energy produced by distributed generation. The analysis will be completed in time to inform the next FiT decision in August 2016 (for effect in calendar year 2017).

The outputs of this part of the inquiry are:

- Output 1: Approach Paper

This Paper should be presented to Government by the end of 2015.

- Output 2: Draft Part 1 Report into the true energy value of distributed generation

This Report should be presented to Government by April 2016.

- Output 3: Final Part 1 Report

This Report should be presented to Government by August 2016.

PART 2. THE TRUE NETWORK VALUE OF DISTRIBUTED GENERATION

This part of the inquiry will seek to account for the impact on the network of investment in distributed generation.

The outputs of this part of the inquiry are:

- Output 4: Discussion Paper on network value of distributed generation

This Paper should be presented to Government in the first half of 2016.

- Output 5: Draft Part 2 Report (methodology) on network value of distributed generation

This Report should be presented to Government by October 2016.

- Output 6: Final Part 2 Report (methodology) and on network value of distributed generation

This Report should be presented to Government by February 2017.

APPENDIX B - LIST OF REFERENCES

Alan Pears 2016, *Submission to the Essential Services Commission Inquiry into the true value of distributed generation,* February, (http://www.esc.vic.gov.au/wp-content/uploads/esc/68/680ee354-e6b2-4adb-a35e-d198909dddb0.pdf)

AusNet Services 2015, *AusNet Services' Australian-first network battery trial,* June, (http://www.ausnetservices.com.au/CA257D1D007678E1/Lookup/MediaReleases2015/$file/150106%20GESS.pdf)

AusNet Services 2016, *Demand Management Case-Study: Residential Battery Storage Trial,* March, (http://www.ausnetservices.com.au/CA257D1D007678E1/Lookup/ManagingUsage/$file/Case%20study%20Residential%20Storage%20Trial.pdf)

Australian Energy Market Operator, *Regional generation information pages: Victorian Summary*, March, (http://www.aemo.com.au/Electricity/Planning/Related-Information/Generation-Information)

Australian Energy Regulator 2013, *Better Regulation Fact Sheet: Expenditure Forecast Assessment Guideline*, June, (https://www.aer.gov.au/system/files/AER%20Better%20Regulation%20factsheet%20-%20expenditure%20forecast%20assessment%20guideline%20-%20November%202013.pdf)

Australian Energy Regulator 2016, *Our role,* June, (https://www.aer.gov.au/about-us/our-role)

Australian Renewable Energy Agency, Intelligent storage for Australia's grid, June, (http://arena.gov.au/project/intelligent-storage-for-australias-grid/)

CitiPower 2016, Residential battery storage, June, (https://www.powercor.com.au/future-thinking/harnessing-new-technologies/residential-battery-storage/)

Clean Energy Council 2015, Calculating the value of small-scale generation to networks, July 2015, (http://fpdi.cleanenergycouncil.org.au/dam/cec/policy-and-advocacy/ARENA/FPDI/the-value-of-small-scale-generation.pdf)

Clean Energy Regulator 2016, *Postcode for small-scale installations*, March, (http://www.cleanenergyregulator.gov.au/RET/Forms-and-resources/Postcode-data-for-small-scale-installations)

Department of Industry 2014, *Smart Grid, Smart City Customer Applications Case Studies: Rural Distributed Generation and Distributed Storage*, February, (http://www.industry.gov.au/Energy/Programmes/SmartGridSmartCity/Documents/Rural-Distributed-Generation-and-Distributed-Storage.pdf)

Department of Industry 2014, *Smart Grid, Smart City*, February, (http://www.industry.gov.au/ENERGY/PROGRAMMES/SMARTGRIDSMARTCITY/Pages/default.asp)

Environmental Justice Australia 2016, *Submission to the Essential Services Commission Inquiry into the true value of distributed generation,* February, (http://www.esc.vic.gov.au/wp-content/uploads/esc/54/5405388a-b731-44cc-aec5-78f0a96d1ff7.pdf)

Environmental Justice Australia 2016, *Submission to the Essential Services Commission Inquiry into the true value of distributed generation,* February, (http://www.esc.vic.gov.au/wp-content/uploads/esc/54/5405388a-b731-44cc-aec5-78f0a96d1ff7.pdf)

Essential Services Commission 2016, *The Energy Value of Distributed Generation, Distributed Generation Inquiry Stage 1 Draft Report*, June, (http://www.esc.vic.gov.au/wp-content/uploads/2016/05/RPT-Distributed-Generation-Inquiry-Stage-1-Energy-Value-Draft-Report-20160506.pdf.pdf)

Essential Services Commission Act 2001 (Vic.) (*http://www.esc.vic.gov.au/getattachment/d6250f4c-a1cc-44de-a756-5a2d634842b7/Essential-Services-Commission-Act-2001-incorporati.pdf)*

Frontier Economics 2016, *Valuing the impact of local generation on electricity networks,* Energy Networks Association, February 2016, (http://www.ena.asn.au/sites/default/files/20160204_frontier_economics_report_on_local_generation_network_credits_-_attachment_a.pdf)

Institute for Sustainable Futures 2016, *Submission to the Essential Services Commission Inquiry into the true value of distributed generation - Proposed Approach Paper,* February, (http://www.esc.vic.gov.au/wp-content/uploads/esc/5e/5e4e0299-695d-4ed5-94dd-c94f57cad580.pdf)

Melbourne Energy Institute (MEI) 2016, Submission to the Essential Services Commission Inquiry into the true value of distributed generation, February, (http://www.esc.vic.gov.au/wp-content/uploads/esc/33/338e75dc-c41f-4b9a-999e-843a5267e51e.pdf)

Powercor 2015, *Powercor installs Australia's largest battery in Ballarat South,* June, (https://www.powercor.com.au/news-and-media/latest-news/powercor-installs-australias-largest-battery-in-ballarat-south/)

Rocky Mountain Institute 2013, *A Review of Solar PV Benefit & Costs Studies,* June, (http://www.michigan.gov/documents/mpsc/solar_pv_benefit_and_cost_studies_448376_7.pdf)

SunWiz 2016, *Database of Australian Commercial Solar Power Projects*, March, (http://solardatabase.sunwiz.com.au/)

United Energy Distribution 2013, *Demand Management Incentive Scheme Report 2013,* March, (https://www.aer.gov.au/system/files/United%20Energy%20-%20Demand%20management%20incentive%20scheme%202013.pdf)

Victorian Competition and Efficiency Commission 2012, *Power from the People: Inquiry into distributed generation – Final Report*, July,

(http://www.vcec.vic.gov.au/files/cbddc4f4-91e7-4466-a060-a35a00f0d432/Power-from-the-People-Final-Report.pdf)