Supporting Document 12.1.9
Network Strategy – Demand Management – CEOP1121
2019-2024

April 2018

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1 Executive Summary

Network Strategy	CEOP1121 Demand Management Strategy
Description	Demand management (DM) and non-network alternatives (NNA) offer substantial potential to achieve the safety, power quality, reliability and capacity levels that Essential Energy's customers and stakeholders require of the electricity network at reduced cost. This Strategy provides the long-term strategic direction for Essential Energy's demand management program. We are committed to providing positive outcomes for customers now and in the future through proactive and efficient promotion, development and implementation of demand management and non-network alternatives, as outlined in this Strategy.
Objectives	> Enhance the value identified within the demand management business cases and process to enable demand management and non-network alternatives as primary elements of the planning process and as a broad-based strategy. > Enable and encourage internal and external stakeholder involvement. > Efficient development and refinement of demand management and non-network alternatives technical skills, experience and solutions. > Increase asset use and reduce peak demand by implementing prudent demand management and non-network alternatives initiatives. > Optimise demand management and non-network alternatives application value now and in the future.
Approach	> Strong focus on fundamental process improvements based on best practice to maximise opportunities for continuous improvement. > Align to Asset Management Objectives as directed by overarching Strategic Asset Management Plan (SAMP)
Customer benefits	> Decreased network expenditure. > Increased customer and industry knowledge and participation.
Implementation timing	2019/20–2023/24

2 Introduction

2.1.1 Purpose

Low-cost energy drives economic productivity and is a fundamental requirement for modern living. Therefore, Essential Energy strives to provide customers with a distribution service that can meet the demands placed on it by generators and customers alike, while using the most cost-effective solutions available to maintain acceptable safety, reliability, security and power quality standards.

One way we can meet customers' growing demands is by building additional network assets. An alternative is to modify the electrical loading (the demand-side of our business) so existing or smaller electrical infrastructure can meet customers' demand requirements.

This approach is known as demand management (DM) or non-network alternatives (NNA) usage. It involves investigating alternatives to network augmentations to meet electricity demand requirements and is embodied in Essential Energy's Demand Management Engagement Strategy, network planning process and licence conditions.

Demand management and using non-network alternatives target two main issues: those created by peak demand, and opportunities created by new, lower-cost technologies.

2.1.1.1 The Demand for Peak Capacity

Historically, Essential Energy's peak demand referred to demand for electricity to service household and commercial loads during the peak period. However, changes in technology availability have led to a change in the definition of peak demand. It now includes both demand for electricity during peak periods to service customer loads, and allowing the peak output of generation during low load periods.

Demand for electricity during peak loading periods and the customer requirement to allow the peak output of generation are best summarised as 'the demand for peak capacity'.

Peak capacity demand growth is due to two things: the connection of new customers and generators to the electricity distribution network, and existing customers increasing their peak electrical impact by using additional or more powerful electrical appliances or generation.

Growth in demand for peak capacity is not consistent across the entire network area, so we don't always see pockets of high growth when considering average high-level growth figures for the network.

Due to growth in peak capacity requirements, we may have to augment or extend the network to maintain the desired quality, security and reliability of electricity supply to all customers within the regulatory licence conditions. Our objective is to achieve these outcomes cost-effectively.

We often have to increase our asset expenditure to cater for peak demand of only a few days or hours each year. The disproportionate cost of doing this means constructing or augmenting network assets may not be the best way to deliver network services that always meet peak capacity.

2.1.1.2 Lower-cost Replacement Options

So far, growth in peak demand has been the focus of Essential Energy's demand management techniques. However, the rapidly changing landscape of available technologies means we must also continually evaluate existing network solutions to determine if non-network alternatives could meet customers' energy and demand needs more cost-effectively, and implement these solutions wherever they provide the best economic outcome for customers.

2.1.2 Scope

This document is limited to outlining the high-level strategy, plans and expenditure required to achieve the stated vision and objectives and the various factors influencing the proposed outcomes.

2.1.2.1 Statutory Requirements and Electricity Distribution Licence Compliance

Essential Energy is subject to a variety of legislative requirements and regulatory conditions, as set out in our distribution licence and the National Electricity Rules (NER).

Our Demand Management Engagement Strategy sets out how we ensure legal and regulatory compliance and meet the requirements of the Demand Management Strategy. It provides information on the business processes involved in determining the economic and technical validity of a demand management solution and Essential Energy's policies and procedures for implementing the legislative requirements.

Figure 1 shows the relationship between the Demand Management Strategy and the Demand Management Engagement Strategy.

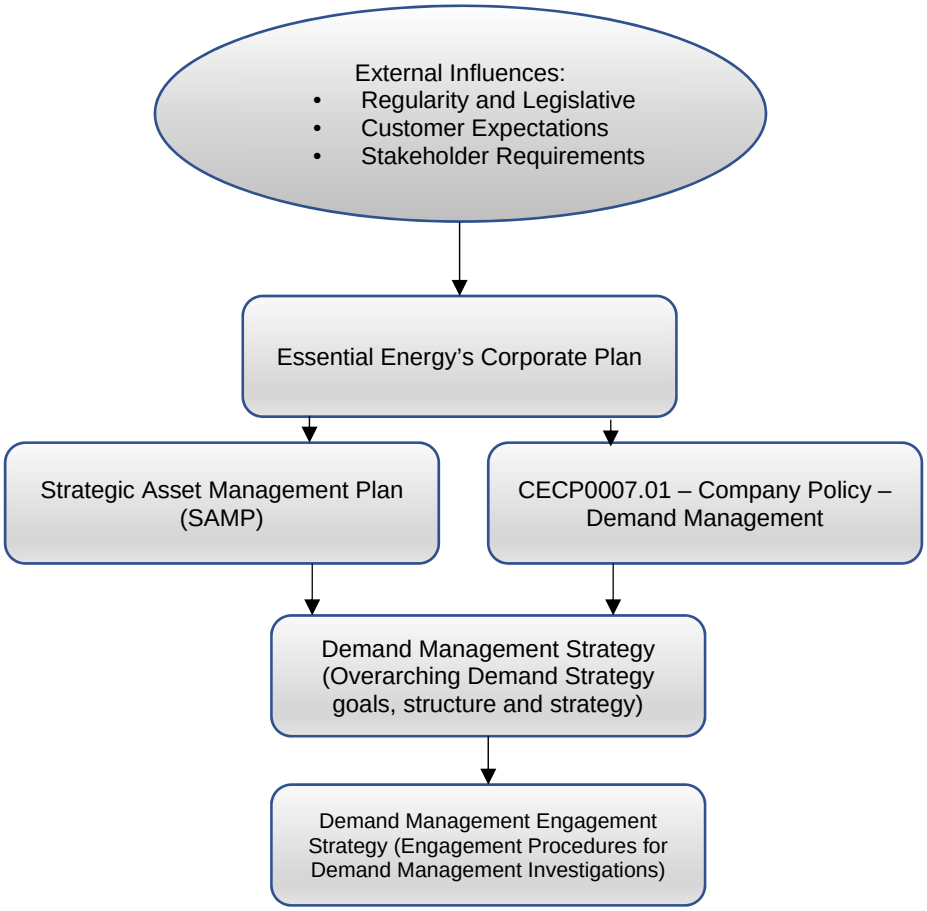

Figure 1- Relationship between Demand Management Strategies

2.1.2.2 Strategy Review and Updating Cycle

We review this document every year to ensure it reflects changing and emerging issues.

3 Background

3.1.1.1 Demand Management Definition

Demand management is the supervision and guidance of consumption levels and patterns of electrical loads and generation so we can meet customers' peak capacity requirements without using traditional network augmentation. It helps us to deliver the best value to customers.

In this document, demand management includes traditional forms of demand management (e.g. load shedding or load shifting) and non-network alternatives (e.g. conservation voltage reduction, power factor correction and stand-alone power systems).

For further background, including peak capacity requirements and types of demand management and non-network alternatives implementations, refer to

Appendix C - Peak Capacity Requirements.

3.1.1.2 Business Objectives

Essential Energy's corporate priorities are:

- Continuous improvements in safety culture and performance.
- Operate at industry best practice for efficiency so we can deliver best value for customers.
- Deliver real reductions in customers' distribution network charges.
- Deliver a satisfactory Return on Capital Employed (ROCE).

Further, the relevant asset management objectives are:

- Manage our assets so investment decisions result in sustainable, cost-effective asset performance outcomes for the present and the future
- Customers receive a quality of service that is in line with community expectations
- Meet the Network Reliability Performance targets as set by the business objectives
- Comply with applicable statutory and regulatory obligations or requirements for asset management

Demand management and non-network alternatives help us to achieve these goals by increasing network utilisation and efficiency and decreasing networks costs.

By using demand management and non-network alternatives, Essential Energy is committing to reducing expenditure related to meeting peak demand by:

- Reducing asset replacement costs.
- Increasing customer awareness.
- Encouraging customers to modify usage patterns.
- Developing innovative technologies to meet customer demands.

These initiatives decrease our expenditure and ultimately decrease electricity costs for customers.

3.1.1.3 Legislative Requirements

As a Distribution Network Service Provider (DNSP), Essential Energy is subject to legislative requirements and regulatory conditions that mandate or encourage the use of demand management where it is efficient to do so.

These include:

- The *National Electricity Rules,* which govern the operation of the National Electricity Market and are made under the *National Electricity Law*.
- The *National Electricity Law,* which states that "the National Electricity Objective is to promote efficient investment in, and efficient operation and use of, electricity services for the long-term interests of consumers of electricity with respect to price, quality, safety, reliability, and security of supply of electricity and the reliability, safety and security of the national electricity system." The Law acknowledges that demand management plays a part in achieving this objective.

3.1.1.4 Resources

Essential Energy's Demand Management Group is capable of developing demand management and non-network alternatives in-house. It uses:

- Multi-skilled distribution and subtransmission planning groups.
- Internal expertise on customer engagement, education and communications.
- An internal expert group focused on delivering load control services and initiatives.
- Internal groups with a history of installing and maintaining power factor (PF) correction devices.
- Various other external partners and well-developed external relationships.

We are committed to investing efficiently in developing demand management and non-network alternatives and have implemented several of these solutions, including:

- Demand response.
- Fuel substitution.
- Increased end use efficiency.
- Conservation Voltage Reduction.

In particular, we have experience in these demand management and non-network alternatives:

- Controlled load, which Essential Energy has had in place for over 50 years and continues to optimise control and costs.
- Embedded generation and integrating renewables into the network.
- Energy storage — lithium polymer and lead acid-based technologies.
- Power factor correction at all levels of the network, ranging in size from 5kVAr four quadrant inverter LV installations at a residential level to 32MVAr capacitor bank installations in our zone substations.
- Decreased losses as the driver for conductor sizing and transformer specification.
- Demand-related tariffs.

Essential Energy has also partnered with leading equipment manufacturers and institutions (including universities) on the development of innovative demand management and non-network alternatives.

As we explore the potential of an ever-changing technological landscape, these partnerships will continue to be a cornerstone of our development.

The experience we have gained from these implementations and previous demand management investigations, along with our global review of best practice demand management, means that Essential Energy is now able to substantially increase the level of demand management we undertake.

3.1.1.5 Key Factors and Emerging Issues

Several issues could significantly change our demand management work programs and direction. They include:

Customer Expectations

The relationship Essential Energy has with customers directly and through demand management service providers is pivotal in realising many demand management opportunities.

To date, the information we have received from customers[1] as part of a major engagement program indicates a broad lack of understanding of issues relating to electricity supply and use and a desire for more and better information.

Information is critical to customer experiences and perceptions. Real-time information about electricity use that is simple and easily understood helps them to understand their electricity needs and informs their future energy choices.

From a demand management point of view, the main outcomes of our Customer Engagement Survey relate to customers':

- Desire for affordable energy.
- Openness to considering different tariffs if it would enable them to manage their energy costs.
- Desire for further information, including the observation that there is a lack of plain language information around demand response and options.

Essential Energy will use the results of this survey, and of future similar surveys, to inform and define the best course of action for customer-related demand management and to measure of the success of future customer engagement programs.

Small-Scale Renewables

The growth of small-scale renewables has been a major focus in recent times. This is likely to continue for the foreseeable future as energy costs rise and renewables costs decrease[2].

The Energy Network Australia and CSIRO's Electricity Network Transformation Road Map estimates that 30%-50% of energy in the NEM by 2050 will be generated at the customer level, resulting in growth of two-way power flows within distribution networks. Our distribution network was planned, designed and operated to supply peak load but we see ourselves now transitioning to managing peak generation. This shift has seen issues emerging, such as a reduction in network utilisation or in some areas of the network, additional capacity is being demanded from the distribution network.

Small-scale renewables can have a negative and positive impact on the distribution network. The impact is largely on DNSPs such as Essential Energy, so we must drive the required changes. The *ENEA Technology & Environment Paper* outlines key issues and possible solutions that we will work towards.

[1] Essential Energy, June 2017,''Engagement Program Summary Report – Phase 1', Woolcott Research and Engagement.

[2] ENEA, February 2017, 'Technology & Environment Paper'

Power Quality

Essential Energy is subject to power quality standards. When we exceed them, our network expenditure increases. The level and types of network demand have a direct influence on power quality.

At the same time as power quality standards are becoming more stringent, power electronic devices are increasingly improving reliability and reducing costs. With demand management, many fast-acting, power electronics-based technologies (such as energy storage) are becoming more viable when traditional solutions cannot perform in the given timeframe.

Customer expectations regarding power quality are also changing, due to more sensitive electronic equipment.

Essential Energy continues to work towards developing solutions to cost-effectively overcome these issues.

We expect to undertake more power quality work in future as power quality standards and monitoring increase.

Reliability

Exceeding reliability standards can also drive network expenditure. However, there is a cost threshold with reliability where customers find it difficult to see the value of infrastructure investments.

As with power quality, these issues allow faster-acting power electronics-based demand management technologies to become increasingly viable.

Essential Energy is also obligated to investigate demand management as an alternative to specific reliability issues. We continue to work towards developing solutions to overcome these issues cost-effectively and address changing customer expectations.

Technology and Environment

In 2017, Essential Energy engaged ENEA to identify, assess, forecast and report on customer and utility scale technologies, trials and related environmental changes that are likely to impact electricity demand and energy use within a series of defined periods.

The highlights of this study were that, from an electricity demand perspective, solar photovoltaic (PV) and behind-the-meter storage will be of highest importance for Essential Energy for the foreseeable future. This is because of the anticipated high uptake levels and their direct impact on energy use patterns.

PV and storage are predicted to reduce energy use from the network significantly, leading to reduced asset utilisation and potentially (along with associated revenue challenges) to an increased cost per kWh delivered.

The impact on maximum demand will vary, depending on how many customers take up PV. With moderate market penetration we expect the bandwidth of Essential Energy's network voltage to expand due to strong correlation between voltage and demand. While in very high penetration areas, we anticipate new maximum local demands under reverse-flow conditions.

Benefits such as the potential demand smoothing effect of behind-the-meter storage will depend on the tariffs and/or control schemes.

From a network asset perspective, Essential Energy will need to ensure we deploy assets that are relevant to the long-term forecast for demand and connections.

From a regulatory and tariffs perspective, the continued cost reduction of rapidly evolving technologies such as battery storage and solar PV, emergence of new market participants and market reforms is increasing customer choice and their capacity to respond to market signals. Noting the potential impacts and benefits of connecting such technologies to the network we need to actively transition to cost reflective network pricing and/or control schemes, supported with appropriate connection standards. The shift to cost reflective pricing and/or control schemes will drive efficient use of the distribution network and guide the uptake of such technologies for the long-term interest of customers. In this way, we can limit the adverse effects of solar PV and battery storage (mainly voltage impact and reverse flows) and leverage their potential benefits (peak shaving, reliability improvement, voltage support etc.) to maintain downward pressure on network charges.

Off-gridding and electric vehicles uptake is expected to remain relatively limited, but will present specific opportunities. With off-gridding, we could lower the average cost to serve by using cheaper options to supply customers on the fringe of the grid, improving the relevance of the grid in the long run. However, based on upcoming regulatory decisions, choosing this path may imply a lower number of customers overall and a downsized (but more efficient) regulated activity.

Among the topics ENEA studied, electric vehicles were the only technology driving an increase in energy use. Potentially, we could limit their maximum demand increase, which would lower the cost per kWh distributed and increase grid efficiency. To achieve this, we would need to incentivise appropriate charging patterns and investigate mechanisms such as specific tariffs, smart chargers and workplace charging stations. These would ensure the integration of electric vehicles into the grid benefit all stakeholders.

We anticipate other major changes during the defined periods resulting from the AEMC *Power of Choice Review* recommendations. These will drive expanded energy market governance frameworks that facilitate customer choice, drive efficient investment, and promote demand-side options.

Figures 2 and 3 show the high-level impacts of specific technologies. Some of them assume that Essential Energy reacts to control negative impacts and encourage positive impacts.

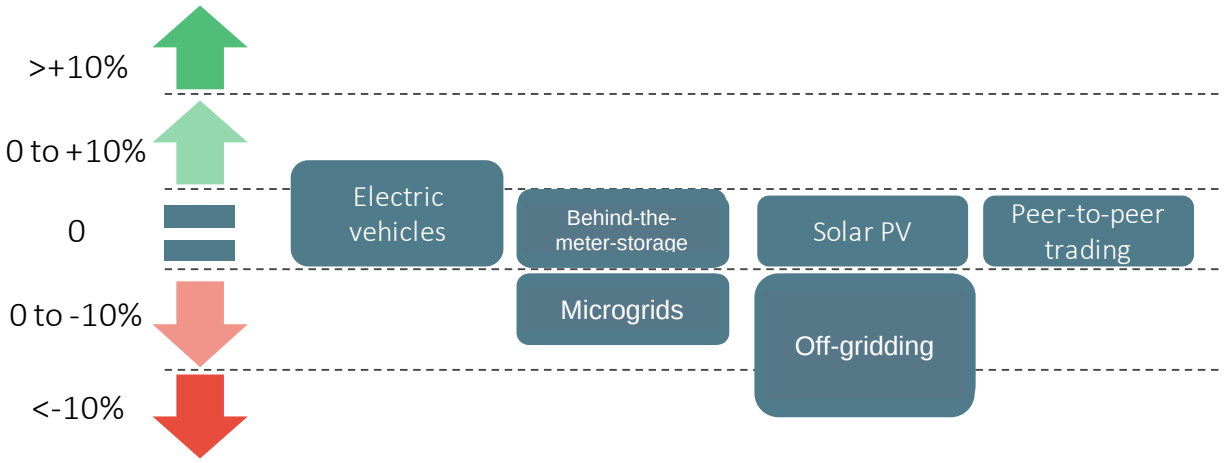

Figure 2- Potential Customer Base Impacts of new Technologies

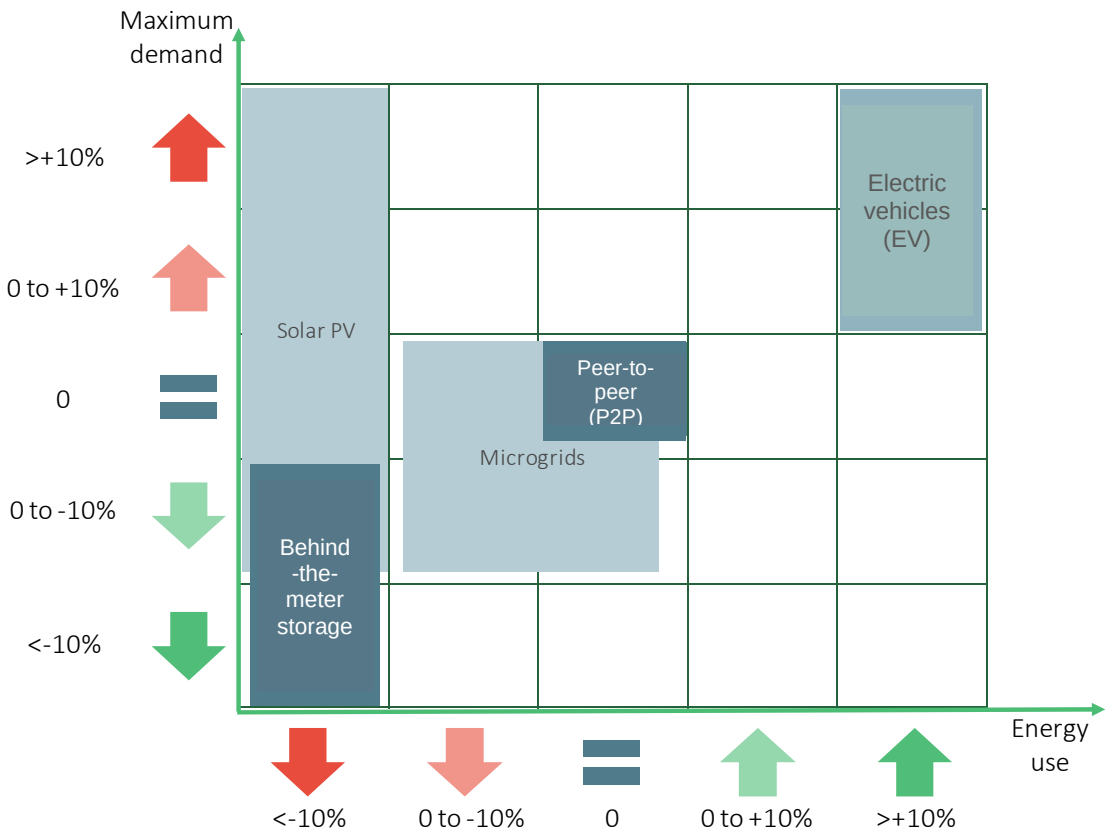

Figure 3 - Potential Demand and Energy Impacts of New Technologies

The Demand Management Incentive Scheme and Demand Management Innovation Allowance

The Demand Management Incentive Scheme (DMIS) and Demand Management Innovation Allowance (DMIA) are developed and administered by the AER and outlined within the National Electricity Rules.

The DMIS aims to incentivise efficient expenditure on relevant non-network options relating to demand management.

The Demand Management Innovation Allowance enables DNSPs to research and investigate innovative techniques for managing demand so in future, demand management projects can be increasingly identified as viable alternatives to network augmentation.

Western Power Rule Change Request - Alternatives to Grid-Supplied Network Services

Western Power's rule change request seeks to make it easier for distributors to provide off-grid supply to customers where it would be cheaper than replacing or maintaining a grid connection.

On the 19 December 2017 the Commission's final determination was not to make a rule at this time due to the concern that the change to the NER could not address a lack of customer protections for off-grid customers and may be invalid due to inconsistencies with the NEL.

The Commission however did make a series of recommendations seeded from submissions and workshops as part of the rule change request to the COAG Energy Council who is coordinating two working groups to further investigate the recommended package of changes to a range of laws, rules and state and territory instruments.

Until such changes are implemented, barriers remain to achieving lower cost solutions for high-cost, low-return connections on Essential Energy's network.

4 Vision & Benefits

Essential Energy's vision for demand management for the 2019-2024 regulatory period can be summed up in five statements. These are our benchmarks for measuring the success of this Demand Management Strategy and associated initiatives.

4.1 We decrease network expenditure and customer costs through efficient demand management

Wherever customers can receive the same standard of service for a reduced cost through demand management, Essential Energy is committed to achieving this.

Essential Energy's long-run marginal cost for network capacity is presented in Table 1.

Table 1: Essential Energy — Long-Run Marginal Cost for Capacity (Annualised) by Voltage Level

Voltage Level	Total LRMC at Voltage Level ($/kVA/p.a.)
ST	10
HV	116
LV	145

This indicates there is a net benefit for Essential Energy's customers from any initiatives that can reduce the increase in demand for less than $145/kVA/p.a. at the low voltage level of the network.

Initial high-level studies suggest we could reduce our growth expenditure by approximately 8.5 per cent through greater application of resource and effort in demand management. We have included these reductions in our Distribution Growth Strategy.

However, these figures involve many high-level assumptions, given the limited nature of demand management within Essential Energy's network.

4.2 We emphasise partnering with customers and communities to ensure the full benefits of demand management options are understood, adopted and realised

Studies of demand management potential show that many low-cost demand management options are already available to consumers. In 2011/2012, Essential Energy partnered with TransGrid and two service providers that were offering energy audits to commercial and industrial consumers in our network area. We worked with them to create an energy demand audit.

By the end of FY13/14, 17 audits had been completed and approximately 171 demand management initiatives had been investigated. These initiatives showed approximately 9MW of potential demand reductions, with the potential to save customers approximately 616MWh.

The results of this study (Figure 5) show that substantial benefits are available to both the consumers involved and potentially DNSPs and their customers.

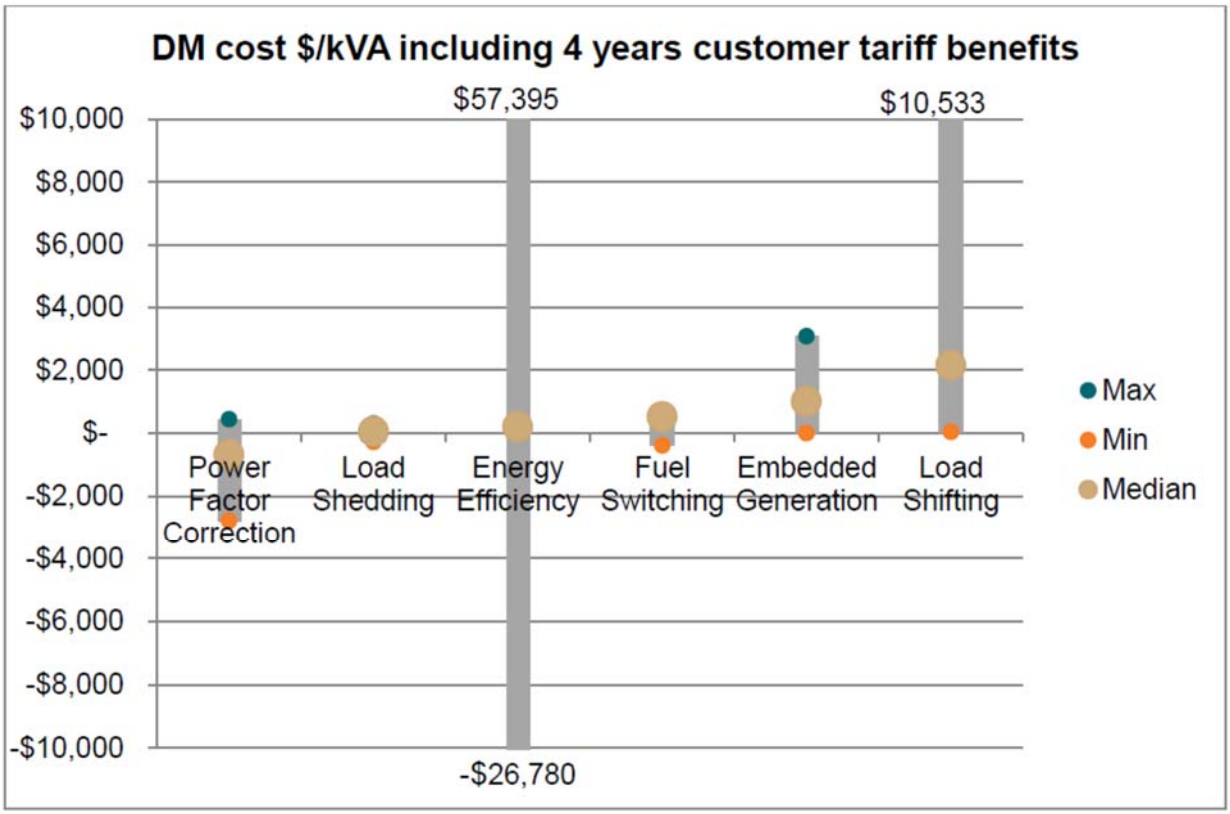

Figure 4 - Cost of Demand Management Options

This table indicates that, to achieve optimal network efficiencies, Essential Energy should target similar projects in the range below the long-run marginal cost of providing network capacity, and incentivise and educate those who own potential demand management services.

4.3 Demand management is our first option for planning to meet peak capacity requirements and all the required tools, techniques, knowledge and processes are available

It is widely accepted that demand management can offer a cost-effective alternative to network augmentation for project-specific constraints, provided that those who are required to implement demand management programs have the tools and processes in place to do so.

4.4 Generation connections are relatively simple and available virtually anywhere, without adverse effects on reliability or power quality

Distributed generation can benefit utilities by reducing demand. However, the connection process is regarded as one of the major issues in connecting distributed generation to the grid.[3]

Distributed generation can also have negative impacts on power quality, and assigning a reliability factor during demand management impact studies can be difficult. The penetration of distributed generation in the Essential Energy network area has increased considerably over the past 10 years, particularly through PV installations evident from Figure 5, and we expect this trend will continue.

With the potential for positive and negative outcomes, and with the level of penetration predicted to grow regardless of these outcomes, it is in the interests of Essential Energy and our customers to ensure the outcomes are positive, and to do so as efficiently as possible.

[3] Dunstan, Ghiotto, Ross, 2011. Barriers to Demand Management – A survey of stakeholder perceptions'

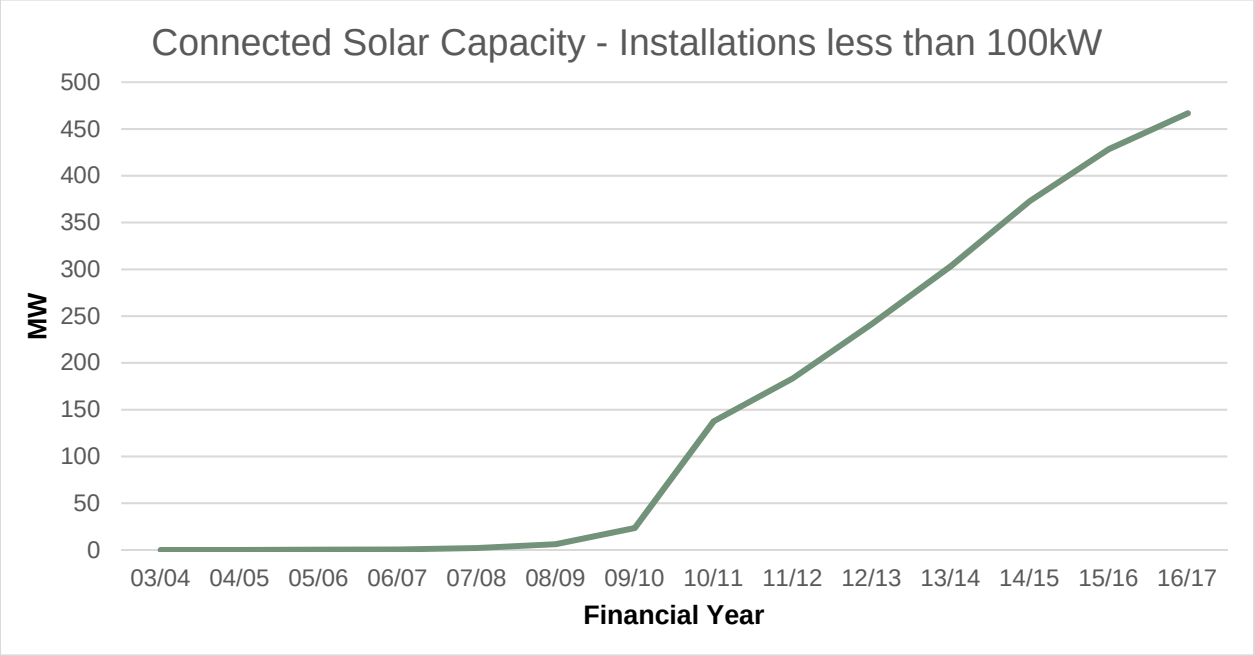

Figure 5: Connected Solar Capacity – Installations Less than 100kW

4.5 We enable customers and service providers with timely knowledge of where and when constraints will arise and have the tools, knowledge and incentives to react to constraints

Demand management initiatives often require considerable lead times to engage electricity customers and implement works.

To overcome this, Essential Energy must be able to advise on the value of demand management implementation within a timeframe that allows an effective response. This will enable the demand management market to invest in the tools and knowledge it needs to take advantage of incentives.

5 Performance and Gap Analysis

5.1 Current Performance

This list of our demand management implementations highlights both the lengthy relationship Essential Energy has with demand management and the increasing research and investigation that is occurring.

- **2004 to 2006** Country Energy Home Energy Efficiency Trial (HEET). To better understand our residential customers' propensity to change their electricity consumption patterns if they are provided with more information about their consumption and its relative cost at different times of the day and year.
- **2004 to 2006** Country Energy/SEDA. Binda and Bigga — 200kVA demand reduction to defer network expenditure by substituting electrical cooking and heating appliances with gas appliances.
- **2008 to 2014** Development of four quadrant inverters/statcoms for use with PV/energy storage/stand-alone for low-cost voltage/power factor/demand correction.
- **2011 to 2015** Development of internal HV feeder power factor correction standards, techniques and manuals for pole top capacitors.
- **2012 to 2013** Development of a model to determine the long-run marginal cost of demand growth in Essential Energy's network.
- **2012 to 2014** Combination energy and demand audits project to establish the estimated for demand reductions across particular customer classes within Essential Energy's network.
- **2012 to 2014** Essential Energy frequency injection-based load control system evaluation and roadmap.
- **2012 to 2014** Trial of large three-phase statcom for use in transient voltage/PF correction.
- **2012 to 2017** Evaluation of conservation voltage reduction through the use of low voltage regulators, allowing a reduction in both consumers' energy and peak demand.

  2013 and ongoing Development and implementation of field switched reactors to reduce reactive power demands in single wire earth return (SWER) systems thereby reducing network voltage swing, reducing loses, reducing the need for larger isolation transformers, deferring or removing the need for augmentation and lowering the cost of supply to customers.
- **2015 to 2017** Development of a process enabling the quantification of all projects or constraint benefits and costs so we could quantify the full benefits of demand management.
- **2016** Customer payments for disconnection and alternate energy supply systems, reducing costs to serve and network risk.
- **2016 to 2017** Network technology roadmap highlighting customer and utility scale technologies and related environmental changes that are likely to impact electricity demand and energy use within a series of defined periods.
- **2016 and ongoing** Joint industry research project (Networks Renewed) with the Australian Renewable Energy Agency (ARENA), University of Technology Sydney, Reposit Power and SMA Australia, to test battery storage systems and advanced solar inverters with eligible customers within a virtual power plant arrangement to better manage the demand for network capacity and integration of renewables. The project will help optimise connection standards, metering and tariffs to guide future uptake of battery storage to achieve optimal integration while ensure such technology does not negatively impact the network resulting in costly network expenditure. In addition, the project will explore the possible value battery storage technology can provide through deferring or avoiding network expenditure and the appropriate signals required to yield such potential.
- **2017** Global best practice Demand Management Review, collating the best aspects of demand management process, structure and analysis from a variety of network businesses with an understanding of the regulatory frameworks and incentives available.
- **2017** Off-gridding Opportunity Review, which aims to identify network elements that may be more suitably supplied by stand-alone systems now or in the future.
- **2017 and ongoing** Off-Grid Implementation, which aims to explore the practicality (both customer and technical aspects) of such lower cost solutions within a trial environment.
- **2017** Peer-to-peer Demand Management Opportunities Review, which aims to identify Essential Energy's position within the market and how we can best achieve demand reductions and avoid network issues through aggregation to a non-local signal.
- **2017** Update of Essential Energy's long-run marginal cost information to inform further demand management investment.
- **Ongoing** Participation in the Network Opportunity and Generation Capacity Mapping projects to help with developing the demand management market.
- **Ongoing** Demand management investigations as part of the network investment process.

- **Ongoing** Refinement and development of Essential Energy's frequency injection-based load control system, which currently provides a demand reduction of approximately 330MVA/113MVA across winter/summer respectively.
- **Ongoing** Compliance with all licence conditions relating to demand management.

5.2 External Review

In 2017, Essential Energy engaged demand management experts Oakley Greenwood and the Institute of Sustainable Futures to produce a critical assessment of worldwide best practice processes, information and technology in electricity non-network alternatives (NNA) analysis and selection.

The final Demand Management Review included:

- Measures of the success of the NNA selection.
- Process used by the business to identify NNA.
- Information and tools available at each stage of the process.
- Performance monitoring method of the NNA analysis and selection process.
- NNA used by the business.
- Indicative costs of the NNA used by the business.
- Research and implementation methods used by the business.
- Resources available throughout the process.

It also incorporated the regulatory frameworks and incentives available to the organisations studied so we could understand their potential application to our business.

Essential Energy aims to include this Review in our ongoing strategic development to assist with achieving our vision, as set out in Section 0.

The Review's highlights included a renewed focus on:

- Probabilistic planning at lower levels of the network to facilitate a greater proportion of demand management.
- The evolution of segments of the distribution network from fully integrated to decentralised, and the tools required to understand the pathway for this development.
- The development of screening tools to minimise resource requirements.
- Methodologies to increase the window of opportunity to assess and act on network constraints.
- Mapping tools to inform internal and external stakeholders.
- Metrics to understand and benchmark network augmentation costs, demand management implementation costs and system performance.

5.3 Gap Analysis

By reviewing Essential Energy's demand management implementations and the outcomes of the global best practice Demand Management Review, we have developed a clear view of our current performance relative to our vision. From this, we can determine the likely issues restricting the vision's implementation.

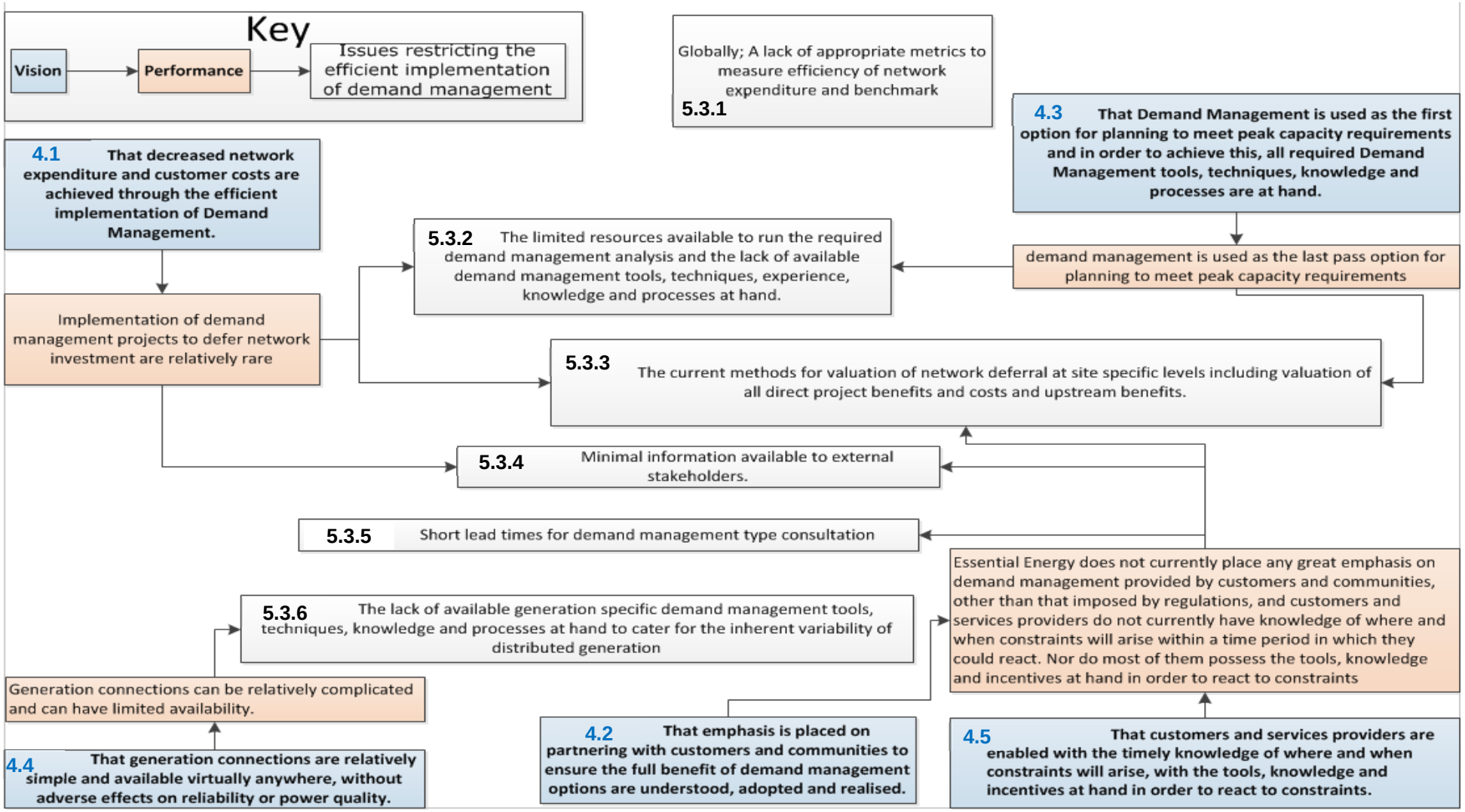

Figure 6 - Demand Management Vision and Gap Analysis

Essential Energy's current performance in demand management does not yet fully achieve our vision. This is due to several factors.

5.3.1 Lack of appropriate metrics to measure network efficiency expenditure and benchmark.

5.3.2 Limited resources to run required demand management analysis and lack of demand management tools, techniques, experience, knowledge and processes.

5.3.3 Current methods for valuing network deferral at site-specific level, including valuing all direct project benefits and costs and upstream benefits.

5.3.4 Minimal information available to external stakeholders.

5.3.5 Short lead times for demand management consultation.

5.3.6 Lack of generation-specific demand management tools, techniques, knowledge and processes to cater for inherent variability of distributed generation.

To address these challenges, we are implementing the Demand Management Strategy outlined in Section 6.1.

6 Strategy

To achieve our demand management vision, we have developed the Demand Management Strategy to achieve the following objectives:

- Enhance the value identified within the demand management business cases and process to enable demand management and non-network alternatives as a primary element of the planning process and as a broad-based strategy.
- Enable and encourage internal and external stakeholder involvement.
- Efficient development and refinement of demand management and non-network alternatives technical skills, experience and solutions.
- Increase asset use and reduce peak demand by implementing prudent demand management and non-network alternatives initiatives.
- Optimise demand management and non-network alternatives application value now and in the future.

The specific relationships between the objectives, strategies and (indirectly) the gap analysis are shown Section 8.

6.1 Demand Management Strategic Initiatives

This section sets out Essential Energy's strategies to move from our current demand management performance to the performance envisioned in Section 4 by targeting the gaps identified in Section 5.**Error! Reference source not found.**

Our Demand Management Strategy forms the action component of an iterative continuous improvement process for achieving our vision. The objectives improve on each component of the process loop, as shown in Figure 7.

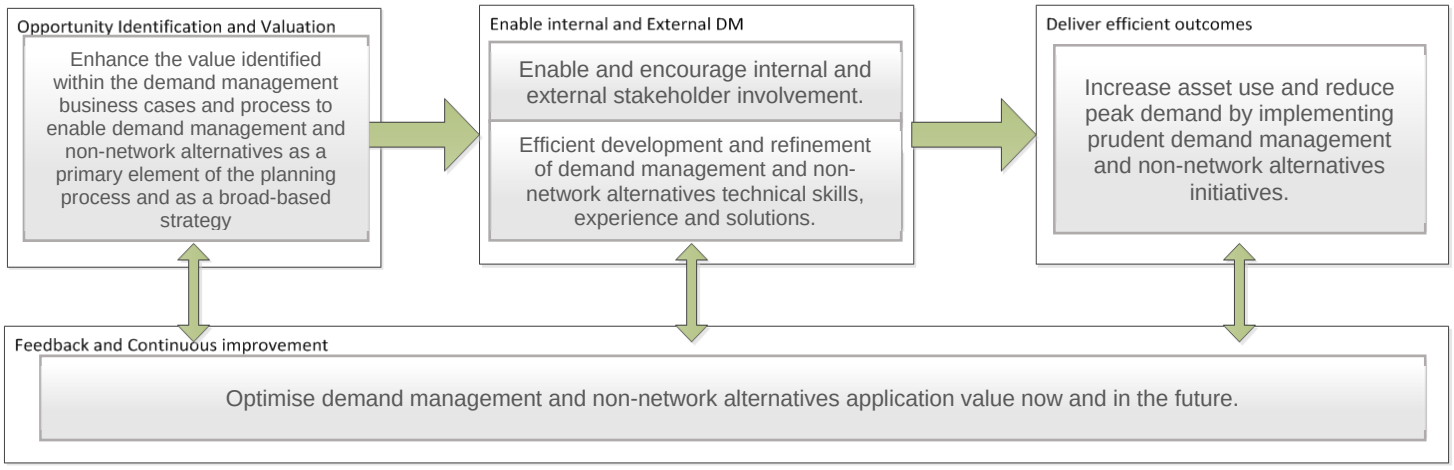

Figure 7 - Objective and Process Relationship

When developing the following strategies, we considered the emerging issues discussed in Section 3.1.1.5 and alignment with the broader Asset Management Plans and various business group Strategies (as discussed in Section 6.4**Error! Reference source not found.**). The estimated cost of implementing these strategies is set out in Section 0.

6.1.1 Enhance the value identified within the demand management business cases and process to enable demand management and non-network alternatives as primary elements of the planning process and as a broad-based strategy

This objective addresses this challenge:

- Current methods for valuing network deferral. Section 5.3.3

We implement network augmentations through inconsistent expenditures and extensions at different levels throughout the network: subtransmission, high voltage, low voltage, mains and substations.

Calculating the true cost of providing a given overall network capacity is complex. It involves adding up the cost of multiple augmentations made to separate parts of the network over indefinite lengths of time. Under current valuation methods, the economic deferral of a single network augmentation is difficult to justify and falsely represents the true value to all stakeholders.

With the help of experienced consultants, Essential Energy has developed models and methodologies that provide a more accurate representation of the financial value of project risks and benefits. These will support many of our demand management and non-network alternatives projects, both large-scale and at specific locations.

We are currently embedding these values into our decision-making processes and developing a governance framework. This work is supported by Essential Energy's recent implementation of portfolio valuation and optimisation software.

This objective also addresses this challenge:

- Short lead times for demand management consultation. Section 5.3.5

Unrealistic timeframes for developing and implementing demand management options remove the ability for demand management to be a primary element in our planning processes. Short lead times for demand management consultation are symptoms of a largely reactive planning process; if constraints are not predicted, then it is impossible to promote longer lead times other than by wearing the constraint risk for longer.

We will complete these initiatives:

- The embedding and governance of project risks and benefits values into our business decision-making processes, including the use of portfolio valuation and optimisation software.
- Substantial improvements to our forecasting and constraint identification processes to allow proactive planning.
- Developing short lead time demand management options for genuinely reactive works.

By applying these methodologies to core business strategies and business case evaluations, we will be able to efficiently and effectively implement demand management and non-network alternatives in the mainstream process.

By ensuring that Essential Energy values demand management appropriately and uses appropriate decision-making processes, we will provide an alternative to network augmentation and enable broad-based applications for treating emerging network constraints.

6.1.2 Enable and encourage internal and external stakeholder involvement

This objective addresses this challenge:

- Short lead times for demand management consultation. Section 5.3.5

The external stakeholders and markets Essential Energy wishes to enable are currently going through a high level of development and change. Many commentators point to block-chain and peer-to-peer markets as the likely enablers of future demand management.

We need to understand the potential and likely operations of the peer-to-peer market so we can encourage the positive benefits through appropriate incentives and minimise any adverse impacts.

This objective also addresses this challenge:

- Minimal information available to external stakeholders. Section 5.3.4

Essential Energy has been actively involved in the AER's Demand Management Incentive Scheme workshops and forums and the Institute of Sustainable Futures' Network Opportunity maps. It is clear from these discussions that the key to engaging with external stakeholders is providing easily digestible information.

We will complete these initiatives:

- Further review and develop a peer-to-peer market.
- Maximise the usable information in the market for demand management initiatives.

Once this work is completed, Essential Energy will be able to take advantage of demand management opportunities in the peer-to-peer market and, more broadly, through demand management service providers.

6.1.3 Efficient development and refinement of demand management and non-network alternatives technical skills, experience and solutions

This objective addresses these challenges:

- Lack of demand management tools, techniques, knowledge and processes. Section 5.3.1
- Lack of generation-specific demand management tools, techniques, knowledge and processes to cater for the inherent variability of distributed generation. Section 5.3.6

We believe it is imperative to develop solutions, relationships, processes and methodologies that allow us to efficiently and sustainably implement demand management and non-network alternatives. We plan to do this in a way that meets business and customer expectations by allowing us to defer network augmentation investment and reduce electricity charges.

By building on Essential Energy's experience and expertise in multiple demand management and non-network alternatives solutions, we can achieve the optimal level of performance and value.

Essential Energy is committed to ensuring our past learning informs tomorrow's solutions. We are using previous trials to develop standard demand management solutions such as energy storage and power factor correction as a means of deferring network investment.

Achieving continuous, meaningful development of demand management and non-network alternatives solutions will involve:

- Investigating state-of-the-art solutions at home and overseas.
- Creating and continually updating roadmaps for individual solutions.
- Continued trials to increase performance, reduce cost and integrate the developed solutions into our existing infrastructure and processes.

To support this approach, we will need to make efficient decisions within Essential Energy and collaborate closely with the distribution industry and stakeholders (e.g. product suppliers and technical institutes). To this end, we will strive to encourage and facilitate open discussion and development so we can achieve cost-effective outcomes for customers and the electricity distribution industry.

We will also continue building on our previous and current investigations into individual demand management and non-network alternatives, which cover: power factor correction, demand response, controlled load, voltage control, generation and storage, customer drivers, loss reduction and alternative measures.

We will undertake these initiatives:

- Continuing to refine our network technology papers, which provide information on future network demands and recommend long-term solutions for Essential Energy's network.
- Running trials to review current demand management and non-network alternative solutions that are directly applicable to Essential Energy's network while also building on the opportunities identified with the network technology papers.
- For each trialled solution, assessing the business value, preparing the business case and integrating it into our business as usual operations so we can evaluate it against existing network augmentations (in conjunction with more accurate valuation methodologies).

6.1.4 Increase asset use and reduce peak demand by implementing prudent demand management and non-network alternatives initiatives.

This objective addresses this challenge:

- Limited resources to run required demand management analysis. Section 5.3.2

Demand management analysis requires a conceptually different process and skillset to traditional network augmentation. Within Essential Energy, this process currently takes longer and requires a greater level of resource than the traditional alternative. We need a combination of approaches to ensure success, including automation and training and support.

More broadly, this initiative aims to ensure we implement the most efficient level of demand management. To ensure this is possible, we will conduct automated analysis of demand management potential wherever possible and regularly review existing demand management controls and tools for optimal operation.

We will undertake these initiatives:

- Enabling and supporting planning groups to deliver demand management and non-network alternatives opportunities.
- Continuing the Off-gridding Opportunity Review.
- Ensuring our connection policies and tariffs support optimal demand outcomes.
- Ensuring existing demand management initiatives are optimised (e.g. load control).

6.2 Optimise Demand Management and Non-Network Alternatives Performance and Value Now and in the Future

Given the long life of many demand management and non-network alternatives solutions, it is imperative that Essential Energy has in place strategies for existing and future technologies and the roles that demand management will play.

To ensure efficient outcomes and measure the performance of strategic changes, we will need to install performance metrics that can be continually updated and compared.

Once we can measure the efficiency of our decisions, achieving our strategies will require a combination of partnering with, and conducting market scans of, other distribution network service providers and similar market participants, both inside and outside Australia. This will help us to understand the available methods and what constitutes best practice. We will encourage and facilitate this collaboration by forming strategic partnerships and publicly releasing non-confidential demand management and non-network alternatives studies.

Through strategic partnerships, Essential Energy will call on our own experience and that of stakeholders to ensure that demand management and non-network alternatives are enabled now and in the future, and that the potential value and performance are achieved. The outcome of these partnerships and our works program will inform how we refine our existing strategies for future iterations of the regulatory process.

We will complete these initiatives:

- Developing and implementing key performance metrics.
- Forming strategic partnerships with stakeholders who can help with, or benefit from, the outcomes of our investigations into demand management and non-network alternatives solutions, including customer and demand management service provider investigations.
- Evaluating and reforming strategic partnerships with stakeholders who may be able to help with, or benefit from, the knowledge we gain from implementing demand management and non-network alternatives solutions, including customer and demand management service provider implementations.
- Refining our strategies to optimise demand management and non-network alternatives performance and value now and in the future.

6.3 Strategy Implementation

From our experience, it is critical that the work we undertake to achieve this strategic program is completed with certain standard methodologies in place so we can achieve the full benefits of each program. As such, we will apply the following methodologies:

- Work will be completed methodically with an appropriate level of detail.
- We will apply consistent methods of evaluating, reporting and archiving the investigations and implementations so the business can benefit from what we have learned even if the staff involved are not available.
- Work plans will be flexible so we can respond to major technology or external environment changes during the regulatory period, optimising funding and resources.
- Works will be completed in collaboration with internal and industry stakeholders to ensure efficient use of funding and resources.
- We will integrate the outcomes into appropriate business units and strategy documents, including the Demand Management Engagement Strategy.
- C55 investment templates will include demand management alternatives for consideration for specific project types
- Demand Management will be involved in the Gate 1 investment governance approval process for large network projects

6.4 Strategic Alignment

To achieve efficient outcomes, we have developed Essential Energy's Demand Management Strategy in conjunction with several other Strategies and Asset Management Plans.

Strategy	Synergies
Distribution Network Growth	Evaluation of demand management options for network deferral
Reliability	Evaluation of network support options such as generation or energy storage
Power Quality	Evaluation of power quality improvement options such as energy storage, statcoms and capacitors
	Evaluation of power quality improvement options for issues created by distributed generation
	Evaluation of power quality standards such as a generic implementation of Conservation Voltage Reduction
Load Control	Development and implementation of broad-based demand management plans and projects based on load control
	Development and implementation of research and demand management projects based on load control

7 Proposed Program Financials

The initiatives outlined throughout Section 6.1 will be budgeted for through:

- Demand management operating expenditure for all process changes and training.
- Demand Management Innovation Allowance for all research projects based on approximately $200,000 + 0.075% x ARR per year.
- Replacement capital for capital-based non-network alternatives. Given the rapidly changing landscape of available technologies means we must also continually evaluate existing network solutions to determine if non-network alternatives could meet customers' energy and demand needs more cost-effectively, and implement these solutions wherever they provide the best economic outcome for customers.
- Growth/augmentation capital for capital-based non-network alternatives. Given the greater amount of demand management predicted, we have budgeted a reduction of approximately 8.5 per cent to the baseline growth expenditure.

7.1 Program Cost Summary Overview

The program of work described in this document relies on a methodical approach to developing expertise that will underpin sustainable demand management strategies. This is so we can ensure the program benefits Essential Energy and the community, both in terms of electricity network service performance and value.

We have reduced Essential Energy's general growth capital expenditure in *CEOP2091 Operational Procedure: Distribution Network Growth Strategy 2019-2024* in response to the benefits we forecast will arise from expenditure on the above programs. Any changes to the allowable capital expenditure for the broad-based programs will need to be offset by proportional changes to that Strategy.

8 Performance Monitoring Plan

Through our Demand Management Group, Essential Energy will monitor and report on each of the strategic objectives twice a year.

Vision Items	Metrics
Decrease network expenditure and customer costs through efficient demand management	$/kWh $/kVA
Emphasise partnering with customers and communities to ensure the full benefits of demand management options are understood, adopted and realised	Number of DM market participants
Demand management is our first option for planning to meet peak capacity requirements and all the required tools, techniques, knowledge and processes are available	% of projects with DM investigations
Generation connections are relatively simple and available virtually anywhere, without adverse effects on reliability or power quality	Network costs due to generation connections/ kW of connected generation
We enable customers and service providers with timely knowledge of where and when constraints will arise and have the tools, knowledge and incentives we need to react to constraints	% of projects the market is told about

Objective Items	Metrics
Enhance the value identified within the demand management business cases and process to enable demand management and non-network alternatives as primary elements of the planning process and as a broad-based strategy	Number of positive demand management business cases
Enable and encourage internal and external stakeholder involvement	% of projects the market is told about
Efficient development and refinement of demand management and non-network alternatives technical skills, experience and solutions	Number of demand management tools available for use
Increase asset use and reduce peak demand by implementing prudent demand management and non-network alternatives initiatives	$/kWh $/kVA
Optimise demand management and non-network alternatives performance and value now and in the future	All of the above

9 Appendix A – Abbreviations

Abbreviations	Definition
ARR	Annual Revenue Requirement
AEMC	Australian Energy Market Commission
AER	Australian Energy Regulator
DM	Demand Management
DMIA	Demand Management Innovation Allowance
DMIS	Demand Management Incentive Scheme
DNSP	Distribution Network Service Provider
HEET	Home Energy Efficiency Trial
NER	National Electricity Rules
NNA	Non-Network Alternatives
OPEX	Operational Expenditure
PV	Photovoltaic
ROCE	Return on Capital Employed
SAMP	Strategic Asset Management Plan

10 Appendix B – References

Reference
Essential Energy, June 2017, *Engagement Program Summary Report – Phase 1*, Woolcott Research and Engagement
ENEA, February 2017, *Technology & Environment Paper*
Oakley Greenwood, Institute for Sustainable Futures, UTS, June 2017, *Best Practice Demand Management and Non-Network Alternatives*, Lance Hoch, Dani Alexander, Bridget Mcintosh
Institute for Sustainable Futures, UTS, *Report of the 2010 Survey of Electricity Network Demand Management in Australia*, Chris Dunstan, Nicole Ghiotto & Katie Ross
Institute for Sustainable Futures, UTS, June 2011, *Barriers to Demand Management: A survey of stakeholder's perceptions*, Chris Dunstan, Nicole Ghiotto & Katie Ross
AEMC, December 2017, Alternatives to Grid-Supplied Network Services
ENA, April 2017, Electricity Network Transformation Roadmap

11 Appendix C - Peak Capacity Requirements

The need for increased peak capacity at the higher network levels is largely driven by new customers' electrical loading during summer and/or winter months and the increased electrical loading of existing customers, with diversified load profiles.

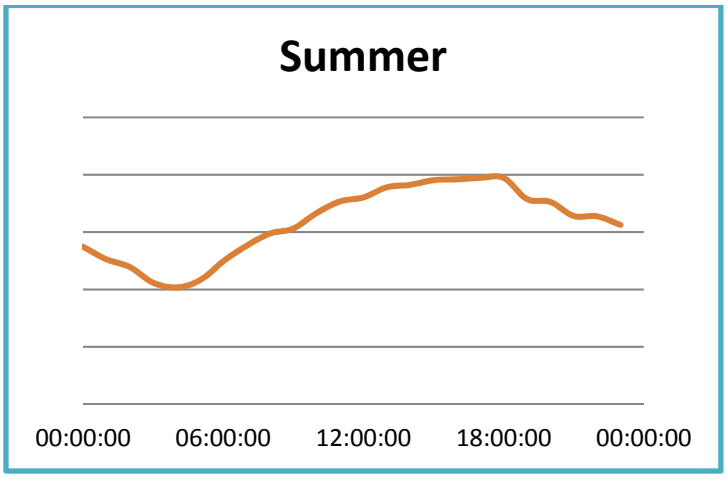

Figure 8 - Typical Summer Peak Demand

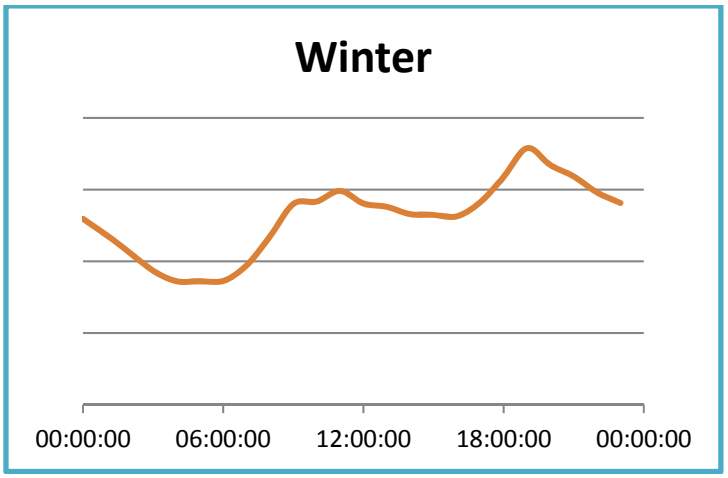

Figure 9 – Seasonal Demand Variations

Due to a lack of diversity at lower network levels, requirements for greater peak capacity can be driven by a much more diverse selection of new or increasing loads or generation at virtually any time of the day or year.

In the case of new customers, we will normally undertake some new dedicated extension works to connect them to the network.

Beyond this, on the energy source side of the connection point, the electrical demand impacts of new customers and growth in existing customers' loads on the existing shared network is similar.

These electrical connections and increased requirement for peak capacity can combine to develop several operational issues, including:

- Voltage degradation.
- Limitations due to thermal current ratings of power lines.

- Decreased reliability and security of supply.
- Reduced quality of supply.

These issues can result in the potential need to augment the existing network to restore adequate levels of supply performance.

Demand management and other non-network alternatives can be employed to meet increased peak capacity requirements as an alternative to network augmentation.

11.1 Demand Management Implementations

Each specific demand management or non-network alternative can be placed into one of the following three broad demand management and non-network alternative implementations

11.1.1 Peak Shifting Strategies

Peak shifting involves moving load (or generation) outside the peak period. The total energy used is approximately the same, disregarding any efficiency losses or benefits. Examples include controlled load, energy storage and demand-related tariffs.

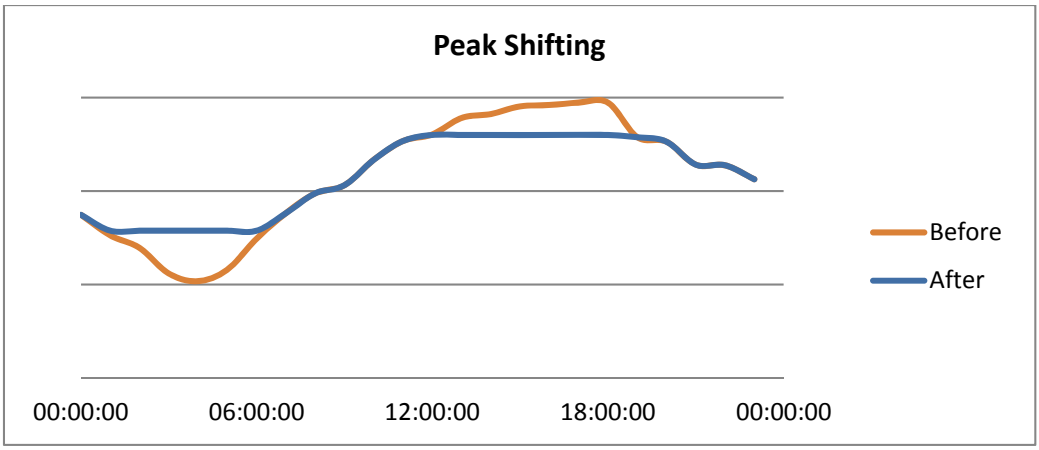

Figure 10 – The Impact of Peak Shifting

11.1.2 Peak Lopping Strategies

Peak lopping involves removing load (or generation) from the peak period. In doing so, total energy used is also reduced. Examples include specific efficiency programs and peak generation.

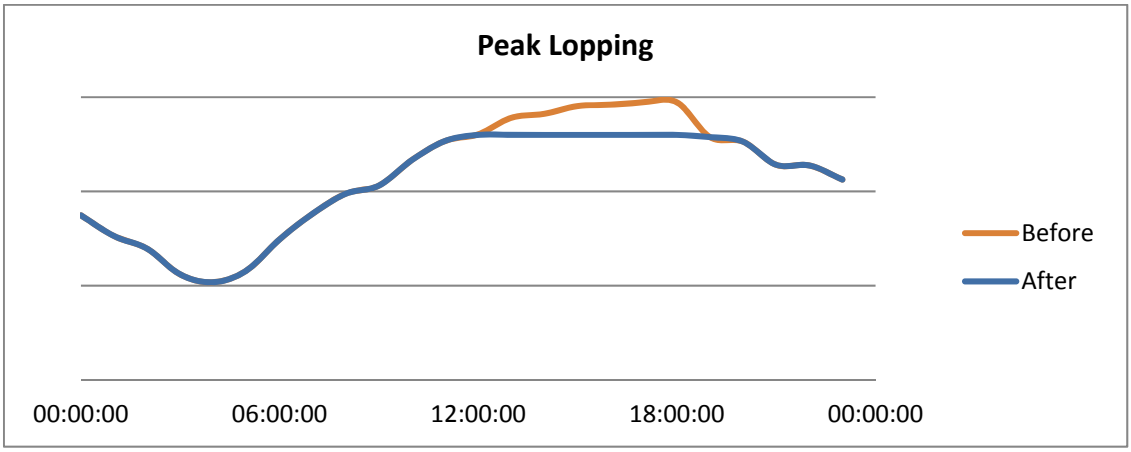

Figure 11 – The Impact of Peak Lopping

11.1.3 General Demand Reduction Strategies

General demand reduction strategies involve reducing the demand (or generation) across the broader load profile. In doing so, total energy used is also reduced. Examples include power factor correction, distributed generation and fuel switching.

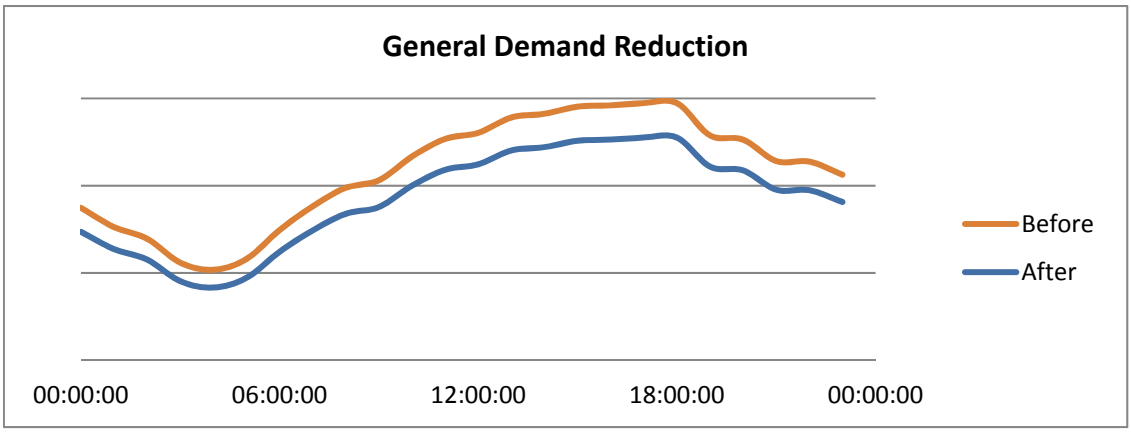

Figure 12 – The Impact of Demand Reduction

11.2 Demand Management Solutions

The demand management and non-network alternatives definition as outlined above includes, but is not limited to, the following demand management and non-network alternatives solutions.

11.2.1 Demand Response or Load Curtailment

A form of peak lopping, demand response or load curtailment is achieved by agreeing with larger customers that we can curtail their load in times of extreme system conditions. We do this through various levels of automation, either directly or through a third party service provider.

11.2.2 Controlled Load

Controlled load activities such as off-peak hot water, pool pumping, slab heating and controlled cycling of air-conditioning are designed to shift or reduce peak load on the electricity system as a whole, or on particular parts of the system.

Essential Energy has a well-established off-peak tariff structure which we devised to shift electric water heating and slab heating load from peak periods to low load periods to reduce peak load and improve load factor.

By controlling customer load timing and/or duration, it is possible to supply existing electrical loads while decreasing stress on the network during peak periods. This flexibility allows us to further manage network infrastructure expenditure.

11.2.3 Fuel Substitution

Fuel substitution involves encouraging customers to change fuels from electricity to another more efficient fuel source, such as natural gas, for heating and cooking. We have implemented fuel conversion programs for residential customers in the past for identified areas where local network constraints have emerged.

11.2.4 Embedded Generation

Distributed generation (embedded generation) refers to electricity generation that is connected within a customer's or distributor's network rather than within the transmission network.

Implementing embedded generation involves connecting small- to medium-sized generators to the distribution network. Distributed generators are sometimes located close to electricity loads or may be linked to industrial processes. The implementation of distributed generation sources reduces the load requirement from the upstream network. Other side benefits include reduced network losses and reduced greenhouse gas emissions.

There are many examples of embedded generation facilities currently operating within Essential Energy's service area, including small co-generation power stations associated with sugar mills, small hydro-electric generation stations, wind farms and solar generators. Improved versions of embedded generation are obtained through co-generation, which uses the otherwise wasted heat from the generator to increase overall generating plant efficiency.

There are large gas fields to the north of Essential Energy's territory and gas pipelines operate through the central and southern regions. The gas pipelines provide opportunities for gas-fired generation.

In recent years, we have received more applications from wind energy generation proponents. Other embedded generation opportunities exist for solar power generation, biomass generation and remote area power systems. However, many renewable energy production opportunities or sources tend to be remote from major network infrastructure.

We would normally only consider distributed generation as a demand management function where we can rely on it to be available when required at specific peak times of the day so it enables us to postpone or avoid network upgrades. Examples include generation systems that have inherently high availability, such as stand-by generators or systems with adequate energy storage capacity. We do not normally offer firm capacity for single-shaft installations. Generators that can be demonstrated to provide capacity coincident with system peaks may also qualify.

In addition to providing the necessary network connection infrastructure, there are significant additional network planning processes involved with distributed generation. These include network connection planning, derivation of generator connection charges, commercial negotiations, commercial and technical administration and other related work arising from the need for greater liaison with the Australian Energy Market Operator (AEMO).

11.2.5 Energy Storage

Energy storage involves charging an energy storage system outside the peak period with the aim of using stored energy within the peak period. It can be in the form of chemical storage, such as batteries; thermal, such as chilled water storage for air-conditioning: or gravitational, such as pumped water storage. Essential Energy has experience in both lead acid storage solutions and lithium ion storage solutions for peak shifting applications.

11.2.6 Power Factor Correction

A certain power factor is required by regulation. Beyond this, Essential Energy, by installing capacitor banks at customer load bus bars and zone substations, can decrease reactive power flow over distribution lines and significantly improve network performance by reducing load flow associated with poor power factor loads. We have used capacitors in the past at the zone substation and feeder level to decrease demand.

Essential Energy is also able to substantially improve the power factor by increasing voltage through installing capacitors in the network.

11.2.7 Increased End-User Efficiency

To decrease the general demand profile, our energy efficiency programs target single large customers and groups of customers with similar usage patterns. The cost of engaging these customers are generally lower, while smaller customers often provide more scalability of solutions.

We promote: higher-efficiency equipment and appliances; process and facility management improvements; reducing wastage by installing thermal insulation or waste heat capture equipment; installing hot water flow restrictors; efficient building design; and general education on energy usage.

Energy efficiency strategies are particularly important for those parts of the subtransmission and distribution network where emerging constraints are evident and where there is high residential growth.

11.2.8 Decreased Losses

Decreasing losses in network assets such as cables and transformers beyond prescribed service requirements (i.e. minimum costs) can have a positive impact on the overall cost to the customer when the reduction in peak demand is considered.

11.2.9 Demand-related Tariffs

One approach to shifting demand is to apply economic pricing principles when setting network prices and structures. Efficient network prices are a mechanism for encouraging and educating energy users about the consequences of their energy usage and the cost of providing supply capacity in the network.

Our efficiency-based network prices include time of use and demand time of use tariffs. Demand is the primary driver for our network capacity investment, so a demand-based network pricing structure more closely reflects the economic costs of providing capacity and sends a pricing signal to customers.

Implementing and promoting efficient network prices is an integral component of Essential Energy's network pricing strategy. We have been doing this since full retail competition was introduced and will continue it into the future.

A related area for further development is interval metering. The meter data facilitates the development of network price structures that send appropriate signals to customers to better manage their demand.

11.2.10 RAPS and Other Alternative Network Options

A remote area power system or stand-alone power system is one that is not connected to the normal distribution network. It may provide a suitable level of service for a customer at a lower cost than an extension to the electricity network.

Where this is the case, we advise the connection applicant. If the required network extension will be less efficient from an economic and environmental perspective, the applicant bears the costs of connection and any necessary augmentation.

Essential Energy recognises the important contribution of remote area power systems and encourages the use of stand-alone generation where connection to the network would be uneconomic.

11.2.11 Conservation Voltage Reduction

Conservation Voltage Reduction is reduction of voltage to the consumer that results in either a demand reduction or an energy and demand reduction. While we are committed to providing optimal power quality standards and voltage levels, for some loads the optimal voltage level may be below what is currently being delivered. We will continue exploring the best ways to meet customers' expectations while providing the best value outcomes.