APPENDIX 17

Demand management program

Energex

Demand Management Program

2015 - 2020

Asset Management Division

energex

positive energy

Version control

Version	Date	Description
1	21/10/2014	Final version for submission

Energex Limited (Energex) is a Queensland Government Owned Corporation that builds, owns, operates and maintains the electricity distribution network in the growing region of South East Queensland. Energex provides distribution services to almost 1.4 million domestic and business connections, delivering electricity to a population base of around 3.2 million people.

Energex's key focus is distributing safe, reliable and affordable electricity in a commercially balanced way that provides value for its customers, manages risk and builds a sustainable future.

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1 Executive Summary

Energex Limited (Energex) is a Queensland Government Owned Corporation (GOC) that builds, owns, operates and maintains the electricity distribution network in South East Queensland (SEQ). Energex provides distribution services to more than 1.4 million domestic and business customers and delivers electricity to a population base of around 3.2 million people. Energex's network covers around 25,000 square kilometres, stretching from Gympie in the north to Withcott in the west, Stradbroke Island in the east and Coolangatta in the south. Energex's assets include approximately 52,000 kilometres of underground cables and overhead lines, 662,000 power poles, 48,000 distribution transformers, 280 zone and bulk supply substations, and 349,000 street lights[1].

Energex has a number of corporate strategies in place to manage its network to deliver balanced outcomes that meet the needs of its customers. One such strategy relates to the management of peak electricity demand on the Energex network. High levels of peak demand relative to overall network utilisation drive a need to invest more capital in network capacity which is required for very short periods of time. This is an expensive solution to a temporary and intermittent problem.

Demand Management (DM) has been a critical component in the efficient design; construction and operation of the Energex network, from the LV network through to bulk supply substations, for decades and has helped contribute to the record low levels of forecast growth related augmentation in 2015-2020. Energex has managed residential hot water load as part of its business-as-usual operations for several decades and this program has been developed and refined over the years. This hot water load management program provides a significant reduction (over 550 MVA diversified[2]) for winter peak demand and, if this load control capability did not exist, Energex would have needed to build additional network capacity to meet this demand.

While growth in demand has reduced recently, in response to a range of factors (reduced consumption, mild weather, etc.); long term forecasts generally indicate future growth in localised peak demand which will lead to a renewed need for additional investment in network capacity. When effectively implemented as a first response solution as part of Energex's everyday operations, DM will continue to reduce localised forward growth in demand resulting in lower future infrastructure related electricity costs for consumers and will also enable more efficient management of technical issues on the Energex network.

Through establishment and delivery of its DM programs, Energex has facilitated the development of a market for DM products and services (including air-conditioning, Power Factor Correction (PFC) and pool pumps). Customers have responded strongly and embraced the choice and cost savings that Energex's DM programs offer through discounted tariffs and direct incentives. This is evidenced by strong participation rates with more than 65 per cent of residential customers enrolled in a DM program and with more than 80,000

1 2013/14 Energex Annual Performance Report

2 Because not all customers use electricity at exactly the same time or in the same way, there is a natural "diversity" of usage between customers. Hence the magnitude of customer connected load is typically much higher than the diversified load seen at a local network level. Diversified load is the coincident load that contributes to times of peak demand.

customers joining the programs in the 2010-2015 period. Results from recent customer research[3] demonstrate that customers believe Energex has a strong responsibility for DM and see it as an important community initiative.

Energex is well placed to leverage the considerable DM capability to reduce costs for consumers in the longer term as well as continuing to provide customers with a range of options to help reduce electricity costs in the short term.

1.1.1 Current Regulatory Period 2010-2015

In 2009/10, Energex set a demand reduction target of 144 MVA for the current regulatory period 2010 - 2015. This target was used to reduce the total system peak demand forecast by 144 MVA. As of June 2014, 88% (126 MVA) of the regulatory period target has already been achieved, and Energex remains well on track to achieve its five year goal by June 2015. The DM program, funded via both the Australian Energy Regulator's (AER) approved DM operating allowance and the Department of Energy and Water Supply (DEWS) (formally the Office of Clean Energy) has achieved these outcomes at a significantly reduced cost than was originally budgeted. For the AER Determination 2010 – 2015, Energex was allowed $165[4] million of expenditure, escalated into 2014/15 dollars ($132[5] million opex and $33 million of capex). The estimated total opex and capex expenditure to be incurred by June 2015 is $90[6] million. When escalated into 2014/15 dollars, this equates to $95 million[7] ($83.5 million opex and $11.5 million capex).

The demand reduction target is also being delivered at a lower cost than originally budgeted for in the AER Regulatory Submission for Energex for 2010 – 2015. The reduced cost to serve is due to the scale of operations and the emergence of a market that has resulted through delivery of these programs. The delivery of Energex's DM programs at lower than expected cost reinforces the value proposition of DM to the Energex network. It has become increasingly clear that in many instances, there is a strong and positive commercial business case for these types of programs in preference to network solutions.

1.1.2 Key Drivers for DM

Along with the current slowing of demand growth, Energex has a window of opportunity to embed its DM strategies and programs into its business in preparation for (and helping to defer) the next growth phase. Given the lead times required to secure DM capability, it is essential that Energex continue to pursue DM over the next five year period to ensure that it has a full range of both network and non-network solutions readily available to address demand growth as it arises, in the most cost-effective way possible. Accordingly, investing in DM programs is an ongoing priority for the Energex business.

The key drivers for DM into the future are:

3 A copy of the research is available on the Energex website https://www.energex.com.au/__data/assets/pdf_file/0007/196126/Research-Summary-Report_v2_120314.pdf

4 The total figures do not include the $5 million of DMIA funding, which was managed from within a corporate budget.

5 The opex figure of $132 million includes $19.6 million for the Summer Preparedness program which concluded during the current regulatory period.

6 The total figures do not include actual DMIA expenditure of approximately $1.6 million.

7 The total AER expenditure to date is $74.7 million. The difference of $8.8 million relates to the seed funding from the Office of Clean Energy (Department of Employment, Economic Development, & Innovation – Qld Government),

- **Localised demand growth and network augmentation** - Demand is forecast to continue to grow at a localised level into the future which will lead to the need for DM as an alternative to capital investment for targeted augmentation of the network where it is demonstrated to be cost effective.

  Factors such as weather, consumer conservation, increasing energy efficiency of appliances and lighting, and growth in solar integrated with batteries will continue to affect demand growth, and these factors have been incorporated into Energex's forward projections for peak demand growth. However, even with these changes factored in, it is expected that in the longer term, there will continue to be demand growth and consequently network constraints at localised levels. This is supported by independent commentators such as Australian Energy Market Operator (AEMO) and National Institute of Economic and Industry Research (NIEIR). Additionally, if Energex fails to sustain current DM programs and operations, then the forecast future localised growth in peak demand will be further exacerbated by the uncontrolled return of load to the network at peak times, which is currently managed through DM programs.

  By continuing to empower customers with a range of DM product choices, and when effectively implemented as a first response solution as part of Energex's everyday operations, DM will reduce forward growth in demand resulting in lower future infrastructure related electricity costs for consumers.

- **Regulatory obligations** - Non-network assessments and the Distribution Network Planning and Expansion Framework rule change Energex fully supports the RIT-D process as the minimum requirement when considering network investment alternatives, including non-network options. Further, Energex runs targeted DM programs in areas where there is expected network investment in the medium term where it can be shown that DM can cost effectively defer that investment.

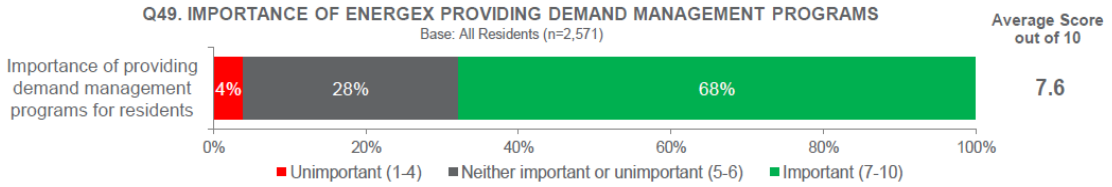
- **Load control capability** - Energex has successfully undertaken hot water load control programs for many decades, providing significant peak load reductions. It is important to maintain and expand this capability into the future as a major tool for effective network management and to match changing customer load profiles brought on by changes in behaviour as well as by distributed generation.

- **Customer expectations** - Recent research[8] commissioned by Energex as part of broader customer engagement analysis, highlights that the majority of residential customers are concerned about their electricity bills and are actively seeking options to reduce electricity costs. When engaged in discussions about DM, customers indicated that they consider DM programs to be an important community initiative, which Energex should be responsible for and actively promote9. This is shown below in Figure 1.

8 A copy of the research is available on the Energex website https://www.energex.com.au/__data/assets/pdf_file/0007/196126/Research-Summary-Report_v2_120314.pdf

9 Colmar Brunton Customer Engagement Research February 2014

Figure 1 – Customer research on DM Programs



Energex's programs have been successfully providing choice and delivering value for customers for many decades now as evidenced by a greater than 65 per cent participation in DM programs by residential customers. Over 80,000 customers have joined one of Energex's DM programs in the 2010-2015 period to take advantage of Energex's load control tariff savings and DM program incentives.

- **Developing a market to deliver DM** – By establishing and delivering its DM programs, Energex has enabled the development of a growing market for DM products and services (including hot water, air-conditioning, PFC and pool pumps). Industry sales channels have increasingly championed the growing range of DM products available and customers have strongly embraced the choice and cost savings that Energex's DM programs offer through discounted tariffs and direct incentives.

- **Emerging technologies and the ability for customers to generate and store energy** - Emerging battery storage technologies, electric vehicles (EVs) and increased penetration of solar PV are going to continue to change the way customers use the energy network and work needs to continue to ensure maximum mutual benefit is derived from these technologies into the longer term, both for the network and for the customer.

1.1.3 DM Programs 2015 to 2020

The DM programs for 2015-2020 are focused on a combination of addressing constraints at localised zone substations and embedding DM capabilities into the network to prepare for anticipated future growth in customer demand due to emerging technology such as battery storage and EVs.

For the 2015 to 2020 regulatory period, Energex's approach to targeting DM has become more sophisticated and has enabled the impact of DM to be better modelled at a localised zone substation level. Hence, the expected impacts of DM programs have been accounted for against individual substation load forecasts.

Details regarding the DM programs being proposed for 2015-2020 are detailed below.

- **Residential DM** – The residential program offers customers DM options for appliances that have been identified as having the most significant impact on residential peak demand. These programs provide customers with the ability to manage their electricity costs while addressing the major drivers of residential peak demand being hot water systems, air-conditioners and pool pumps (and potentially in the future batteries and EVs).

- **Load management, DM strategy, compliance and reporting** – This program encompasses the ongoing management of the successful load control system (LCS), including better optimisation of the LCS and monitoring its operational integrity. The program also includes further development of DM strategies (including customer engagement and education), reporting obligations to the Technical Regulator, the Queensland government and the AER.

- **Business DM** – Energex supports the regulatory investment test for distribution (RIT-D) as a minimum obligation when considering network investment alternatives. In addition, Energex runs programs to embed DM into specific targeted areas where it is financially justified, in the years prior to a network constraint arising and the RIT-D process commencing. Business customers within targeted areas are incentivised to participate in programs to reduce load at peak times. The targeted areas are updated bi-annually and published on the Energex website.

- **Small to medium enterprises (SME) DM** – Whilst the customer sectors of residential and larger businesses have been well catered for in existing DM programs, the sector where Energex has so far only allocated limited resources and had limited success is in the SME market. Generically SME customers are not strictly customers of only a particular tariff class but rather cover a range of customer types. From an electricity network (and demand) perspective some SME's are very similar to residential customers, while others may have more in common with large business customers.

  The possible DM solutions that could be deployed may include Energex's range of residential products such as PeakSmart air-conditioning or any of a number of business solutions such as improvements to building management systems, PFC, or demand response etc.

- **Demand Management and Innovation Allowance (DMIA)** – There are a number of proposed innovative projects to investigate options to manage demand that are outlined in the document DMIA Proposals 2015 – 2020 Asset Management Division.

- **Tariff reform** – DM has had measureable success in market penetration when implemented in conjunction with the load control network tariffs. The historical success of customer enrolment in load control tariffs (gazetted retail Tariff 31 and Tariff 33) indicates the penetration that price signals can achieve in conjunction well-constructed DM products. DM will continue to advocate appropriate tariff reform to support the network and to provide options for customers to manage their electricity costs.

  In the meantime, Energex will continue to incentivise customers directly to enrol in programs as has been done successfully for some time through the Energex's Positive Payback programs. This strategy allows Energex to target incentives to the principal drivers of demand and DM products, such as PeakSmart air-conditioners as well as shaping incentives to drive support through supporting market channels (e.g. air-conditioning retailers). As new tariffs or price signals are developed, these programs will be transitioned away from direct incentives. The use of direct incentives to support tariffs allows Energex and the DM market to target and engage with customers directly.

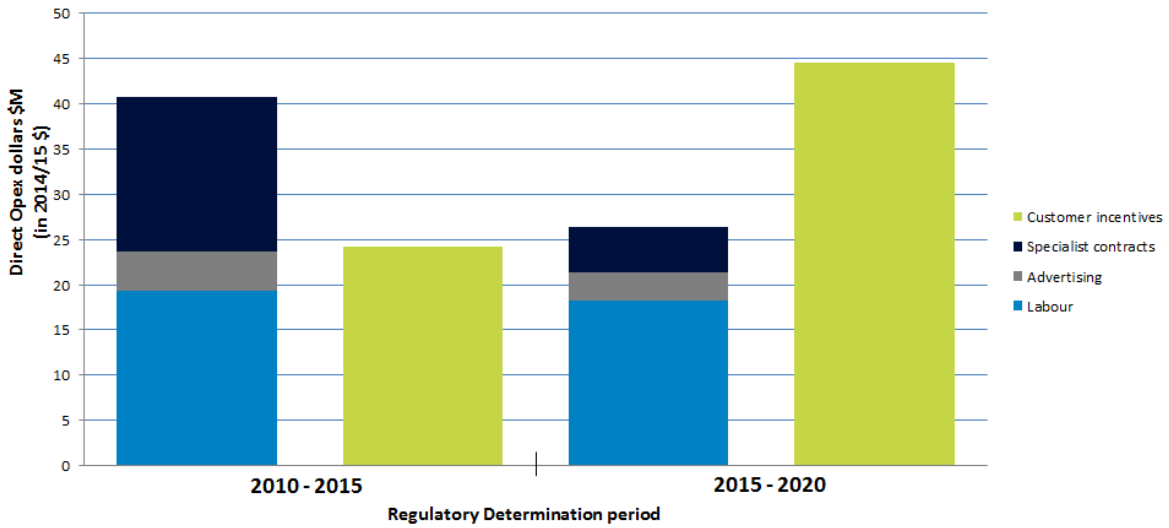
1.1.4 DM Opex Budget Summary & Cost Comparison

The total opex expenditure forecast to run the proposed DM programs in 2015 - 2020 is $95.3 million in 2014/15 dollars to achieve a total load under management of 170 MVA. Detailed modelling, outlined later in this document, shows that the proposed DM programs achieve an overall NPV benefit of $75.1 million. The proposed opex expenditure of $95.3 million includes $5.8 million for the continuing Bromelton deferral project (refer to Section 7.1.2 in Business DM).

The unit cost of delivering DM is continuing to decrease, building on efficiencies already established. In 2010 – 2015, $24 million of total funding was provided as direct incentives to customers whereas in 2015 – 2020 customer incentives accounts for $44 million.

Figure 2 below highlights how the proposed DM opex budget for 2015-2020 has reduced when compared to the program costs for the current regulatory period 2010 - 2015. As the program has gradually been improved and benefited from the establishment of supportive markets, relatively more of the program costs are able to be passed to customers in the form of DM incentives. This cost effectiveness is a critical driver for the 2015 - 2020 programs which also aim to gain a significant increase in the uptake of DM products when compared with that of 2010 - 2015.

Figure 2 - Comparison of DM Program Costs 2010-15 / 2015-20



The objective of the proposed 2015 - 2020 program is to continue to build on the foundation established in the 2010 - 2015 regulatory period and to deliver more load under control for less cost, thereby producing improved cost benefits to customers. The increased number of DM products will represent a greater uptake of options for customers to reduce their electricity costs which will result in longer term cost reductions for electricity consumers.

2 DM journey from 2010-2015

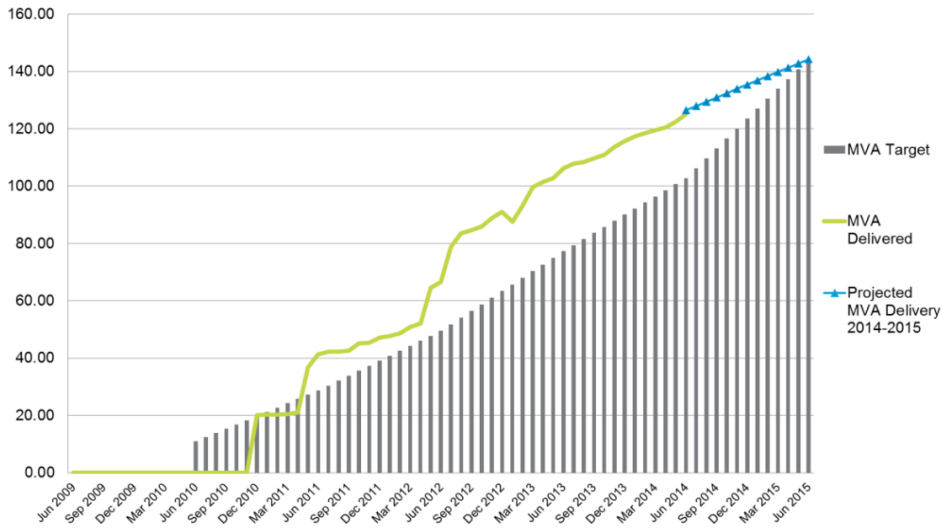
DM has been a critical component in the efficient design, construction and operation of the Energex network from the LV network through to bulk supply substations for decades and has helped contribute to the record low levels of growth related augmentation that is forecast in 2015 - 2020. Energex has managed residential hot water load as part of its business-as-usual operations for several decades and this program has been developed and refined over the years. This hot water load management program has resulted in a significant reduction (over 550 MVA diversified[10]) in winter peak demand. If this load control capability did not exist Energex would have to build additional capacity to meet the peak demand that this capability has been shifting. The peak load reductions are factored into Energex's forecast growth which in turn filters into technical design of new network and, in this fashion, the DM programs continue to have a significant impact on reducing network augmentation costs.

Energex has been working for a number of years to develop additional DM capability to address summer peak demand with the same success as hot water load control has delivered to winter peak demand. This capability is now well advanced and Energex is well placed to leverage the foundation it has built to grow a critical mass of peak DM into the future. Progress made in Energex's current DM program is outlined below.

2.1.1 Current Energex DM Programs (Regulatory Period 2010-2015)

For the 2010-2015 Regulatory Determination, Energex committed to reduce peak demand by 144 MVA. Energex is well on track to achieve this target of (at least) 144 MVA of peak load reduction by 2015 (refer to Figure 3). This new load under control has been removed from forecast peak load growth resulting in reduced growth driven capital expenditure.

Figure 3 - Energex DM Program 2010 to 2015 as at 30 June 2014 (144 MVA target)



10 Because not all customers use energy at exactly the same time and in the same way, there is a natural "diversity" of usage between customers. Hence the magnitude of customer connected load is typically much higher than the diversified load seen at a local network level.

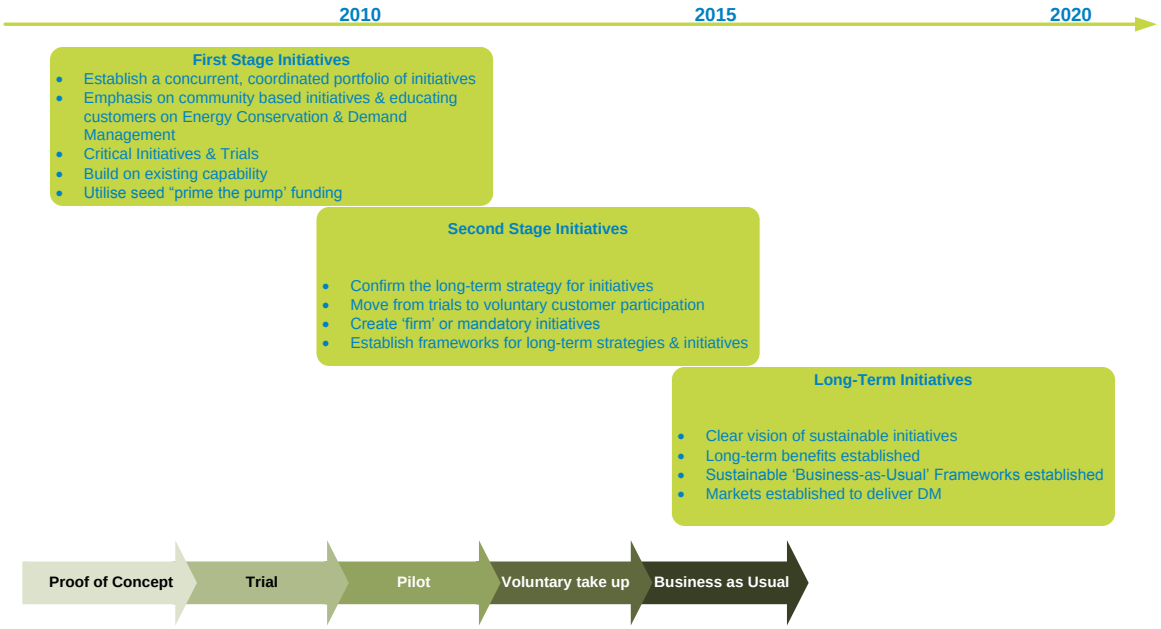
Energex is also on track to deliver the DM programs at a lower than planned cost. The projected total expenditure is $95 million opex and capex compared with $165 million approved in the 2010 - 2015 determination. This reduced cost to serve is due to a number of efficiencies including the development of markets and delivery channels that support these programs.

By establishing and delivering its DM programs, Energex has facilitated development of a market for DM products and services (including air-conditioning, PFC and pool pumps). Customers have responded strongly and embraced the choice and cost savings that Energex's DM programs offer through discounted tariffs and direct incentives. These established DM products and markets form a firm foundation for DM initiatives to continue to build upon in the coming 2015-2020 regulatory period.

2.1.2 DM program success to date (2008 – Current)

Established in 2008, through seed funding provided by the Office of Clean Energy (Department of Employment, Economic Development, & Innovation – Qld Government), Energex's initial Energy Conservation & DM program laid out a staged process where initiatives were tested, piloted and expanded to ensure only cost effective and sustainable programs were progressed to an operational state (illustrated in Figure 4).

Figure 4 - DM strategy 2008 - 2015



By testing, trialling and proving concepts, Energex was able to approach the AER with a firm set of proposed initiatives for the 2010-2015 Regulatory Determination period. These programs are listed with progress made to date in Table 1 and Table 2 below.

Table 1 - Residential DM programs 2010 - 2015 performance outcomes

Programs			Target MVA 2010-2015	Actual MVA 2010 - 2014	Actual MVA	Performance outcomes as at June 2014
DM program	Residential programs	**Residential DM Programs:** Continue to expand existing broad-based residential programs, including direct load control of air-conditioners, pool pumps, hot water systems combined with energy efficiency measure where appropriate	67 MVA	**48.7 MVA**	Hot Water Load Control **13.6 MVA**	• Reduced barriers to customers participating in load control tariffs • Engaging with industry channels to encourage customers to switch to load control tariffs. Over 1500 rebates paid to customers • Optimised the (AFLC) Load control program to increase load under control
					Pool Pump Peak Load Reduction **15.0 MVA**	• Over 13,500 rebates paid to customers switching their pools to (Tariff 33) off-peak load control or purchasing and installing 5 star rated or better energy efficient pumps. • Over 19,000 pool pumps are connected as a result of the Positive Payback campaign • Engaging industry channels to overcome barriers to off-peak pool load control
					Air-conditioning Direct Load Control **20.1 MVA**	• Over 27,000 air-conditioners enrolled in the program since 2008 through Cool Change & ECC (now disbanded as the PeakSmart program is well established) • Of this number, over 13,000 activated PeakSmart air-conditioning units with strong manufacturer support • Strong industry sales & installation support & strong delivery channels established
						• **Yourpowerqld.com.au** established as a 'one stop portal' for energy information in Queensland. • There have been 126,557 recorded users of the website since its inception
		RBT: Development of reward based tariff structure trial	Delivery of a trial report defining & quantifying the impact that 1) Consumption Tariffs & 2) Capacity Tariffs have on residential peak demand			Trial demonstrates an 17-23% average **household consumption reduction** during peak events
		Energy Conservation Communities:	Work with communities to provide ways to reduce demand & conserve energy			Targeted residential campaigns designed to educate customers about DM initiatives, reduce peak demand & establish delivery models for DM programs Actual MVA included above.

Table 2 – C&I DM programs 2010 to 2015 performance outcomes

Programs			2010-2015 Targets	Detail	Actual MVA	Performance outcomes as at June 2014
DM program	C&I	**C&I:** Provide EC&DM projects that match Commercial & Industrial customers with appropriate technology solutions to deliver whole network benefits	77 MVA	PFC, Demand Response (Embedded Generation & Load Curtailments), Energy Efficiency	**77.6 MVA** of either peak load reduction in place & avoidable loads contracted	• 20.5 MVA of demand reduction gained by power factor improvements • 10.5 MVA of permanent demand reduction through energy efficiency (lighting, HVAC, refrigeration and motors) • 46.6 MVA of demand response through generation and load curtailment. • The average cost to serve from 2010 to 2014 has been $215/MVA. • Strong and increasing support from suppliers and manufacturers • Repeated collaboration with dozens of nationally recognised brands • Multiple collaborations with local councils on energy efficiency initiatives for small-medium enterprises, better building working groups, district energy feasibility projects

2.1.3 Residential program - hot water DM

Approximately 65% of Energex's residential customers are currently connected to a controlled load tariff with Energex currently controlling 550 MVA (diversified) of peak loads in winter and 150 MVA (diversified) of peak loads in summer, providing significant capability for network management. The high penetration of hot water DM participation (currently 65 per cent of residential customers) sustained over a long period of time provides Energex with a strong background in successfully engaging residential customers in DM programs.

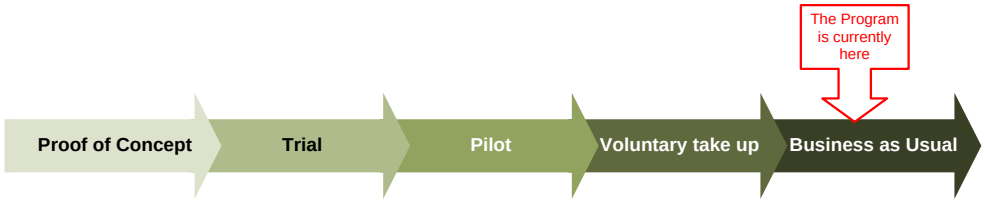
The two network tariffs offered are:

- NTC 9100 (gazetted retail Tariff 33) - supply is provided for a minimum of 18 hours per day, with control generally only occurring during peak load periods
- NTC 9000 (gazetted retail Tariff 31) - a night rate tariff typically for larger hot water systems with supply being provided for eight hours overnight.

Although a large percentage of customers already have hot water systems connected to these tariffs, the take-up rate in new homes has dropped significantly since the early 2000's. This is the driver for the residential hot water program.

Figure 5 provides information on the performance outcomes of the hot water DM program.

Figure 5 - Hot water DM project stage and outcomes



Hot water 2010-2015 Regulatory Determination performance outcomes (as at June 2014)

- Against a background of gradual decline in hot water load under control, this DM program has re-established interest in hot water load control in the market, achieving an additional 13.6 MVA of (diversified) hot water peak load under control and adding to Energex's already considerable DM program. This has been achieved through:
    - Reducing barriers to customers participating in hot water load control tariffs
    - Engaging industry channels to encourage customers to switch to off-peak tariffs
    - Optimising the (AFLC) load control programs to increase load under control

2.1.4 Residential program - pool pump DM

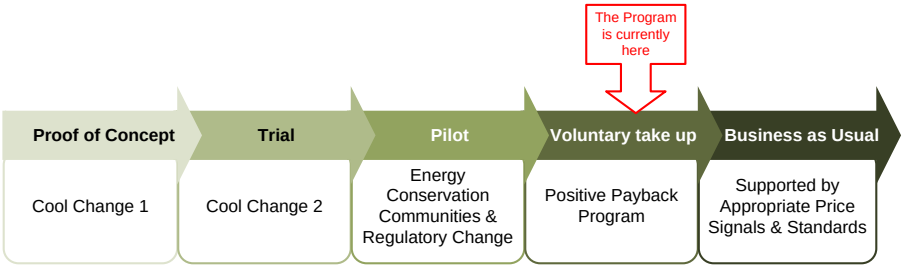
Pool pumps are one of the largest appliance loads in many households and often run coincident to residential peaks exacerbating peak demand. In similar fashion to electric hot water systems, a large number of pool pumps are also connected to off-peak control tariffs with approximately 34 per cent of the 280,000 pools on the Energex network currently connected to Tariff 33. Five years ago, Energex began working with the pool industry to understand why only 5 per cent of new pools were being connected to off-peak load control tariffs. This work found that there was a lack of industry support because:

- Connection was potentially expensive because of hard wiring requirements
- Hard wiring requirements drive extra costs to connect / reconnect pool pumps for servicing purposes
- Pool servicing is difficult if power is cut off during variable load control events.

Energex successfully addressed these industry concerns by working jointly with the Queensland Government and Ergon Energy to change tariff connection requirements. These changes have been implemented as part of the Energex Positive Payback campaign. The tariff connection requirements work also occurred in parallel with other developments in the pool pump market, specifically the evolution of new energy efficient pumps. As these pumps can also provide significant demand reduction savings during domestic peak load times, their use was also included in the pool pump DM program. Now over 19,000 controlled and/or

energy efficient pool pumps have been added to Energex DM programs. Figure 6 provides information on the performance outcomes of the pool pump DM program.

Figure 6 - Pool pump DM project stage and outcomes



Pool pump 2010-2015 Regulatory Determination performance outcomes (as at June 2014)

- 15 MVA of (diversified) pool peak load reduction through:
    - Over 13,500 rebates paid to customers switching their pools to (Tariff 33) off-peak load control or purchasing and installing 5 star rated or better energy efficient pumps
    - Over 19,000 pool pumps connected due to the Positive Payback campaign
    - Engaging industry channels to overcome barriers to off-peak pool load control

Energex has further strengthened its ability to deal with industry third party delivery channels through successful engagement with pool pump manufacturing and installation parties who are now very supportive of pool pump peak DM. Some further work is required to embed pool energy efficiency standards but pool industry channels are currently delivering the bulk of these solutions to customers as part of everyday business reducing Energex's cost of delivery.

2.1.5 Residential program - air-conditioning DM

Energex has developed and implemented considerable residential air-conditioning DM capabilities through a range of trials and subsequent programs culminating in the successful launch of Energex's broad-based PeakSmart program. Through these progressive programs, Energex has enrolled over 27,000 air-conditioners in DM programs since 2008 (as at June 2014).

These programs are designed to address the growth in air-conditioning loads at peak times across the Energex network. The national stock of air-conditioners more than doubled in the 10 years to 2008, and by 2020, the associated use of electricity is projected to be five times greater than it was in 1990. Rising incomes and the declining cost of air-conditioners are key causes of this trend. Other factors include increasing housing size and density and the increasing use of multiple air-conditioners and ducted systems (particularly by higher income households). Air-conditioners contribute significantly to peak loads despite often being used for relatively short periods of time, resulting in very poor load factor. Much of the air-conditioning stock installed in the late 1990's and early 2000's is now coming to its end of life and an opportunity to replace this stock with demand response activated units is emerging.

2.1.5.1 Cool Change Trials and Energy Conservation Communities (ECC)

Energex was one of the first DNSPs to trial air-conditioning DM (compressor cycling load control) through the Energex Cool Change I & II trials beginning in 2008. These trials involved over 2,000 customer air-conditioners and demonstrated that:

- Customers are positively responsive to air-conditioning DM
- Significant peak load reductions can be achieved through air-conditioning DM.

Energex expanded these trials into targeted Energy Conservation Communities which subsequently demonstrated that such air-conditioning programs can be cost-effectively delivered on a large scale. The Energy Conservation Communities program has overseen the installation of over 13,000 retrofit air-conditioning control devices in over 10,000 homes across multiple targeted areas further demonstrating strong acceptance for air-conditioning DM programs.

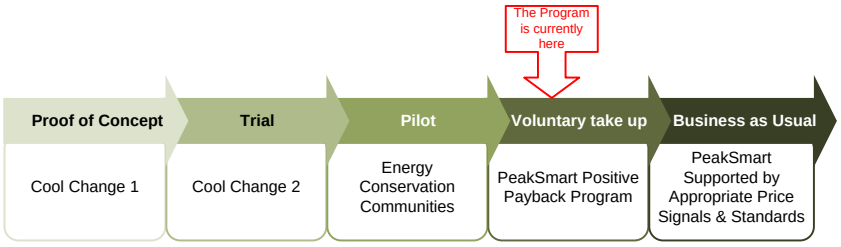
2.1.5.2 PeakSmart air-conditioning program

Using the experience developed from Cool Change and ECC, Energex has worked in parallel with the air-conditioning industry and installation channels, Energy Networks Association, other DNSPs and Standards Australia to assist in the development of the appliance demand response standards (AS4755) suite of solutions to address the peak demand challenge presented by air-conditioners (and other large appliances). Subsequently, the majority of major air-conditioning manufacturers have voluntarily commercialised demand response ready technology (as per published Australian standards – AS4755) into their unit ranges and made these available for sale in Queensland. Energex has subsequently worked with industry to develop Demand Response Enabling Devices (DREDs - signal receivers) that allow the demand response capabilities of these appliances to be activated by Energex's ripple (Audio Frequency Load Control - AFLC) load control system.

To activate these technologies and create a market opportunity, Energex has developed and launched the PeakSmart air-conditioning program which has been made available to customers across the Energex network (South East Queensland wide) from September 2012. By leveraging strong industry support, the PeakSmart delivery model builds on existing industry sales and installation channel efficiencies to deliver PeakSmart units to customers with Energex signal receivers (DREDs) connected at time of installation. The program has experienced strong support with over 13,000 PeakSmart air-conditioning activations to date. Energex believes that the positive support from key proponents across the air-conditioning industry value chain (manufacturers, appliance retailers and installers) further demonstrates that demand response appliance capabilities present a sustainable peak DM solution and valuable network management tool.

Energex is now established as a recognised leader in air-conditioning DM. Figure 7 provides information on the performance outcomes of the PeakSmart air-conditioning program.

Figure 7 - PeakSmart DM project stage and outcomes



2010-2015 Regulatory Determination performance outcomes (as at June 2014)

- Over 20.1 MVA of (diversified) peak load under control through:
    - Over 27,000 air-conditioners enrolled in the program since 2008 through Cool Change & ECC (now disbanded as the PeakSmart program is well established)
    - Of this number, over 13,000 are activated PeakSmart air-conditioning units with strong manufacturer support
    - Strong industry support & successful delivery channels established

2.1.6 Commercial and Industrial program

During the 2010–2015 Regulatory Determination period Energex improved its ability to assess and secure peak load reductions from commercial and industrial customers across the broader network.

At the outset, Energex's DM program for the 2010–2015 regulatory period was generally broad-based as the technology and processes were trialled with customers. The direction for the business DM program has changed now to be targeted for business customers in local areas where future peak load growth issues are anticipated. Business customers within the targeted areas are incentivised to participate in programs to reduce load at peak times. The targeted areas are updated bi-annually and published on the Energex website.

As part of this program Energex has successfully delivered 77.6 MVA of peak load reductions to June 2014 from a range of DM initiatives:

- 20.5 MVA of demand reduction gained by power factor improvements.
- 10.5 MVA of permanent demand reduction through energy efficiency (lighting, HVAC, refrigeration and motors).
- 46.6 MVA of demand response through generation and load curtailment.

Incentives offered to business customers to reduce network peak demand in targeted areas are advertised on the Energex website at https://www.energex.com.au/residential-and-business/commercial-and-industrial-initiative/eligible-areas. Both the areas and offers are revised bi-annually to ensure alignment with network characteristics, to reflect changes in planning criteria and to account for load reductions achieved. While the nature of this program means targets need to be updated periodically, the overall objective is to ensure that Energex secures savings through the deferment of future capital projects.

2.1.7 Load Control System (LCS)

Energex uses Audio Frequency Load Control (AFLC), which operates by the injection of a high frequency (1042 Hz) coded signal onto the high voltage network at Energex zone substations, to send DM signals to certain appliances. Through AFLC, loads at the customer's premises are controlled (turned off and on, or had their consumption reduced) from a centralised system for the purpose of reducing localised demand at a zone substation level. This LCS has been used to control hot water load since 1956.

In recent years, the LCS has been leveraged to manage other customer loads, such as pool pumps, demand response ready air-conditioning (AS4755) and EVs. As a result of these new customer loads, it is imperative that Energex ensures that the LCS remains robust, with its operation evolving to optimise these new types of load under control. The operational reliability of the entire LCS is now more important than ever due to the heightened visibility of control of these customer loads.

Furthermore, as deregulation of metering services evolves, Energex will be investigating its options to maintain load control capability particularly in the instances where metering ownership is lost or shared. Where possible, these options will be designed to optimise the operational life of the existing AFLC LCS to keep costs as low as possible for customers.

3 DM justification in 2015-2020

The DM Strategy Current to 2020 and Beyond (refer to Attachment 2) describes trends that are likely to emerge in the 2015-2020 period. This ranges from new drivers of demand to changing consumption patterns as market business models change and as customers acquire new technologies to manage their energy needs. At this stage, it is likely that the period between now and 2020 will see the emergence of technologies such as smart appliances, electric energy storage, EVs and smart home energy management systems. However, the rate at which these technologies will emerge and the ways in which customers will use these products is unclear.

Along with the current slowing of demand growth, Energex has a window of opportunity to embed its DM strategies and programs into its business in preparation for (and helping to defer) the next growth phase. Given the lead times required to secure DM capability, it is essential that Energex continue to pursue DM over the next five year period to ensure that it has a full range of both network and non-network solutions readily available to address demand growth as it arises, in the most cost-effective way possible. Accordingly, investing in DM programs remains a priority for the Energex business.

The key drivers for DM into the future are:

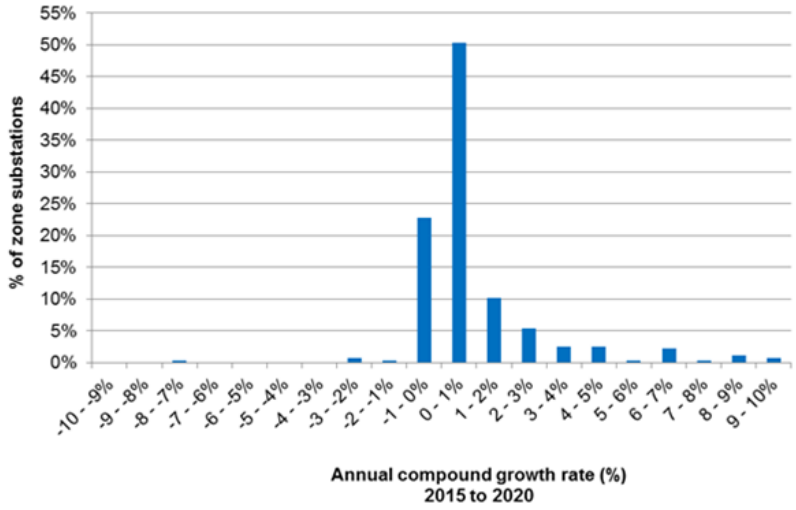
- Localised peak demand growth will continue to drive investment
- Regulatory obligations
- Load control capability
- Customer expectations and behaviour
- Established markets to deliver DM
- Emerging technologies and the ability for customers to generate and store energy
- Power of Choice and metering contestability

3.1.1 Localised Peak demand will continue to drive investment

Despite recent reductions in system demand growth, in combination due to mild weather, customer behaviour and increasing energy efficiency long-term demand forecasts consistently predict growth in localised peak demand (see Figure 8 below).

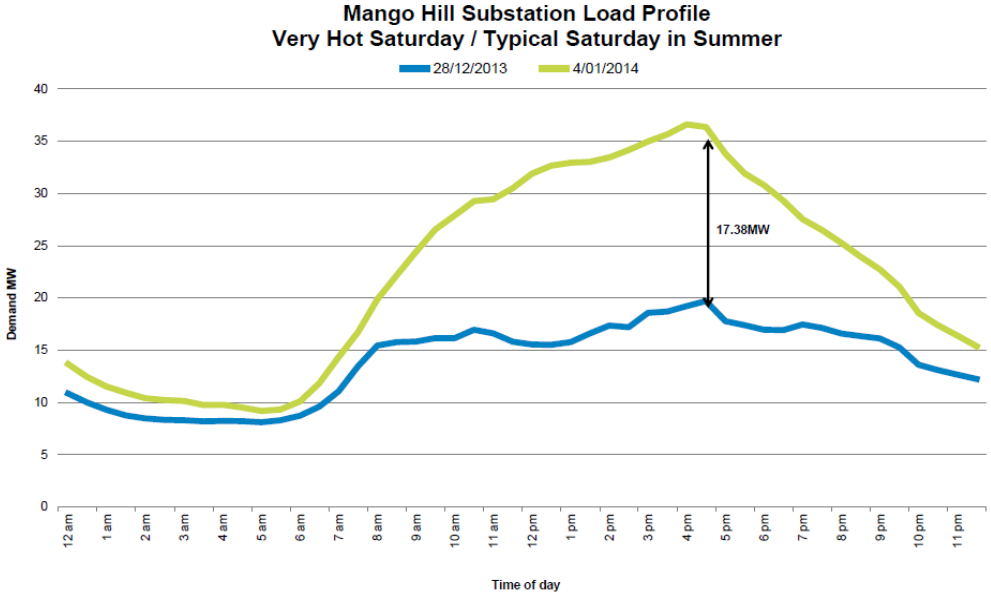
This is supported by the independent commentators such as AEMO and NIEIR. Additionally, if Energex fails to sustain current DM programs and operations, then the forecast future localised growth in peak demand will be further exacerbated by the return of load to the network at peak times, which is currently managed through DM programs.

Figure 8 - Forecast localised sub-station load growth 2015-2020



Another factor is that the Energex network is becoming more thermally sensitive, the 'peakiness' of network peak demand will continue to increase. Localised peak growth will, in turn, drive localised augmentation in the future and DM programs will help to reduce this growth related expenditure. Figure 9 below demonstrates the impact that thermal sensitivity has on peak demand by demonstrating the impact of temperature on substation peak load.

Figure 9 - Example of Thermal Sensitivity Relation to Peak Demand



Energex's DM programs give customers a range of choices to manage their energy and, by also reducing peak demand, will provide downward pressure on the cost of electricity in the longer term. By implementing cost effective DM programs Energex can improve network utilisation, improve load factor and ensure future growth related network investments are minimised.

3.1.2 Regulatory Obligations

The Distribution Network Planning and Expansion Framework rule change took effect on 1 January 2013 and introduced several demand side engagement obligations on Energex, including an obligation to engage with non-network providers and consider non-network options in accordance with Energex's published demand side engagement strategy. Energex fully supports the RIT-D process as the minimum requirement to consider all reasonable credible options, including non-network options without bias. Energex also considers non-network options earlier in the planning process to ensure that they won't be excluded for consideration due to timing. For this reason, Energex approaches network constraints from both the short term (less than five years away) and mid-term (up to ten years). This ensures more opportunity for DM initiatives to compete with supply side only options on an equal footing. The Brisbane CBD is a good example of an area which faces high future augmentation costs in the mid-term but also has a high concentration of business customers who may be able to provide DM solutions if given sufficient time to respond to incentives.

In keeping with recommendation 40 of the Queensland Government's Independent Review Panel[11] (IRP) which requires that "DM projects and activities should proceed only where a rigorous commercial assessment has been completed", all targeted areas are developed through a rigorous assessment of the difference in the net present value (NPV) of building capital projects with and without DM. This assessment closely parallels processes undertaken when preparing Energex regulatory submissions and RIT-Ds.

Energex's experience to date demonstrates that, even with significant financial incentives that provide a positive business case, that it can take a number of years for business to choose to invest to reducing their peak demand. Therefore, to provide the required level of certainty to defer or avoid capacity upgrade projects, targeted non-network activities require long lead times and commitment. This is equally true for businesses that provide DM products and services as well as those that participate in the programs.

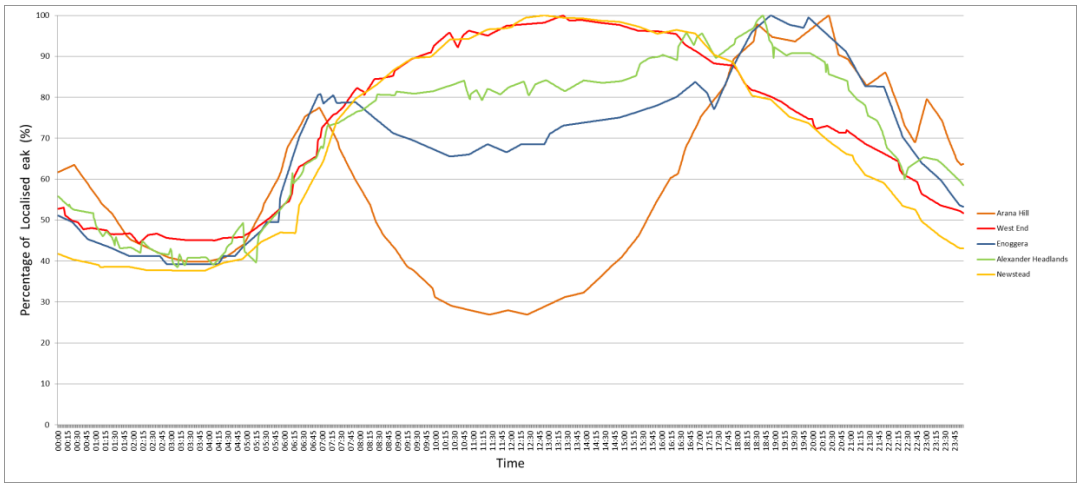
3.1.3 Load control capability

Energex has successfully undertaken hot water load control programs for many years, providing significant localised peak load reductions. The LCS has been further enhanced and developed to improve DM in two ways; firstly, the system can now manage new customer loads, such as pool pumps, demand response ready air-conditioning (under AS4755) and EVs, and; secondly, the LCS can now target localised peak demands at zone substation levels as opposed to a system wide peak demand. It is important to maintain and expand this capability into the future as a major tool for effective network management and to match changing customer load profiles brought on by changes in behaviour as well as by distributed generation.

Figure 10 below demonstrates the ways in which localised substation peaks occur at different times and during different seasons and are thereby thermally driven. The LCS is applied to target each of these peaks at a localised level and provides a valuable network management tool.

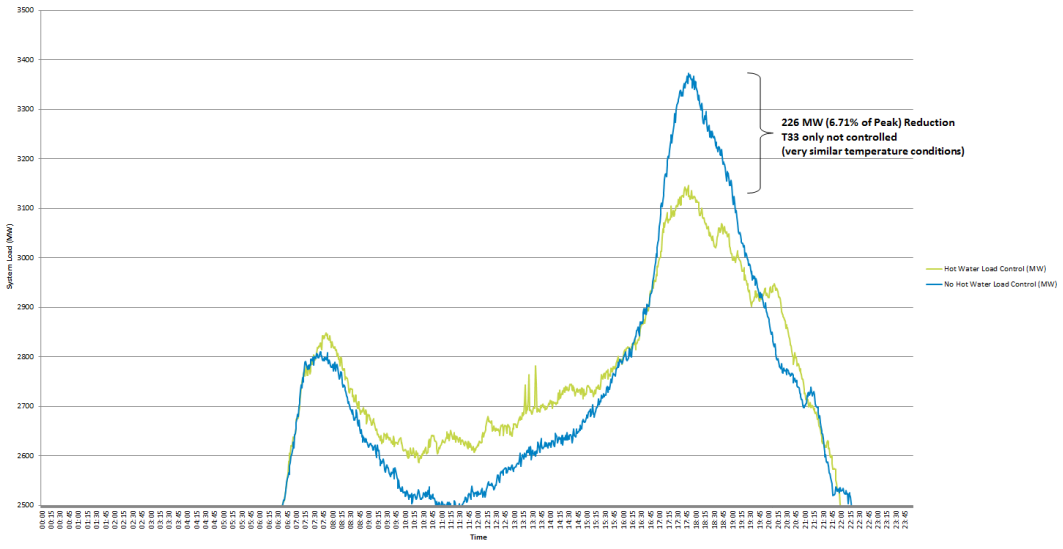
11 In 2012, the Queensland State Government engaged an independent review panel to investigate the impact of Queensland's electricity network prices and provide solutions for secure and cost-effective network. Refer final report http://www.dews.qld.gov.au/__data/assets/pdf_file/0010/78544/irp-final-report.pdf

Figure 10 - Variation in time and seasonality of localised network peaks



The LCS can also be applied to target different appliances at times of critical peaks. For instance, Figure 11 below demonstrates how hot water systems can be demand response activated to lop winter peaks in a targeted fashion. This figure highlights how the operation of gazetted retail Tariff 33 reduces peak demand when compared with a day with very similar temperature conditions where Tariff 33 is not operated.

Figure 11 – Hot Water Load Control & Peak Reduction

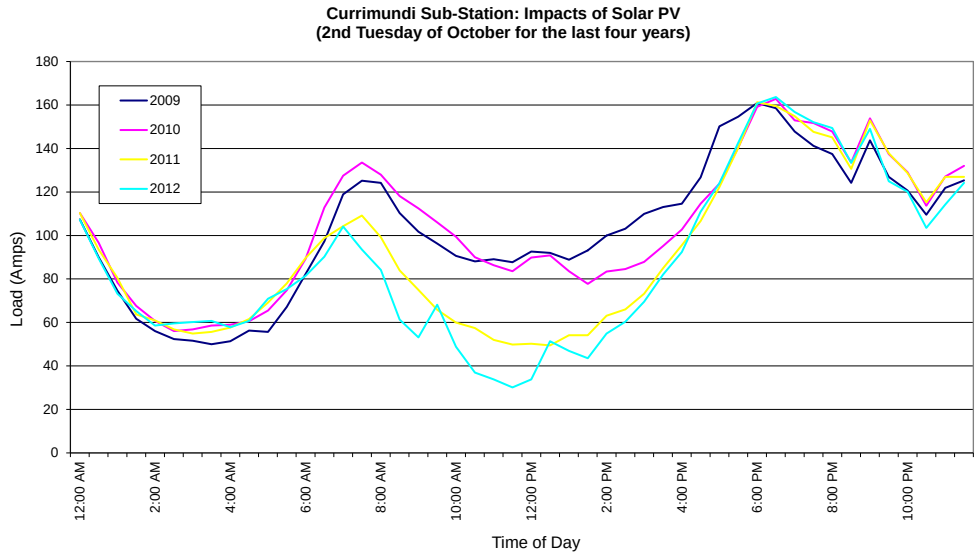


3.1.4 Customer Expectations & Behaviour

To reduce the impacts of rising electricity costs, many customers are modifying their behaviour to reduce consumption and are investing in solutions that will decrease their electricity costs, such as energy efficient appliances and solar PV. This is evidenced in the reducing consumption passing through the Energex network and also in ongoing growth in solar PV connections across the network.

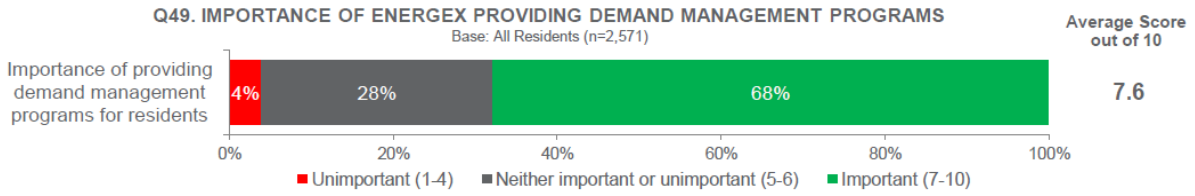
However, while these changes in behaviour are having a significant ongoing reduction in energy consumption they are not having a similar effect on peak demand. This is evidenced by the changing load curve demonstrated in Figure 12 below.

Figure 12 - Zone Sub-Station Yearly Comparison of Growing Impact of PV Generation



Recent research[12] commissioned by Energex as part of broader customer engagement analysis, highlights that the majority of residential customers are concerned about their electricity bills and are actively seeking options to bring costs down. Figure 13 shows that customers consider DM programs to be a strong option to help reduce electricity costs and view these programs as an important community initiative, which Energex should be responsible for and actively promote.

Figure 13 – Customer research on DM programs



Energex's programs have been successfully providing choice and delivering value for customers for many decades, now as evidenced by a greater than 65 per cent participation in DM programs by residential customers. Over 80,000 customers have joined one of Energex's DM programs in the 2010 - 2015 period to take advantage of Energex's load control tariff savings and DM program incentives. The historical success of customer enrolment in load control tariffs (gazetted retail Tariff 31 and Tariff 33) indicates the penetration that price signals can achieve in conjunction well-constructed DM products.

In the meantime, Energex will continue to incentivise customers directly to enrol in programs. This strategy allows Energex to target incentives to the principal drivers of demand and DM products, such as PeakSmart air-conditioners as well as shaping incentives to drive support through supporting market channels (e.g. air-conditioning retailers). As new tariffs or price signals are developed, these programs will be transitioned away from direct incentives. DM products and incentives provide customers with reduced network costs in the longer term

12 A copy of the research is available on the Energex website at https://www.energex.com.au/__data/assets/pdf_file/0007/196126/Research-Summary-Report_v2_120314.pdf

and also as a valuable means of providing an additional tool to manage their electricity costs in the shorter term.

Across business customers, electricity affordability is also an area of concern. In targeted areas there are opportunities to work with business customers to provide incentives to manage peak demand. This provides education to business customers to better understand the drivers of their electricity costs, their demand charges and the importance of a single half hour of peak demand and how it can impact their electricity bill. Energex's DM programs work with business customers to improve the economic viability of projects that support reduced demand on the Energex network.

3.1.5 Established markets to deliver DM

By establishing and delivering its DM programs, Energex has facilitated the development of a market to deliver DM products and services (including air-conditioning, PFC and pool pumps) to customers.

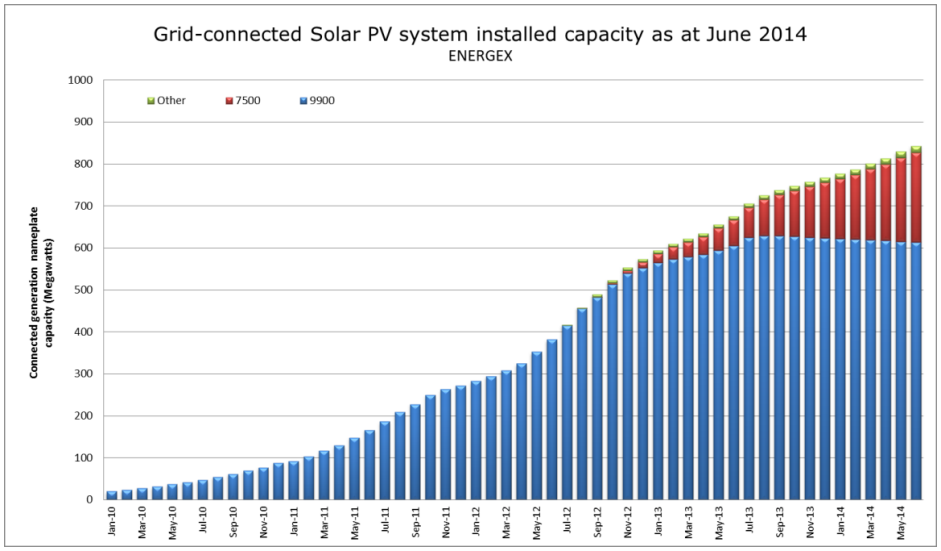
The market has been enabled through Energex establishing a strong and successful support base of industry participants to deliver components of its DM programs. This market has resulted in a reduced cost to serve in Energex programs as well as improved outcomes for customers through dedicated specialist industry support.

The engagement of industry channels from manufacturing to sales and installation has resulted in the development of a growing range of DM products (such as PeakSmart – AS4755 compliant air-conditioners) as well as a sustainable base from which to run DM programs into the future. Energex will to continue to enable the development of markets that minimise DM program costs while making it easy for customers to participate and benefit.

3.1.6 Emerging technologies and the ability for customers to generate and store energy

The penetration of solar generation across the Energex network has accelerated significantly due to a range of incentives such as those available under the Solar Bonus Scheme (SBS) and the Queensland Government Feed-in Tariff (FIT). As at June 2014 there is over 843 MW of connected solar generation capacity installed by 261,454 customers across the network (see Figure 14 below). Ongoing reductions in the costs of solar panels are expected to see this growth continue for the foreseeable future.

Figure 14 - Energex network growth in connected solar-PV



This growing generation capacity has resulted in a reduction in residential consumption, but has only had a minimal impact on residential peak demand.

The recent changes to the FIT encourage many customers to consume more PV in the home, rather than exporting to the grid, but these customer systems will still only have a limited benefit to residential peaks (which mostly occur later in the evening when solar PV is not generating). Solar PV businesses are also adjusting their business models to recognise the potential benefits of combining energy storage (batteries) with solar PV. As battery storage technologies become more affordable, it is anticipated that battery penetration will begin to accelerate, reinforcing the already strong PV market.

Wherever possible, Energex will assess how solar PV and associated generation technologies can be integrated effectively into parts of the network and where the timing of those loads can achieve the optimal benefit in terms of the reduction of localised peaks.

The emergence of battery storage technology in a material way on the Energex network has immense potential to be used as a tool to manage peak demand and to address voltage issues caused by large scale penetration of PV on local networks. Energex is exploring ways of managing this growth, including use of tariffs, connection policies and incentives, to harness these potential benefits. This will form a major focus for Energex's DM program into the medium term and supports Energex's Asset Management Strategy to accommodate distributed generation and storage devices within the network infrastructure.

3.1.7 International research on battery storage

Internationally, many countries are already investing in research and implementation of battery storage:

- California passed a landmark energy storage bill in 2010 to accelerate the rollout of energy storage technologies on the electrical grid. Additionally, the United States is laying the foundation for three additional Acts, designed to drive innovation in future battery technologies through research and investment grants. These projects aim to

accelerate the deployment of storage technologies in order to protect the economy from the cost of power interruptions.

- In 2011 Germany released the 6th Energy Research Programme with a possible $200 million earmarked for energy storage as a priority technology necessary for achieving its renewable energy aims of 35% renewable generation by 2030.

- The European Union has identified energy storage as a high priority technology under the European Industrial Initiative on electricity networks, setting aside €1.2 billion for research and development including energy storage over the 2010 to 2020 period.

3.1.8 Battery storage and EVs and the DM program

While the emergence of a range of residential technologies is difficult to predict, recent research and industry trends indicate that the emergence of affordable residential battery storage and EVs is likely to occur in significant numbers between 2015 and 2020. Hence, residential battery storage and EVs have the potential to have a significant impact on the electricity network by 2021. Research commissioned by Energex[13] predicts that, by 2021, systems could be installed at a rate of 85,000 per annum (19% market share in Qld) with a market turnover of $350 million nation-wide. By 2021, this would equate to 412,000 units installed and $1.7 billion invested across Australia.

It is expected that the first major market opportunity will emerge shortly after 2015 in back-up supply and network niches, with an increased mass market span emerging in 2016. As with solar PV, it is anticipated that, whilst there will be some early adopters, a higher uptake rate more will likely to emerge after 2017.

It is proposed that the Energex DM program focus resources specifically on this emerging trend to ensure that these residential technologies can be managed in a way that benefits the network when they emerge in significant numbers.

Battery storage and EVs will impact the network in two ways as they can drive demand growth due to charging from the grid and conversely, batteries can also be used to generate back into the network. Both of these capabilities can impact network quality of supply and peak load growth.

3.1.9 Power of Choice and metering contestability

The recent AEMC Power of Choice review aims to introduce competition in the supply of meters, and to empower customers to be compensated for their ability to manage and reduce demand.

Energex's DM programs support these aims by providing customers with the means and options to control and manage their energy costs. Energex's DM platform can be operated independently of metering ownership and DM products can be accessed by all customers across the Energex network.

13 Game Changer: The Australian Residential Energy Storage Market to 2021 (Energeia 2012)

4 Residential DM Program 2015-2020

As indicated in section 3.1.4, residential customers consider DM programs to be an important community initiative which Energex should be responsible for and actively promote. DM programs provide customers with options for appliances that have been identified as having the most significant impact on residential peak demand. Energex will continue to build on the success of its historical hot water load management program and, more recently, upon the successful establishment of the Positive Payback PeakSmart air-conditioning and pool pump programs.

These are offered as broad-based programs to all residential customers in the Energex network. Broad-based delivery of residential programs in 2010-2015 has proven to be the most cost effective method of delivery due to the economies of scale in marketing and education to all residential customers, along with strong industry engagement; specifically, engagement with the swimming pool industry, air-conditioning manufacturers and appliance retailers. Table 3 details the Residential DM program for 2015-2020.

Energex has a strong track record in enabling markets to deliver DM solutions to customers. This is evidenced in Energex's successful Cool Change trial, PeakSmart and other successful DM programs to date. It is proposed that Energex apply these same capabilities to develop and deploy DM solutions to manage the demand that will occur due to a growing emergence of residential battery storage and EVs.

It is assumed that each battery connecting to the grid could contribute up to 1kVA (diversified) to peak demand if not managed appropriately. Given the estimated penetration rates of battery storage and EVs outlined in section 3.1.8, it is proposed that a DM program be constructed to connect the following numbers of batteries and/or EVs to a load control program. This program is summarised below in Table 3 and is included in the overall residential DM program.

Table 3 - Residential DM program 2015-2020

Residential Programs	Description
Hot water load control	• The current load control program has been optimised to better manage the growing range of electric hot water systems. • Continue to build on current load control capability by expanding uptake of current broad-based load control tariffs. Hot water reward incentives paid to customers for connection to a load control tariff • Influence regulation for connection of smaller hot water systems to appropriate load control tariffs and/or demand response enabling technologies (AS 4755)
Pool pump load control	• Continue to build on improved pool pump load control capability by expanding uptake of network tariff 9000 (gazetted retail tariff 33) through the payment of incentives to customers • Influence regulation for connection rates of pools to load control tariffs and/or demand response enabling technologies (AS 4755) • Continue to influence Minimum Energy Performance Standards (MEPS) ratings for pool pumps and encourage / educate customers to purchase energy efficient pumps that reduce peak demand and reduce running costs
Residential battery storage and EVs	This program will provide incentives to customers to connect and control battery storage systems and the charging of EVs in a manner which provides peak demand benefits.
PeakSmart air-conditioning load control[14]	• Work conducted through 2009/10 to 2012/13 has firmly established strong industry support for demand response capable (AS 4755) air-conditioning technologies. The PeakSmart program has established proven delivery models through industry channels and this program will now be expanded by: • Growing industry support for PeakSmart air-conditioning • Developing sustainable industry-led delivery models for PeakSmart air-conditioning units • Developing sustainable PeakSmart price signals Influencing standards and regulations to support the widespread delivery of PeakSmart demand response capable technologies and appliances.

The proposed program will deliver 110,609 DM residential products, providing a load under management of 75 MVA. This is 88,609 DM products plus 22,000 batteries/EVs for the five years between 2015 - 2020.

14 There have been 3,400 products included for SME customers in the residential DM program.

5 Residential DM 2015-2020 – Costs & Network Benefit Analysis

5.1.1 Residential DM program modelling summary

The DM program has been modelled by using a range of variables and investigating a range of scenarios to examine the impacts that a residential DM program can have upon growth driven network augmentation. The modelling has been narrowed to three scenarios which provide the most likely anticipated business cases for DM product penetration in the 2015 – 2020 period.

These scenarios are modelled to determine the benefit that a broad-based campaign will have in terms of avoided peak growth driven augmentation of network. The DM product penetration is modelled at a substation level and compared with the forecast growth on each substation to determine the impact that a broad campaign has in terms of deferring localised growth driven capex investment.

The cost to deliver each of the residential DM scenarios has been compared against an NPV analysis calculating the benefits of these programs in terms of discounted, avoided future capex costs based on long run marginal cost (LRMC).

5.1.2 Key assumptions:

All three scenarios modelled assume that given the lead times required to introduce new tariffs, the PeakSmart air-conditioning program is not supported by an attractive or appropriate tariff price signal / incentive (as is currently the case) until the end of the regulatory period. Therefore these scenarios include funding to incentivise customers directly to enrol in DM programs.

Additionally, the benefits are calculated based on 50% activation of PeakSmart capable (AS4755 – Demand Response Capable) appliances (ie: activating demand response capability in air-conditioners so that they are drawing no more than 50% of the energy they would normally). Energex has the capability to activate 100% demand response (doubling the benefits) in cases of an extreme network event. However, as this level of activation is not planned for peak events the more conservative activation value is used in scenario modelling outlined below[15].

15 An NPV and benefits snapshot is provided in Appendix 1 for a 100% DRM Activation scenario

5.1.3 DM program scenario – recommended

This recommended scenario with 110,609 products (refer to Table 6 and Table 7 "Base case plus 22,000 batteries/EVs") is based on a product mix of:

- 88,609 residential DM products (controlled hot water, pool pumps and PeakSmart air-conditioners) at an average reduction of 0.60kVA (diversified) per product
- 22,000 Batteries/EVs at an average of 1kVA peak reduction per battery or EV enrolled in DM programs.

This is considered to be a low–range scenario in terms of DM product penetration and load under control achieved per DM product. Given current forecast demand growth, this is considered to be a balanced option for the next five years. The scale of this program is similar to current Energex residential DM programs and will be delivered at a lower cost/kVA than current programs. This reduction in cost to serve is due to the foundation established of strong industry support and growth in available range of DM products (particularly PeakSmart air-conditioning – now represented by all major air-conditioning manufacturers). Maintaining the proposed scale of operations will maintain strong industry support which provides reduced cost to serve through industry delivery and sales channels. A detailed NPV output for each scenario is included in Appendix 2**.**

5.1.4 DM Program cost to serve analysis

All three scenarios provide NPV positive business cases and compare favourably in terms of cost to serve ($/kVA). Comparing with a base year of DM programs 2012/13 the proposed DM programs and budgets demonstrate the reducing cost to serve achieved through the increasing scale of operations (see Table 4 below).

Table 4 - Residential DM program cost to serve $/kVA

Residential DM Program Cost Comparison (Capex & Opex)	
Original Approved Budget 2012/13	**$1531 / kVA**
Actual DM program Spend 2012/13	**$1077 / kVA**
Proposed DM base case 2015-2020	$817 / kVA
Proposed DM base case + 22k batteries/EVs 2015-2020 (preferred option)	**$725 / kVA**
Proposed DM High battery/EVs penetration case 2015-2020	$672 / kVA

5.1.5 Residential DM modelling methodology and approach

Energex is now well placed to grow the penetration of its current suite of DM products and can do so at an efficient cost to serve due to the scale of operations established during the current determination period.

Residential DM benefit should ideally be tied to localised growth due to the targeted and geographic specific nature of network investment. To properly measure the benefits of residential DM then, new DM peak reduction capability should be assessed against specific zone substation areas of supply.

To address this, a three part model has been developed which ties forecast localised peak growth on substations to the growth deferral that could be achieved through the penetration of residential DM products.

These DM models applied are as follows:

1) **DM product penetration model:** Predicts the uptake and load under control derived from DM products between 2015-2020 at a substation by substation level based on established market opportunities, with calculations based on appliance sales and historic uptake.

2) **Substation benefits model:** Takes DM product penetration model outputs and compares the growth of localised diversified DM capability against forecast substation growth and predicts the amount of peak growth avoidance at a localised level.

3) **Cost / benefits analysis model:** Takes outputs from the substation benefits model and calculates the costs of broad-based program scenarios and compares this on an NPV basis against the anticipated, avoided capex benefit of delivering the DM program across the network.

In order to determine the value of residential DM on the network, a number of assumptions have been made and these assumptions are reflected in the approach to modelling outlined below. Key to these assumptions is the recognition that growth related investment in the network is 'lumpy' and targeted to specific network constraints created by growth in demand. Due to this lumpy and geographically specific nature of network augmentation, it is recognised that only a portion of new load under control derived through broad based DM will have a benefit, in terms of deferring (or avoiding) growth driven augmentation projects at any particular point in time.

However, a targeted approach does not work efficiently for residential products as the bulk of DM products are reliant on industry channels and industry production which serves a broader market. A broad-based approach has instead been adopted in part because this secures strong industry support, which reduces the program cost to serve dramatically. Furthermore, a broad-based campaign also suits the meshed and fluid nature of the Energex network effectively, meaning that DM is available where it is needed as loads are transferred constantly across the network. Finally, over the medium term, a broad-based DM capability will provide benefit no matter how the configuration of the network changes over time.

The process applied in the three DM models is outlined in Appendix 3. The three models key assumptions and outputs are explored at a high level below (for detailed assumptions and inputs refer to Appendix 4).

The outputs of this DM model are factored back into the network forecast and projected reductions in peak loads are subsequently taken into account in forecast driven capital planning activities.

5.1.6 Residential DM product penetration model

The DM penetration model applies a range of demographic, appliance ownership, appliance purchase and replacement, and other factors across the network at a substation by substation level. This model forecasts the likely uptake of a range of different DM products across the network and maps this uptake to individual, localised network elements. This model focuses on the current range of DM products and analyses the current market opportunity presented by these DM products (in all instances an industry led delivery model is applied):

- PeakSmart air-conditioning (new and replacement)
- Pool pumps connected to load control tariffs
- Electric hot water systems connected to load control tariffs
- Replacement of fixed speed pumps (predominantly not connected to load control tariffs) with energy efficient pool pumps.

Consideration is also given to the likely impacts of battery storage and EVs in the network within the DM business case analysis.

5.1.7 Outputs from Residential DM product penetration model:

The DM product penetration model provides output that predicts the mix, type and size (kVA) of DM products that may be adopted by customers during the 2010-2015 period. These outputs are shown below in Figure 15. The model matches this uptake to individual substations and, unsurprisingly, substations with a higher share of residential NMIs have a higher share of DM product penetration.

Figure 15 - Appliance penetration model outputs

Outputs Residential DM product penetration model - Base case + 22,000 batteries 6% take-up											
PeakSmart Total	Split A/C in living areas 4kW to 10kW	Split A/C in other parts of home 4kW to 10kW	Split A/C in bedrooms < 4kW	Ducted A/C > 10kW	**Pool Total**	Pool tariff	Energy efficient pool pump	**Electric HW total**	Electric element storage	**Battery storage**	**Total**
57,436	23,498	4,585	23,497	5,856	**18,828**	8,828	10,000	**12,345**	12,345	**22,000**	**110,609**

5.1.8 Substation benefits model

The substation benefits model as shown in Table 5 takes input from the DM product penetration model and calculates the impact that the forecasted DM product penetration will have on localised peak growth across the network.

Table 5 - Substation benefits model

Input category	Input elements	Description
Diversity	Substation load profile	Each substation peaks at different times of day and in different seasons. A different diversified peak reduction is achieved dependent on the different type of peak profile: • Summer vs Winter • Day vs Night A different diversity is applied to each product dependent on the substation profile it is connected to. (e.g. A hot water system has a different value on a winter night peak compared with a summer afternoon peak when its energy usage would be much lower). See Appendix 4 for DM product Diversity values. The diversified benefit of each DM product is a factor of the likelihood of the appliance being run during a peak event, the size of the appliance and the load the appliance places on the network peak when running. Each substation's historical load profile is examined to identify the peak profile and then a different diversified DM profile is applied to that substation to assess the DM product mix's capability to address that type of peak profile.
	Summer and winter peak profiles	If a substation has a winter peak and summer peak that are within 20% of each other the value of both summer and winter peak management is important. So in instances where substations have a winter and summer peak close together then the maximum diversified value is applied to appliances, whether that be a winter value (e.g. hot water systems) or summer value (e.g air-conditioner load).
Forecast substation peak growth		Each substation has a forecast peak growth for winter and summer between 2015 and 2020. The growth is converted to an MVA value by applying the median growth factor to the historic peak load on each substation. Block loads and load transfers are eliminated by using the median growth value.

Input category	Input elements	Description
Growth deferral benefit	DM benefit calculation: 1 year deferral minimum cut off	If the diversified DM product penetration on a substation is equivalent of ***at least 1 year*** of forecast peak demand growth then the benefits of DM is assumed to be significant on that particular substation. If the peak demand benefit of predicted diversified (kVA) DM products does not equate to at least 1 year of forecast substation peak load growth, then there is assumed to be no benefit achieved through DM on that substation. The reason for this measure is that typically a 1 year deferral of a growth driven project is assumed to have value in terms of reduced capex. Therefore, the residential DM products are only counted as benefit if they achieve an equivalent of at least a 1 year deferral of localised growth (if not they are discounted as having no benefit in the 2015-2020 period*). **As penetration of DM products grows beyond 2020 there will be additional future benefits in terms of peak load reduction, but these benefits are not factored in this model.*

5.1.9 Outputs from substation benefits model

The substation benefits model analyses the impact that the residential DM product mix will have on the predicted peak growth of each substation.

Only substations where an equivalent of deferral of at least 1 year is achieved are counted as having peak reduction benefit. The product mix is assessed to determine how many DM products have a deferral value and this is then used as an input in the costs/benefits analysis. The output from the model is shown below in Table 6.

Table 6 - Substation benefits model 2015-2020 high-level outputs

Residential DM			kVA	
Penetration of products	**Base case** **6% take-up**	Total products	88,609	Total products in the DM program
		Total LuC (all)	53,531	Total diversified kVA load under control (all products)
		Avg LuC per appliance	0.6041	Average diversified kVA load under control per appliance
	Base case + 22,000 batteries/EVs **6% take-up**	Total products	110,609	Total products in the DM program
		Total LuC (all)	75,531	Total diversified kVA load under control (all products)
		Avg LuC per appliance	0.6829	Average diversified kVA load under control per appliance.
	High battery/EVs penetration case, **45,000 batteries/EVs** **6% take-up**	Total products% products	133,609	Total products in the DM program
		Total LuC (all)% substations	98,531	Total diversified kVA load under control (all products)
		Avg LuC per appliance kVA	0.7375	Average diversified kVA load under control per appliance.

5.1.10 Cost / benefits analysis (CBA) model

The CBA model takes outputs from the substation benefits model and analyses the costs of delivering such a program against the anticipated capex avoidance benefits.

The DM benefit is applied in terms of an avoided capex value equivalent to LRMC of building a unit (kVA) of additional network. Each DM product enrolled in DM programs provides a permanent reduction to peak loads on the network. Therefore each kVA of peak load reduction benefit is equivalent to the marginal network equivalent cost of building an additional unit of network (capex).

Given the difficulty in predicting a program of work beyond 2022 the benefits of the DM program are assumed to be spread over a range (2015-2030) of time reflecting the time-spread in network benefits. Also, given the range of benefits that DM capability has across all elements of the network from HV through to LV it is also assumed that these benefits are spread across the full network over a range of time reflecting the lumpy and targeted nature

of network investment. Therefore to appropriately spread the anticipated benefits of the DM program, the avoided capex benefits are normally distributed between 2015 and 2030.

The benefits and costs of the DM program are discounted into 2015 terms and compared through a NPV analysis.

5.1.11 Outputs from CBA model:

The recommended scenario outlined above in section 5.1.3 has a distribution network NPV that is positive and the conclusion of this modelling is that a broad-based program will avoid a sufficient amount of required localised peak driven capex to result in an overall benefit to Energex and therefore south-east Queensland energy consumers. The NPV for the three 6% product penetration scenarios, shown in Table 7 are all NPV positive.

Table 7 - CBA model high-level outputs

Residential DM			Benefit distributed from 2015-2020
Penetration of products	**Base case** **6% take-up**	Total products	88,609
			Positive NPV
		NPV calculation	$1,248,058
	Base case + 22,000 batteries/EVs **6% take-up**	Total products	110,609
			Positive NPV
		NPV calculation	$21,122,908
	High battery penetration case, **45,000 batteries/EVs** **6% take-up**	Total products	133,609
			Positive NPV
		NPV calculation	$41,700,707

An additional benefit of the program which has not been included in the program justification is the long run transmission benefits. Based on the cumulative impacts of the program over the five years, there is an estimated benefit in reduced transmission use of system costs of $6.9 million per annum by 2020.[16]

16 Based on 2014/15 TUOS demand charges, there is an annualised long run transmission benefit of $92 per kVA.

6 Load Control Management, DM Strategy, Compliance & Reporting

There are a number of functions undertaken within DM which are not specifically related to only one individual DM project. In the previous Regulatory Determination these functions were actually included as sub-components of the large projects known as Residential Targeted Initiatives (RTI) and Energy Conservation Communities. For the 2015-2020 Regulatory period these (more strategic and administrative) functions have been separated out from the main DM projects of Residential and Business DM (which are focussed solely on the delivery of DM products to customers). These aspects of DM are:

DM Strategy, compliance and reporting - The development of DM strategies for the future, involvement in national standards and industry groups (eg Energex has been a strong advocate and supporter of development of AS 4755) and compliance and reporting at both a national and local jurisdictional level. It should be noted that Energex has a compliance obligation under section 127 C of the Queensland Electricity Regulations with regard to development of DM strategies, plans and reporting.

Management of load control - Concerned with the day-to-day management of the Energex load control system, monitoring of its operational integrity, system equipment issues, and development of future life-cycle management strategies.

6.1.1 Strategy, compliance and reporting

Energex has a small DM Strategy team who are responsible for:

- Ongoing development of DM strategies (including integration of emerging technologies)
- High level design of DM programs
- Involvement in national standards and working groups which have influence on DM development (eg Demand Response Enabling Devices AS 4755)
- Engagement with industry groups to develop viable product delivery models
- Compliance and reporting at both a national and local jurisdictional level, including:
  - Obligations under the NER such as publication of a Demand Side Engagement Strategy and maintenance of a Demand Side Engagement facility
  - DM obligations under section 127 C of the Queensland Electricity Regulations which include annual submission of a DM Plan (and reporting on performance against that plan) to the Jurisdictional Regulator.

6.1.2 Load control management

Energex actively manages its load control system to achieve optimal results. This work includes ongoing monitoring of load profiles and regular changes to the load control scheduling system to allow for seasonal changes to network loads.

Recently, Energex completed a major upgrade of its Distribution Management System (DMS) which provides real-time operation and monitoring of the Energex network. A sub-system of the new DMS, known as LCS (Load Control System) is effectively a new scheduling system for the existing load control capabilities, but with some major new advantages.

Until recently, Energex's LCS scheduled and broadcast exactly the same switching timetable program to all zone substations. This gave a system level demand response but lacked the granularity to enable Energex to better manage localised peaks. The recent upgrade to Energex's LCS has provided the capability to address peak demand at individual zone substations.

Leveraging this robust system provides a low cost and proven method of executing load control across the Energex network. As the program is tailored to individual zone substations, coupled with the management of new types of controlled customer loads (such as pool pumps and PeakSmart air-conditioners), more optimal load management will be possible. The program to optimise the load control scheduling for residential zone substations is planned to provide peak demand benefit of 25 MVA. This equates to a positive distribution network NPV of $29 million based on a distribution LRMC of $2,072 per kVA.

In addition, the transmission benefit based on a peak demand reduction of 25 MVA would equate to $2.3 million[17] per annum by 2020.

6.1.3 Signal monitoring and management for load control

As Energex is more reliant than ever before on its load control system capabilities it is important that the systems performance is rigorously monitored and assessed to maximise benefits and minimise any potential operational problems. This project will establish a regular audit program of AFLC signal injection quality at all zone substation and establish measures of system performance, which will provide data on system integrity and will contribute to future asset management decisions about the system. This is particularly important as the existing load control system is expected to be an integral part of providing DM solutions throughout the 2015-20 regulatory period and beyond.

6.1.4 Load control equipment projects

There are two load control equipment projects that are proposed:

1) **Expansion of customer load control device operation monitoring** - Due to the nature of the AFLC communication protocol being one-way, there is no direct acknowledgement that the signal has propagated through the network and a

17 Based on the cumulative impacts of the program over the five years, there is a benefit based on the annualised transmission costs of $92 per kVA.

particular individual device has operated effectively. The deployment of monitoring equipment to a statistically valid sample of load control devices will be used to monitor the operational integrity of the end to end system.

2) **AFLC Relay Operation Survey Stage 2** - The initial project was completed by September 2010. Stage 2 evaluates the recommendations from this project and completes further statistically meaningful in-field audit of the AFLC relays and the reliability of these devices four years later. Since the audit in 2010, there have only been limited resources available to ensure the systems end-to-end operation has continued to provide reliable load management. This project will conduct a reliability assessment of AFLC relays, which will include in field testing and some further workshop based testing. Results such as failure modes, volumes, relay types and failure causes will be evaluated to enable the development of recommendations for optimisation. This project will:

   - determine the percentage of controllable load that is not being reliably switched
   - determine the in-field operational status, failure mode and failure-cause of the relays and/or the end-to-end system
   - evaluate the current state of processes and IT systems which cause relays to be accessed, replaced and how data is captured
   - make recommendations concerning the management action required to realise benefit from improvement opportunities.

As these two projects relate to maintaining the operational integrity of the existing LCS (which currently manages in excess of 550 MVA of controlled load) and also serve to provide information for better future asset management decisions; no additional demand reduction benefits have been associated with these projects.

6.1.5 Standardisation of Demand Response Enabled Devices

Energex is currently undertaking a DMIA project examining the development of a new type of Demand Response Enabling Device which will align with anticipated national standards developments in this area. The major benefit of this project with be the development of a device which is not just specific to Energex (as the devices currently being used for the PeakSmart program are) but will be able to used nationally, regardless of whether smart meters are in use or not.

This project relates to the role out and establishment costs around adoption of a new standard device.

There has already been significant industry engagement over recent years about demand response capability with the introduction of AS4755. This project would include education of the relevant industry participants in relation to the new devices and deployment.

6.1.6 Customer education and engagement

Customer education and engagement is very important to DM because customer behaviours and adoption of DM products are the key to obtaining desired results. Since 2010 Energex (in conjunction with Ergon Energy) has sought to engage customers in the following ways:

- Partnership advertising – exploring and creating joint advertising partnerships with key stakeholder groups
- Sales and trade professional contact - through event activities such as the pool and spa industries shows, and information sessions.
- Media advertising – specific Positive Payback Program media advertising through press, radio and billboard advertising. General peak demand awareness advertising through supporting corporate communication general messaging to the public
- Website – Energex will continue to maintain the website www.yourpowerqld.com.au as a collective authority in fields of energy efficiency, energy conservation and DM for Queensland energy users and stakeholders.

There are several facets to the proposed continuing education program:

1) www.yourpowerqld.com.au is a joint website that was developed by Energex and Ergon Energy. It offers a single reference point for Queensland customers looking for residential energy related information. This site aims to provide accurate and impartial information on energy conservation and DM including education services and advice to the Queensland Government, general public and industry sectors. The website provides practical tips and information about saving energy and reducing your energy use during peak demand times. This website will require updating to ensure that customer information remains relevant, up-to-date and enables customers to make informed choices with regards to energy usage.

2) General customer education and information around peak demand issues including:
   - for residential customers: network tariffs, demand response enabled equipment and load control
   - for business customers: demand tariffs, PFC and energy efficiency.

Whilst exact demand benefits for these types of programs are difficult to measure accurately, the proposed expenditure on this project when compared to LRMC equates to a demand reduction of approximately 1 MVA per annum, which is a total of 5 MVA over the five years. This benefit is seen as easily being justified considering that over 125,000 customers have already accessed the www.yourpowerqld.com.au website. This equates to a positive distribution network NPV of $4.4 million based on a distribution LRMC of $2,072 per kVA.

In addition, the transmission benefit for this program is estimated at $462,000[18] per annum by 2020.

18 An additional benefit of this program which has not been included in the NPV calculations is the long run transmission benefits. Based on the cumulative impacts of the program over the five years, there is a benefit based on the annualised transmission costs of $92 per kVA.

6.1.7 Load control SACs upgrade

SACS stands for *Substation Automated Control System* which is Energex's system that provides controls and monitoring of the network. The DMS, previously mentioned, is effectively the platform which sits over the top of the SACS which is used for real-time control by Energex's Control Centre.

The upgraded LCS within the DMS as stated in section 6.1.2 has significant advantages and additional flexibility over previous systems. Whilst major zone substation switching schedule revisions proposed within section 6.1.2 will provide significant benefits, further additional improvements are also achievable through some additional firmware upgrades within the SACS system. These changes relate to historically how the systems were setup many years ago in relation to geographical boundaries and two different types of signal injection systems (one of which no longer exists).

Hence, this is a small capital project which is required to increase the number of available individual AFLC load control channels at zone substations operating with an old version of firmware. The replacement to new firmware will allow better mapping and control of the new customer loads, which were not accounted for in the original version of the firmware.

7 Business DM Program

As has been previously stated in section 3, there are a number of key drivers for DM in 2015-2020. In particular, whilst growth in demand on the Energex network has reduced overall recently in response to a range of factors (reduced consumption, mild weather as well as DM programs); most long term forecasts indicate future growth in peak demand. In particular, demand in different parts of the Energex network is expected to grow at different rates, which is not obvious at the system demand level. This drives local peaks at zone substations which continue to need to be addressed.

For the 2015 to 2020 regulatory period, Energex intends to direct DM for larger business customers to areas forecast to have localised growth (refer to section 7.1.1), using the approach discussed in section 3.1.2.

7.1.1 Business DM targeted approach for 2015-2020

To ensure security and reliability of supply, capital investment is undertaken where growth in demand for electricity creates emerging limitations at substations and on feeders. Energex uses forecasts produced bi-annually to identify network limitations and then investigates the cheapest and most efficient solution to address these limitations, which may include increasing capacity, load transfers or DM.

Energex's experience to date demonstrates that, even with significant financial incentives that provide a positive business case, that it can take a number of years for business to choose to invest to reducing their peak demand. Therefore, to provide the required level of certainty to defer or avoid capacity upgrade projects, targeted non-network activities require long lead times and commitment. This is equally true for businesses that provide DM products and services as well as those that participate in the programs.

While growth in demand is relatively static at a system level, significant growth remains at the localised substation level. DM targets business customers with incentives to reduce peak demand through demand response (DR), energy efficiency (EE) and PFC. The resulting reductions are captured in planning and forecasting tools and in the ten year peak demand forecasts. As EE and PFC provide permanent load reductions the exact timing of the constraints they address becomes less important. Energex Business DM processes are published on the Repository of Energex Documents (RED) on the Energex Intranet.

All targeted areas are developed through a rigorous assessment of the difference in the net present value (NPV) of building capital projects with and without DM. While targeted areas rely heavily on business customers responding to incentives, contributions are also made by residential DM programs in these areas. In some instances additional marketing may be directed to existing residential programs.

7.1.2 Overview of business projects

A project at Bromelton is a continuation of a non-network option initially identified in 2006 which has been confirmed as being required for the 2015-2020 period. This project will produce deferral savings for Energex with a high level of certainty. An additional two projects, at Fisherman Island and Wellington Road (Brisbane CBD), have been identified that provide an opportunity in the medium term. In addition to these three projects, a number of other constraints which will arise in the medium to long-term have been identified which could potentially be addressed through DM. Due to the fact that these projects are beyond the five year horizon, there is less certainty about the exact timing of these projects. However, by pursuing a strategy of the progressive early deployment of permanent DM strategies such as EE and PFC, and later the procurement of demand response, DM is expected to ultimately secure project deferrals by reducing peak demand.

The projects listed in Table 8 represent total future capital expenditure of in excess of $200 million. A number of possible load growth scenarios for each of the projects involved have been considered in developing this DM proposal. By the appropriate allocation of DM resources to these areas, at the appropriate time, project deferrals in the medium term can be achieved. Furthermore, early establishment of DM in these areas will allow development of a flexible program which can be targeted as required to focus more on areas where higher growth develops.

Table 8 - Targeted DM deferral projects: medium to long term opportunities

Constraint area and proposed supply side solution
Bromelton: Address limitations on F82 and F7351 near Bromelton to provide network support of 24 MVA
Fisherman Island Bulk Supply: Address limitations on F3302 and F3303 at Fisherman Island
Wellington Road: Address limitations on F7287 and F7288 in Brisbane CBD
Gold Coast: Beenleigh: WR6287949: BLH Beenleigh Install additional transformer & 11kV switchgear
Gold Coast: Coomera: WR6278979 CMA Coomera Install 3rd 33/11 kW Transformer
Gold Coast: Molendinar: WRWR5973804 MDR Molendinar Replace 30 MVA with 60 MVA Transformer
South West: Springfield: WR5523788: SFC (922) Springfield Central Establish 110/11kV1x60 MVA Zone Sub
Sunshine Coast: Sunrise Hill: WR6050411 SRH Sunrise Hill - TWT Tewantin New 33kV SCCT UG feeder with one spare conduit
Sunshine Coast: Caboolture: CBT Caboolture Bulk Supply - MFD Morayfield Establish DCCT 33 kV fdr from CBT to MFD

As outlined in Table 8, the total amount of network support proposed in this program is 49 MVA. However, as the Bromelton project is a DM solution which is already in place, the amount of new network support is 25 MVA. It should be noted that this 25 MVA of support is proposed based on currently known growth rates, forecasts, developments and network support requirements in these specific areas. Hence if future growth rates in these areas were to change, the amount of network support required for each particular area may vary.

From the scenarios considered, the recommended scenario is Business DM with medium growth. This scenario has a positive distribution network NPV of $3.7 million. This is shown in Table 9 below.

There is also an additional $2.3 million[19] transmission benefit per annum by 2020 based on the DM opportunities outlined above in Table 8, which has not been included in the analysis.

19 An additional benefit of this program which has not been included in the NPV calculations is the long run transmission benefits. Based on the cumulative impacts of the program over the five years, there is a benefit based on the annualised transmission costs of $92 per kVA.

Table 9 - Targeted Business DM Scenarios

		KEY DATA
Business DM - low growth	Value of potential deferred capital	$57,000,000
		Positive NPV
	NPV Calculation	$113,504
Business DM - medium growth	Value of potential deferred capital	$150,000,000
		Positive NPV
	NPV Calculation	$3,672,929
Business DM - high growth	Value of potential deferred capital	$214,000,000
		Positive NPV
	NPV Calculation	$6,039,916

Therefore, it can be seen than even if growth is higher or lower than assumed, at the medium growth case, the business case remains NPV positive.

7.1.3 Small to Medium Enterprise (SME) Business DM Program

Customer engagement research as per section 3.1.4 with Small to Medium Enterprises (SME) customers revealed that SME customers view the DM program as very important, which Energex should be responsible for and actively promote. Smaller businesses are particularly interested in incentives for off peak use. Medium sized customers are also interested in the same incentives, as well as expressing an interest in PFC, load curtailment and generation.

Whilst the customer sectors of residential and larger businesses have been well catered for in existing DM programs, the sector where Energex has so far only allocated limited resources and had limited success is in the SME market.

Generically SME customers are not strictly customers of only a particular tariff class but rather cover a range of customer types. From an electricity network (and demand) perspective some SME's are very similar to residential customers, while others may have more in common with large business customers. For example a suburban accountant's office is probably very similar in load types to a residential customer ie typically has its own lighting, air-conditioning and a hot water system. Whilst some other SME's such as small supermarkets, schools, nursing homes or regional hospitals have more in common with larger business customers.

The possible DM solutions that could be deployed may include Energex's range of residential products such as PeakSmart air-conditioning or any of a number of business solutions such as improvements to building management systems, PFC, or demand response etc.

In support of this Energex is currently undertaking a project (utilising DMIA funding) to identify demand response potential and the issues associated with making economical use of it within the SME market. This project will be completed by June 2015, enabling its outcomes to be utilised in the 2015-2020 regulatory period.

The SME program will also serve to better identify and provide improvements to the delivery channels used for this category of customers. This program will provide a peak demand benefit of 16 MVA, which equates to a positive NPV of $16.9 million based on a LRMC of $2,072 per kVA.

In addition, the transmission benefit based on a peak demand reduction of 16 MVA would equate to $1.5 million per annum by 2020.[20]

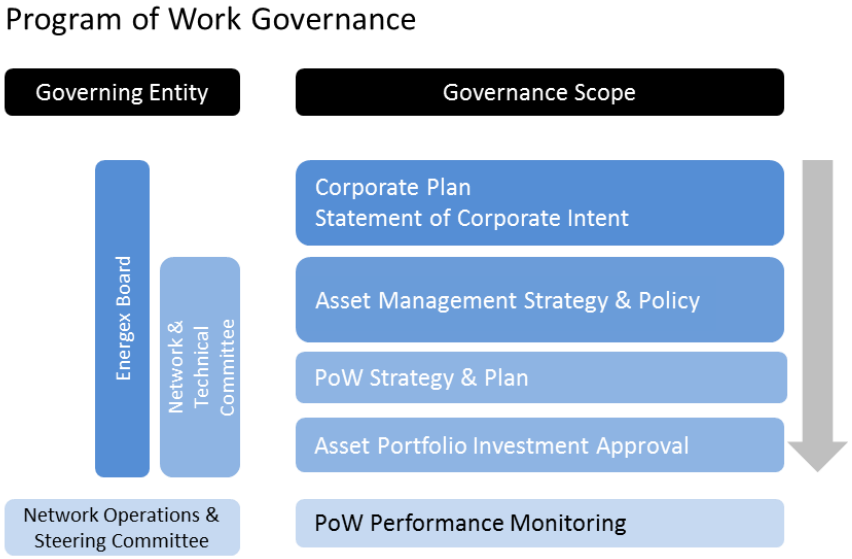
20 Based on 2014/15 TUOS demand charges, there is an annualised long run transmission benefit of $92 per kVA.

8 Governance and review

8.1.1 Governance

Energex Program of Work Governance ensures strategy & policy development and resulting portfolio investment approvals align to achieve the strategic objectives of the business as shown in Figure 16. Monitoring and review of the program of work performance against annual targets and performance standards is undertaken by the Network Operations & Steering Committee.

Figure 16 - Program of work governance



8.1.2 Performance Monitoring and Reporting

Energex DM expenditure and the performance achieved compared to the target is monitored by the Executive General Manager Asset Management, the Network Technical Committee (NTC) and the Energex Board. There are a number of reports that are presented as follows:

- Progress is reported monthly through established corporate reporting processes
- Energex's DM Plan – this is a detailed plan which outlines budget and targets for the DM programs for the next financial year and the following four years, which is reviewed and approved by the NTC and the Energex Board annually. It is submitted to the Technical Regulator in April each year
- Report on the Performance of Energex's DM Plan – this is a detailed report outlining the expenditure and achievements of the DM programs for the last financial year, which is approved by the NTC and Energex Board annually. It is submitted to the Technical Regulator in August each year
- Measurement and verification processes for the programs have been established through good engineering practices and having a number of staff trained and accredited to the International Performance Measurement and Verification Protocol (EVO10000 – 1:2010).

9 Conclusion

High levels of peak demand relative to overall network utilisation will continue to drive a need to invest more capital in peak network capacity which is required for very short periods of time. This is an expensive solution to a temporary and intermittent problem. To address this issue, Energex has developed a suite of DM programs to encourage and incentivise customers to either reduce their consumption at peak times for the network, or shift their consumption to a non-peak time.

For the 2010-2015 Regulatory Determination, Energex committed to reduce peak demand by 144 MVA. Energex is well on track to achieve its target of (at least) 144 MVA of peak load reduction by June 2015. This new load under control has been removed from forecast peak load growth resulting in reduced growth driven capital expenditure.

Energex has a proven and long-running track record in successfully using DM to improve network management outcomes. The DM Programs for 2015-2020 are focused on a combination of addressing constraints at localised zone substations and embedding DM capabilities into the network to prepare for anticipated future growth in customer demand due to emerging technology such as battery storage and EVs.

The Energex DM program for 2015 – 2020 strives to:

- Address localised demand growth and reduce network augmentation
- Embed systems and processes in support of RIT-D and non-network alternatives
- Leverage the benefits of increased load control capability
- Take a leadership role in DM to meet customer expectations
- Continue to leverage well developed DM markets
- Build additional capability to adapt and respond effectively to emerging technologies

Customers have responded strongly to Energex DM programs with over 80,000 customers enrolling in DM programs since 2010. Energex plans to build on foundations established since 2010 and to continue to provide customers with choice and options to help manage electricity costs.

Details regarding the DM Programs proposed for 2015-2020 are:

- **Residential DM** – Offering customers DM options for appliances that have been identified as having the significant impacts on residential peak demand. These programs provide customers with options to manage their electricity costs and to address the major drivers of residential peak demand being hot water systems, air-conditioners and pool pumps (and potentially in the future batteries and EVs). The business case is positive with an expected NPV of $21 million.

- **Strategy, load management, compliance and reporting** – This program encompasses the management of the successful load control system (LCS) to optimise switched loads at the zone substation level, continue development of DM strategies, ensure compliance with the NER (eg RIT – D and non-network alternatives) and comply with reporting obligations to the Technical Regulator, Queensland government and AER.

- **Business DM** – Energex runs programs to embed DM into specific targeted areas where it is financially justified, in the years prior to a network constrain arising and the RIT-D process commencing. Business customers within targeted areas are incentivised to participate in programs to reduce load at peak times. This business case is positive with an expected NPV of $3.7 million.

- **Small to medium enterprises (SME) DM** – From 1 July 2015, the new kVA-based demand charges will apply to approximately 10,000 small business customers. This SME DM program will assist customers to transition to the new tariff and improve their power factor thereby reducing peak demand on the network. This business case is positive with an expected NPV in excess of $400,000.

- **Demand Management and Innovation Allowance (DMIA)** – There are a number of proposed innovative projects to investigate options to manage demand that are outlined in Attachment 3.

- **Customer education and engagement** - www.yourpowerqld.com.au is a joint website that was developed by Energex and Ergon Energy. This site aims to provide accurate and impartial information on energy conservation and DM including education services and advice to the Queensland Government, general public and industry sectors.

The DM program recommended forms a key component of Energex's strategy to distribute safe, reliable and affordable electricity in a commercially balanced way that provides value for its customers, manages risk and builds a sustainable future. From an electricity infrastructure point of view, the DM program's objective is to achieve better utilisation of network assets, hence optimising investment in new network, so that the benefits can be passed onto electricity customers in the form of reduced electricity costs in the longer term.

APPENDICES

Appendix 1 - 100% DRM Activation NPV Analysis

If 100% DRM is activated in PeakSmart (AS4755 – Demand Response Enabled) appliances the benefits anticipated in the DM program increase as follows:

Figure A 1 - Substation benefits model high-level outputs – 100% DRM Input

Residential DM			kVA	
Penetration of products	Base case 6% take-up	Total products p.a	17,722	Total products p.a. in the DM program
		Total LuC (all)	88,150	Total load under control (all DM products)
		Avg LuC per appliance	0.9948	Average load under control per appliance
	Base case + 22,000 batteries/EVs 6% take-up	Total products p.a	22,122	Total products p.a. in the DM program
		Total LuC (all)	110,150	Total load under control (all DM products)
		Avg LuC per appliance	0.9959	Average load under control per appliance
	High battery/EVs penetration case, 45,000 batteries/EVs 6% take-up	Total products p.a	26,722	Total products p.a. in the DM program
		Total LuC (all)	133,150	Total load under control (all DM products)
		Avg LuC per appliance	0.9966	Average load under control per appliance

Figure A 2 - CBA model high-level outputs – 100% DRM input[21]

Residential DM			Benefit distributed from 2015-2020
Penetration of products	**Base case** **6% take-up**	Total products p.a	17,722
			Positive NPV
		NPV calculation	$43,093,226
	Base case + 22,000 batteries/EVs **6% take-up**	Total products p.a	22,122
			Positive NPV
		NPV calculation	$63,006,855
	High battery/EVs penetration case, **45,000 batteries/EVs** **6% take-up**	Total products p.a	26,722
			Positive NPV
		NPV calculation	$81,477,897

The increased load under control increases the number of substations where a deferral in growth is achieved which in turn increases the number of DM products that have a benefit in terms of reduced peak growth. This increased benefit is demonstrated in the NPV analysis summarised below.

21 Includes overheads

Appendix 2 - Detailed DM Program Scenario CBA NPV Outputs

1) Base case (88,609 DM Products and 0 batteries/EVs)[22]

1 OPTION:	PENETRATION OF PRODUCTS	6.0%	AVERAGE LOAD UNDER CONTROL			MEDIUM KVA	COST	PER MATRIX		YEAR	2022			Useful KVA	30,220
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027		
KVA multiplied by LRMC								62,615,921							
DM Residential Project costs		(8,748,472)	(8,748,472)	(8,748,472)	(8,748,472)	(8,748,472)									
Network capital	-														
Network opex															
Cash flow	-	(8,748,472)	(8,748,472)	(8,748,472)	(8,748,472)	(8,748,472)	-	62,615,921	-	-	-	-	-		
Discounted cash flow	-	(8,081,729)	(7,465,801)	(6,896,813)	(6,371,190)	(5,885,626)	-	35,949,217	-	-	-	-	-		

2) Medium case (88,609 DM Products and 22,000 batteries/EVs) **(This scenario is applied in the business case above)**

2 OPTION:	PENETRATION OF PRODUCTS	6.0%	AVERAGE LOAD UNDER CONTROL			MEDIUM KVA	COST	PER MATRIX		YEAR	2022			Useful KVA	53,658
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027		
KVA multiplied by LRMC								111,179,182							
DM Residential Project costs		(8,748,472)	(9,748,472)	(10,748,472)	(12,248,472)	(13,248,472)									
Network capital	-														
Network opex															
Cash flow	-	(8,748,472)	(9,748,472)	(10,748,472)	(12,248,472)	(13,248,472)	-	111,179,182	-	-	-	-	-		
Discounted cash flow	-	(8,081,729)	(8,319,184)	(8,473,503)	(8,920,112)	(8,913,048)	-	63,830,484	-	-	-	-	-		
PV @2013	**21,122,908**														

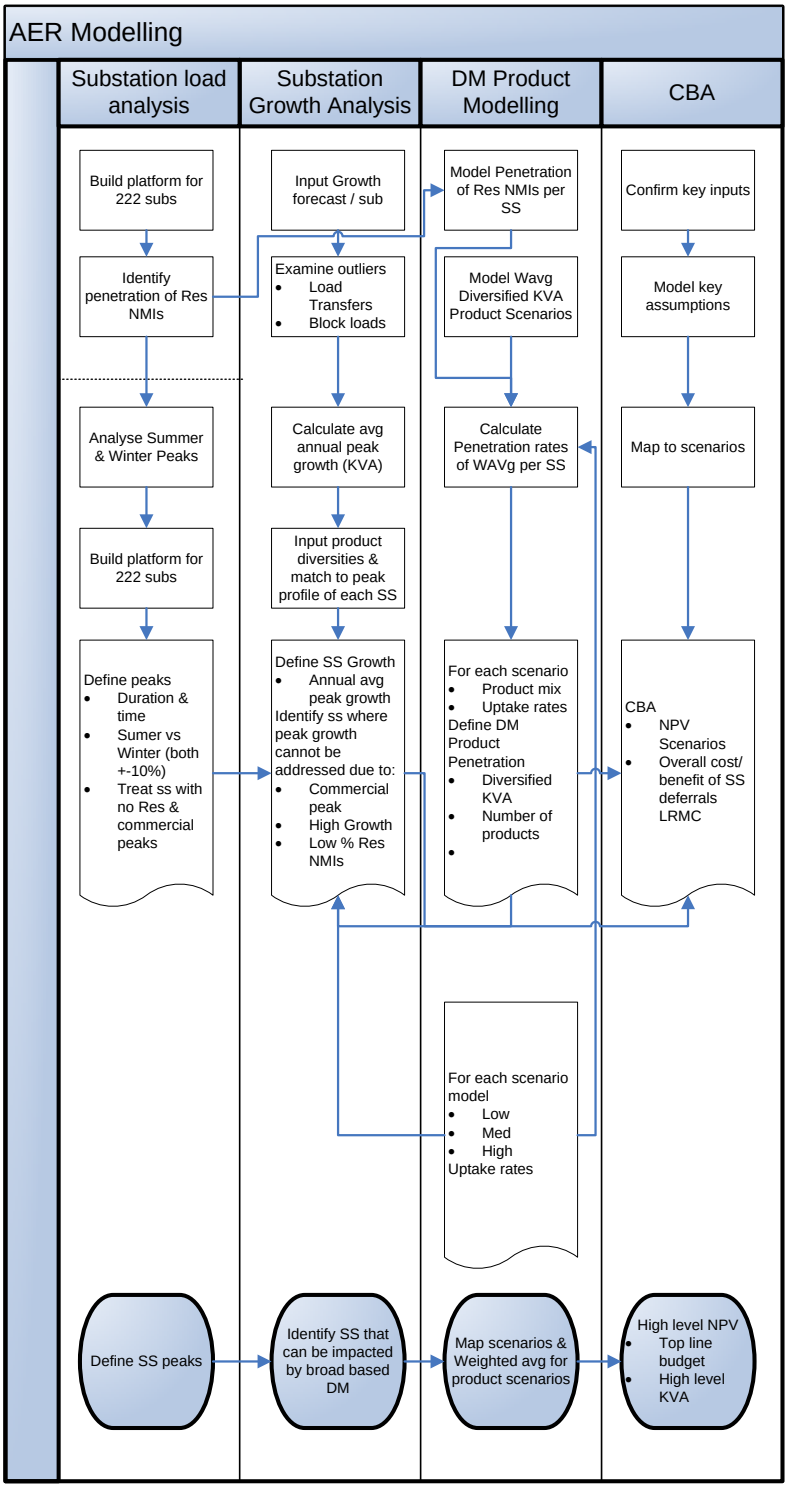
3) High case (88,609 DM Products and 45,000 batteries/EVs)

3 OPTION:	PENETRATION OF PRODUCTS	6.0%	AVERAGE LOAD UNDER CONTROL			MEDIUM KVA	COST	PER MATRIX		YEAR	2022			Useful KVA	78,143
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027		
KVA multiplied by LRMC								161,911,361.17							
DM Residential Project costs		(8,748,472)	(11,248,472)	(13,748,472)	(15,748,472)	(16,748,472)									
Network capital	-														
Network opex															
Cash flow	-	(8,748,472)	(11,248,472)	(13,748,472)	(15,748,472)	(16,748,472)	-	161,911,361	-	-	-	-	-		
Discounted cash flow	-	(8,081,729)	(9,599,259)	(10,838,538)	(11,469,033)	(11,267,710)	-	92,956,976	-	-	-	-	-		
PV @2013	**41,700,707**														

22 The CBA Benefits (Avoided capex) are assumed to happen over a range (normally distributed) from 2015-2030, given the impacts of DM on all parts of the network from LV to HV and given the lumpy nature of network investment. This benefit is discounted from the mean of the normal distribution, which in this case is the 2022 FY.

Appendix 3 - DM Peak Penetration Model Process

Figure A 3 – DM process for DM peak



Appendix 4 - Key Modelling Assumptions and Inputs

Figure A 4 - DM appliance penetration model

Category	Scenario/Input
DM product	Scenarios being tested are based on ~ 8% uptake of products across residential customers over five years, and product mixes achieving diversified load of ~ 0.45, 0.57 or 0.87 kW per product
Augmentation deferral	Measure of deferral required to count benefits is based on median growth of 5 year demand forecast
	Where kVA benefits of DM do not equate to equivalent of 1 year deferral at substation level, kVA benefit at that substation is not included in overall kVA totals
Diversity	Diversities per appliance are applied for summer and winter, day and night based categorised time and type of peak
	Diversities are applied per appliance as shown below

Load under control per appliance - diversity assumptions			Summer peaking		Winter peaking	
Product	Input KVA Avg	DRM (%)	Day LuC	Night LuC	Day LuC	Night LuC
Fixed speed pool pump on to T31 / T33	1.15	100%	0.81	0.81	0.81	0.81
Replace fixed speed pump with energy efficient pump	0.8	100%	0.56	0.56	0.56	0.56
Connect an energy efficient pool pump to T31 / T33	0.35	100%	0.25	0.25	0.25	0.25
Air conditioning -- Bedroom	0.7	50%	0.09	0.09	0.11	0.11
Air conditioning -- Other	1.2	50%	0.26	0.26	0.26	0.26
Air conditioning -- Main	2.3	50%	0.88	0.88	0.94	0.94
Air conditioning -- Ducted	4.83	50%	1.54	1.54	1.51	1.51
Hot water -- Electric	3.6	100%	0.11	0.38	0.38	0.77
Hot water -- Heat pump	1	100%	0.20	0.20	0.20	0.20
Hot water -- Solar w/ electric boost	3.6	100%	1.44	1.44	1.44	1.44
Note - PeakSmart PROVIDES capability up to 100% DRM (DRM1) - as shown below						
Air conditioning -- Bedroom	0.7	100%	0.19	0.19	0.23	0.23
Air conditioning -- Other	1.2	100%	0.52	0.52	0.52	0.52
Air conditioning -- Main	2.3	100%	1.76	1.76	1.89	1.89
Air conditioning -- Ducted	4.83	100%	3.08	3.08	3.03	3.03

Substations	Where substations with similar peaks in summer and winter have been identified, (i.e. peaks within 20%) benefits are measured on the highest peak

Category	Scenario/Input
	Some substations are excluded - Bulwer Island Energy Co, Australian Paper Mills, Visy, etc. as these are almost completely C & I load.
	The time of the highest historic load (at substation peak, not system peak) defines substations as Summer Day, Summer Night, Winter Day or Winter Night, using the same seasonal day and night time definitions as forecasting models.

Costs Benefits Analysis Model

Category	Scenario/Input
Labour costs	Contact Centre employees x 4 are no longer funded by DM 2015 - 2020 ($421,536)
	Labour FTEs assumed unchanged from 2014
	Overheads based on 2014/15 rates for fleet and general overhead percentages[23]
Incentives	No incentives paid for efficient pool pumps in 2015 to 2020 (however, benefit claimed due to industry work in prior years)
	Economy tariffs grouped regardless of product (eg: hot water and pools)
Contractors/consultants	Assumed CycleIts are no longer used in 2015 to 2020
	No travel costs included and no contractors required as all work completed by FTEs (Consultants for M & V included)
Advertising	• Low KVA & Medium KVA Scenario - $600,000 • High KVA Scenario - $700,000
Capital	$72 per DRED plus overheads (material and general overhead)

23 Corporate overheads are based on rates from 1 March 2014. The NPV analysis will need to be reviewed and updated for any changes to the overhead rates.

Category	Scenario/Input
	Add 10% contingency costs
Financial	RIT-D Model uses the pre-tax real WACC of 8.25%. No escalation required for budget as using real dollars.
	Inflation of 2.50% in accordance with 2012/2013 Corporate budget rates.
	a. WACC Nominal - 9.72% b. WACC Reg Test - 8.25% c. LRMC - $2,072 (See Appendix 5 – below- for calculation details) d. Inflation - 2.50%

Appendix 5 - Long Run Marginal Cost Calculation

Background to the long run marginal cost

Long run marginal cost (LRMC) is defined as the marginal cost of building an additional MVA of capacity in an electricity network to meet forecast demand. It is approximated by estimating how long run operating and future capital costs change if expected demand changes. It provides a signal of the long run costs of future network expansion costs.

Within Australia, the LRMC calculation is required by the National Electricity Rules under Clause 6.18.5(b)(1) as part of the tariff pricing calculation for a distribution network. The Australian Energy Market Commission (AEMC) has advocated the use of LRMC pricing in its current "power of choice review".

There is currently no set benchmark LRMC available from the Australian Energy Regulator for the cost of building an additional megawatt of capacity in an electricity network. The Australian Government Productivity Commission[24] has provided an estimation of an appropriate range of LRMC for an electricity network. This is shown below in Table A 1.

Table A 1 - Productivity commission LRMC per kVA

Network costs per additional KVA	LRMC per kVA p.a. (Annualised)	LRMC per MVA
Distribution infrastructure	$150 to $220 per kVA	$1,5M to $2.2M
Transmission infrastructure	$30 to $70 per kVA	$300k to $700k
Generation infrastructure	$90 per kVA	$900k

In September 2009, a LRMC of $2,090 per kVA was endorsed by the Energex Network Technical Committee[25] and Energex Ltd Board[26]. This calculation was based on two accepted methodologies:

1. Future peak infrastructure costs from 2009/2010 to 2014/2015 and
2. Historical peak infrastructure costs at 2007/2008

24 Australian Government Productivity Commission Electricity Network Regulatory Frameworks – Supplement to Inquiry Report No 62, 9 April 2013 – page 22.

25 Network and Technical Committee Memorandum – Meeting date 11/08/2009.

26 Energex Limited Board meeting 28/09/2009.

Updated Long run marginal cost calculation methodology

In calculating an updated long run marginal cost calculation, there were a number of considerations.

1. Since 2007/08 and including the current AER Determination period of 2009/10 to 2014/15, the 50 POE summer MVA forecast has not grown significantly, however, there has been a notable increase in the capital expenditure of the Energex network. This is in accordance with security standards requirements.

The LRMC calculations based on the actual capital expenditure from 2007/2008 to 2012/2013 and based on the actual and forecast growth expenditure from 2007/2008 to 2019/2020 did not provide a logical LRMC value due to the low growth in forecast demand and high capital investment in the network during this same period. This calculation has not been considered further.

2. For the future peak infrastructure LRMC calculation, only growth capital expenditure was included as outlined in Table A 2 - .

Table A 2 - Growth capital expenditure activities

Activity	Description
C2010	Customer driven primary
C2020	Demand driven primary
C2510	Domestic & Rural Customer Requested Works
C2550	Commercial & Industrial Customer Works
C2565	Company Initiated Distribution Augmentation
C2570	Service Connections

3. The LRMC calculation has been based on the following methodologies.

a. Future peak infrastructure cost - forecast growth capital expenditure for the AER Determination period from 2015/2016 to 2019/2020 compared to the forecast MVA growth for the same period.

b. Historical peak infrastructure cost – 2012/2013 supply system cost at directors' valuation compared to the 50% POE summer actual MVA for 2012/2013

Long run marginal cost calculation

Table A 3 - LRMC: Future peak infrastructure cost [27]

Activity	Description	2015/16 $	2016/17 $	2017/18 $	2018/19 $	2019/20 $	Total $
C2010 & C2020	Customer driven primary & Demand driven primary						$389,500,000
C2510	Domestic & Rural Customer Requested Works	$29,584,894	$34,733,657	$38,370,730	$42,277,434	$42,947,264	$187,913,979
C2550	Commercial & Industrial Customer Works	$29,661,066	$30,721,465	$31,024,436	$31,428,397	$31,276,912	$154,112,276
C2565	Company Initiated Distribution Augmentation	$43,426,908	$43,426,900	$43,426,864	$20,210,084	$20,210,047	$170,700,803
C2570	Service Connections	$39,324,271	$39,628,970	$39,944,326	$35,416,670	$35,525,606	$189,839,843
	Total growth capex						$1,092,066,901

27 Forecast C20 and C25 capital expenditure 2015/2015 to 2019/2020 provided by Network Investment Optimisation (Julian James and Michael Wright).

Table A 4 - Forecast growth[28]

Forecast	Year	MVA
Forecast: 47 base case 2013 post DAPR	2015/2016	4,840
Forecast: 47 base case 2013 post DAPR	2019/2020	5,367
Growth		527

Long run marginal cost calculation $1,092,066,901 / (527 MVA x 1,000) = $2,072.23 per KVA

28 Forecast: 47 base case 2013 post Distribution Planning Annual Report - SIFT

Table A 5 - LRMC: Historical peak infrastructure cost

Asset Cost	Year	$
Supply System at Directors' valuation[29]	2012/2013	$14,923,600,000
Actual MVA	Year	MVA
Summer 50% POE (MVA)[30]	2012/2013	4,590

Long run marginal cost calculation:

$14,923,600,000 / (4,590 MVA x 1,000) = $3,251.33 per kVA

Conclusion

Based on the estimated range $1,500 to $2,200 per kVA outlined in the Productivity Commission Report[31] and the previous LRMC used for the 2009/2010 to 2014/2015 AER Determination, the historical peak infrastructure LRMC of $3,251.33 per kVA seems high and has not been applied in Energex modelling.

Therefore, the forecast peak infrastructure LRMC of **$2,072.23 per kVA** has been used in the Net Present Value model for the residential DM program.

This value is in line with previous LRMC applied and is well within the range outlined by the Productivity Commission review of distribution networks.

29 Energex Limited Annual Financial Report for the year ended 30 June 2013 – Note 8 Property, plant and equipment page 37.

30 Forecast: 47 base case 2013 post Distribution Planning Annual Report - SIFT

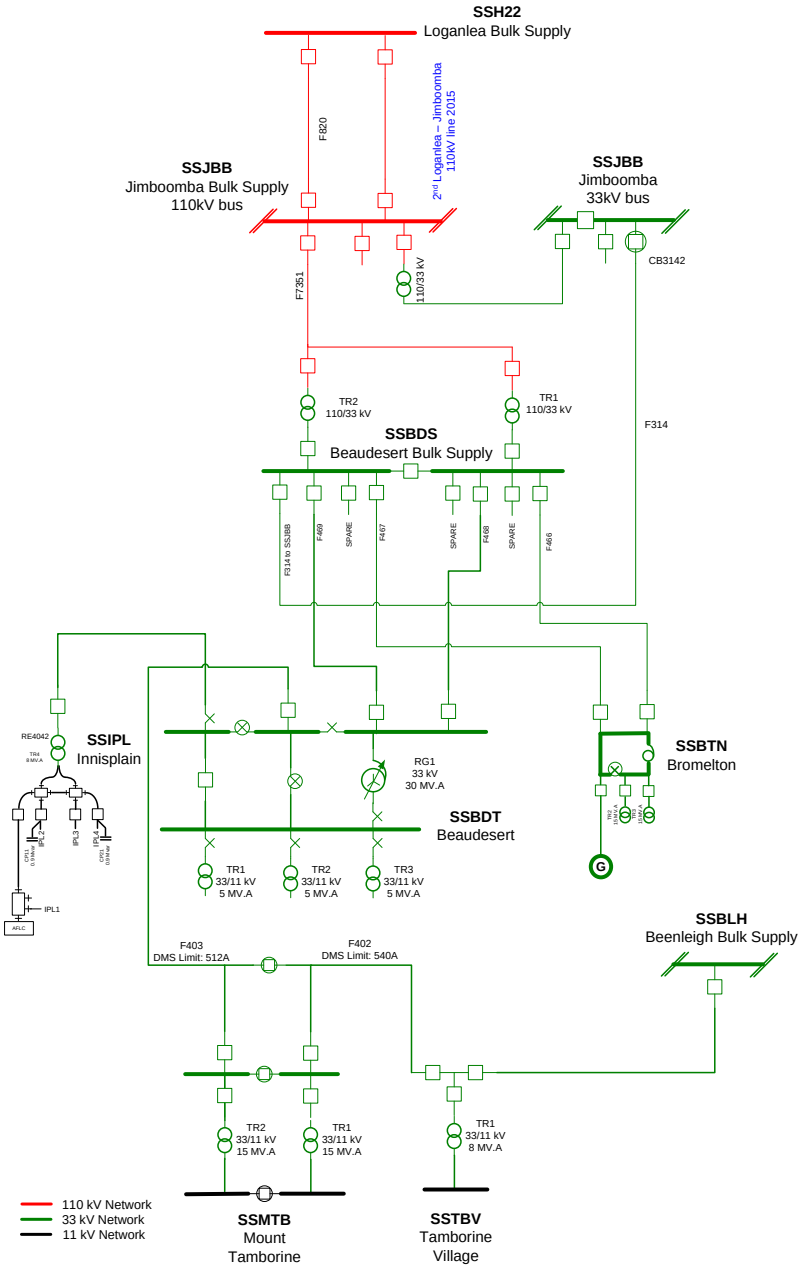
31 Australian Government Productivity Commission Electricity Network Regulatory Frameworks – Supplement to Inquiry Report No 62, 9 April 2013 – page 2

Appendix 6 – Targeted DM Bromelton

Background

Beaudesert bulk supply substation (SSBDS) feeds Beaudesert (SSBDT), Bromelton (SSBTN), Innisplain (SSIPL) and Mount Tamborine (SSMTB) zone substations, providing electricity supply to approximately 16,000 predominantly domestic customers. SSBDS is supplied from Jimboomba bulk supply substation (SSJBB) via a single circuit 110kV feeder F7351.

Figure A 5 - Existing network arrangements



Embedded generating units (EGs) located at Bromelton Zone Substation have provided network support in case of a network outage since March 2006 with the contract for these EGs renewed once in March 2011. The March 2011 renewal decision was based on detailed technical and economic analysis that revealed the least cost option to address the then 8.75 MVA of load at risk would be to continue using the EGs already located at the substation. This extension provided support up until March 2019 with an option to extend for a further two years (i.e. to March 2021). The two year extension was to be contingent on load growth and other technical constraints. Key facts concerning the decision to continue with the arrangements at Bromelton included:

- The requirement to address load at risk for an outage of F7351 (JBB to BDS) remained.
- The estimate for the least cost capital project without EGs was $27.4M providing an estimated annual deferral value of $2.7M.
- The estimated cost of the EGs was less than $1M.

As the annual value of deferral of capital exceeded the annual cost of EGs the generation option represented the lowest cost option.

Further detail on the decision outlined above can be found in the Transmission Project Approval Report PAR2010-007 concerning the work request number WR5680540.

Current Requirement to 2021/22

Up until October 2016, when a second 110kV feeder is commissioned from Loganlea Bulk Supply (SSH22) to Jimboomba Bulk Supply (SSJBB), the Bromelton generators will be used to support 23 MVA of load at risk in the event there is a loss of feeder F820. After that, the EGs are required to provide network support for feeder F7351.

If a contingency occurs on 110kV feeder F7351 there is only one back up feeder, F314 SSBDS to SJBB at 33kV. However, as F314 cannot supply the entire load to SSIPL, SSBDT, SSBTN, SSBLH, SSTBV and SSMTB the developed contingency plan is:

For F7351 (110kVA) open circuit:

- Open circuit breakers (CBs) on F469 and F468 at SSBDS to allow EGs at Bromelton to sync with the grid prior to operating in islanded mode to supply SSBTN;
- Transfer load of SSMTB to Beenleigh Bulk Supply so that SSMTB and SSTBV are both supplied by SSBLH; and then
- Close CBs at SSBDS so that F314 now supplies SSIPL and SSBDT.

Financial Analysis

Undertaking a financial assessment of addressing the load at risk outlined here with and without EGs at Bromelton provides savings as below:

Table A 6 - Financial assessment of savings from deployment of EGs at Bromelton

	A 3.5% p.a. escalation rate applies to these costs			
	Fixed costs EGs per annum – Year 1	Variable EG costs per annum – Year 1	Total costs per annum – Year 1	Estimated savings (NPV) $12/13
Worst case	$851,040	$100,000	$951,040	$6,154,285
Expected case	$851,040	$50,000	$901,040	$6,417,219
Best case	$851,040	$0	$851,040	$6,680,153

Conclusion

Based on current estimates the use of EGs at Bromelton will represent the lowest cost option for addressing the limitations in the Beaudesert region as outlined above from now to 2021/22 (i.e. beyond the next regulatory period). As such Energex are requesting funds of approximately $1 million per annum to fund the EGs. It is estimated that this will provide a saving of approximately ($12/13) $6.4 million to Energex.

Appendix 7 - Justification for kVA Demand Charging for SACD Customers in 2015/16

Network Pricing upholds a number of principles in the refinement of existing tariffs. These Pricing Principles are intended to ensure Energex meets it obligations under *the Rules* and to provide clarity in the development of robust tariffs. These are:

- **Cost-reflectivity** – as far as possible, tariffs should reflect the actual cost of service provision to customers.
- **Efficient use of the network** – tariffs should incorporate appropriate signals to network users of their impact on existing and future network capacity and costs, and to encourage DM.
- **Free from cross subsidy** – for a network user, or group of users, there should be no cross subsidies between each tariff class of SCS, or between standard control and alternative control tariffs.
- **Equity** – tariffs should be equitable for customers and should reflect the users' utilisation of the existing network and the use of specific dedicated assets.
- **Price stability** – tariffs should not widely fluctuate over time to permit customers to make informed investment decisions.
- **Simplicity** – tariffs should be simple and straightforward to apply, based on a well-defined and clearly explained methodology and be readily understood by customers.

When customers place demand on the network, both kW (kilowatts) and kVAR (reactive power) is delivered. When demand charges are denominated by kW only, the charges do not take into account the kVAR of individual customers, so two customers with the same demand in kW but different demand in kVAR will pay the same. Network costs associated with delivering and managing kVAR are currently recovered through kW demand charges, so customers with lower kVAR are effectively subsidising customers with higher kVAR.

The network must invest in capacitor banks in order to manage kVAR in the network. Since this investment is driven by kVAR, the equity and cost reflectivity principles suggests that customers should pay for this component of the network proportionate to their kVAR.

Power factor (PF) reflects the relationship between kW and kVAR through the following formula, PF = kW/kVA.

A customer with a higher PF will contribute less loss to the network than a customer with lower PF. Charging customers for their equitable share of the network associated with managing kVAR sends customers a signal to be efficient in the use of the network by improving their power factor, i.e. by reducing their kVAR.

Energex could reflect these network issues by charging for demand in kW and demand in kVAR as two separate tariff charge components. However, kVA (kilovolt amperes) is a unit of demand that takes into account both kW and kVAR and provides a much simpler method of charging in an equitable and cost reflective manner.

The kVA unit is a measure of both kW and kVAR[32]:

$kVA = (kW^2+kVAR^2)^{1/2}$.

Currently ICC and CAC customers pay for their DUOS demand charges denominated in kVA and Energex seeks to continue this simple and cost reflective approach by charging SACD customers for their demand denominated by kVA.

This change from kW demand charging to kVA demand charging is expected to confer network benefits well in excess of $5 million as infrastructure associated with kVAR management is deferred.

Customers will see their final bill change as a result of the change from kW to kVA demand charging, with customers with low PF expected to see bill increases, and customers with higher PF expected to see bill reductions.

Table A 7 – Power Factor and impact on customer bill

PF	% increase
0.75	17%
0.8	9%
0.85	3%
0.9	-3%
0.95	-8%

The table above illustrates indicative percentage changes in annual demand charges (DUOS + DPPC) as a result of the pricing change. Note that demand charges are approximately 80% of the network bill, and approximately 40% of the overall bill.

32 kVA is the hypotenuse of a right angled triangle where kW and kVAR are the sides.