Energy Insights

Demand Management and Smart Network Technologies

About the Energy Insights series

This material was originally developed for our Technical Insights Workshop series held from June to August 2014. These workshops brought together representatives of our key customer groups, to discuss customers' views and preferences in the complex network decisions and trade-offs we make on their behalf.

Following positive feedback from attendees, we have used the workshop material as the basis of a series of stand-alone information briefs with the aim of building understanding about our business and the services we provide.

AusNet Services Customer Relations

1. Introduction

AusNet Services is developing new approaches to meet growing peak demand. We are also running our network more efficiently using smart meter technology.

While overall energy consumption is falling for AusNet Services, peak demand, i.e. the energy that customers use within defined peak periods, is increasing, (see graph below). The challenge of supplying reliable power to customers during peak demand times is a key driver of network expenditure. Upgrading the network to manage growth in peak demand is costly, especially when the full capacity of the upgraded network is only required on a few occasions throughout the year, typically during hot summer afternoons and evenings. Therefore, AusNet Services is continually evaluating other methods to manage these intermittent and sometimes localised peaks in electricity demand.

The first part of this Energy Insights document examines demand management, *i.e.* reducing peak network load through innovations in infrastructure, technology, tariffs and customer agreements for our commercial and industrial customers.

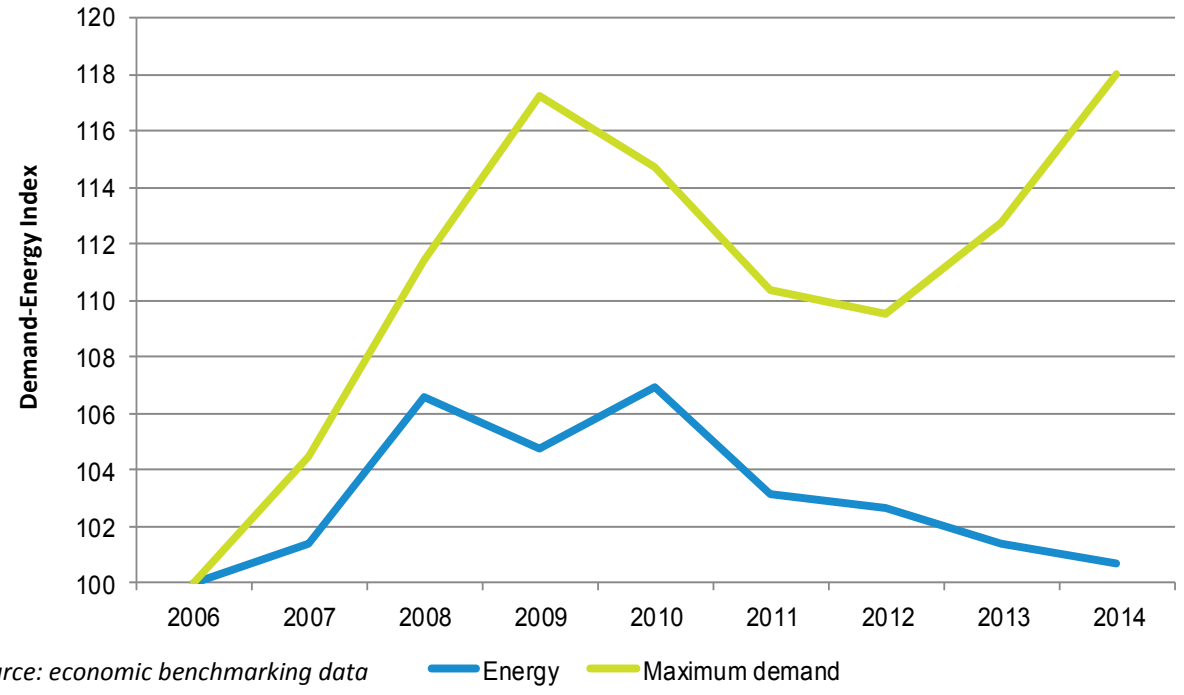
We look at the drivers of demand management, as well as outline AusNet Services' current demand management program and future priorities.

The second part of this document shows how smart meter technology is improving network efficiency and management procedures.

One benefit of smart metering is that it enables better management of peak demand growth through increased data and control, but this technology also has great potential to increase the safety and efficiency of the network.

AusNet Services is capitalising on smart metering capability to improve public safety, better plan our network investments and operate the network more efficiently on a day-to-day basis.

Electricity consumption and maximum network demand: 2009-2014



Source: economic benchmarking data

The above graph shows that while energy consumption is falling, network demand during peak periods is rising for the AusNet Services distribution network.

2. Drivers of demand management and new data technology

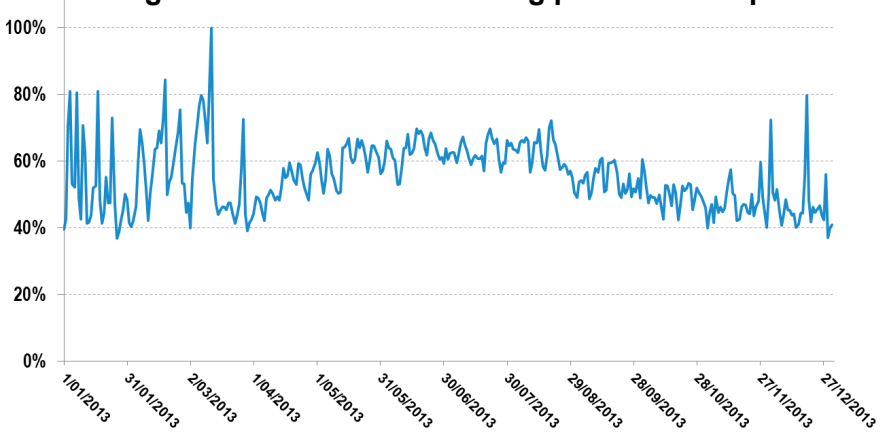
In Australia there are three principal drivers behind the development and adoption of demand management and new data technologies. These are: changes to the regulatory regime, changes in consumer behaviour and changes in technology associated with electricity generation, supply and consumption.

In our regulatory regime, we have been mandated to roll-out a smart metering capability. We are also seeing stronger incentives to save capital expenditure, and to investigate and deploy economic non-network solutions.

Changes in consumer behaviour include lower energy consumption but higher peak demand, and the uptake of embedded generation such as solar power.

Technological changes include falling costs of distributed generation and storage, the development of smart meters and smarter electricity grids and the emergence of products and services that provide end-user control and automation. (For example, air-conditioning, pool pumps, audio-visual equipment, electric vehicles and solar systems).

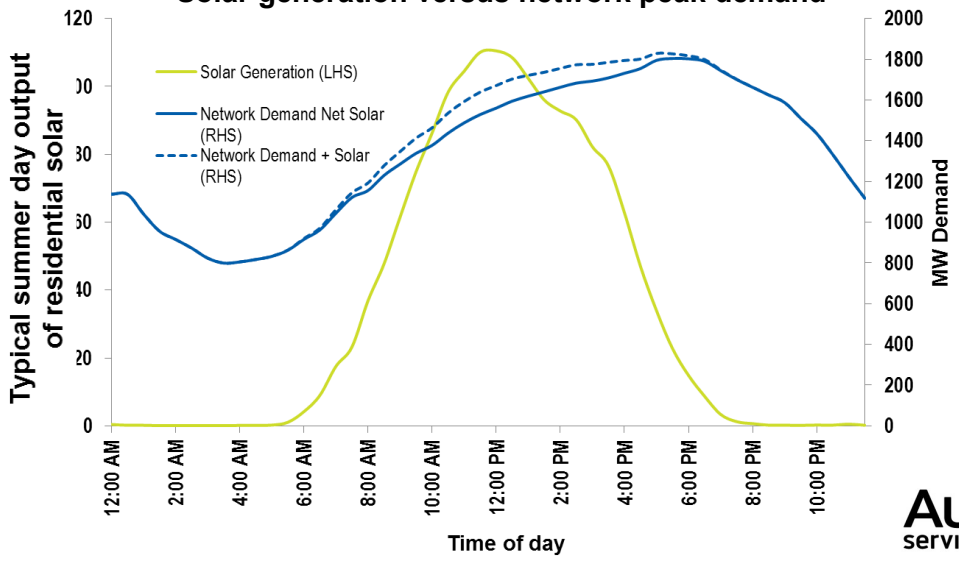
Percentage of network utilised during peak demand periods.



The graph above demonstrates how our network is only utilised at or above 80% of its capacity on a few occasions each year, representing a small percentage of the year. While around 10 percent of our customers now have solar panels, the graph below provides an example of how this does not significantly reduce the evening network peak.

Solar generation peaks at around midday and typically drops to zero at around the same time that residential demand peaks during the evening. (The left-side scale applies to the yellow solar generation curve. The right-side scale applies to the blue network demand curves).

Solar generation versus network peak demand



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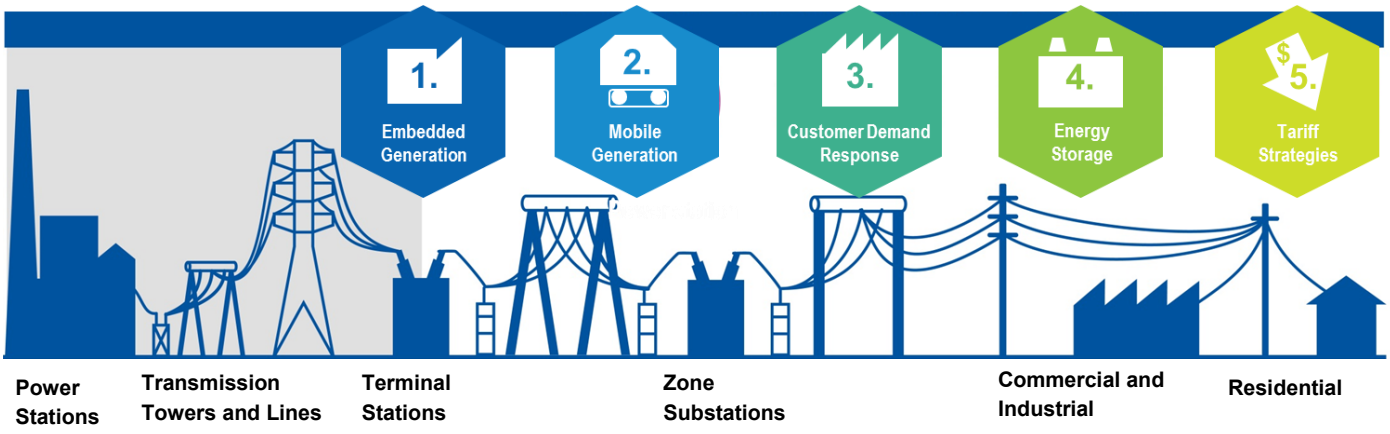
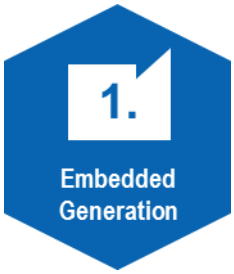
3. AusNet Services Demand Management program

AusNet Services currently implements, or is trialling for future use, a range of demand management strategies throughout our network. These 'non-network' approaches offer a cost efficient alternative to network augmentation.
They include embedded generation, mobile generation, customer demand response, energy storage and tariff strategies.

This section summarises AusNet Services demand management approaches. Across the 2011-15 regulatory period, AusNet Services has prioritised the development of new demand management approaches utilising our funding under the Demand Management Innovation Allowance. The diagram below shows how each solution is applied in our network.

Demand management solution in a network context





Embedded generation refers to Megawatt-scale semi-permanent generation that is connected to the electricity distribution network, usually at the zone substation. It has proven a technically and economically successful way of managing network capacity constraints and reliability risk. Embedded generation provides a high level of reliability and long duration of network support, but with higher fixed costs than customer demand response.

Embedded generation is a viable alternative to augmenting capacity through, for example replacing powerlines, building new zone substations or replacing transformers.

In 2012, AusNet Services successfully negotiated with a non-network provider, NovaPower, to install 10MW of gas-fired embedded generation at Traralgon. The project became operational in early 2013, deferring replacement of a zone substation transformer for at least five years. The advantages of deferral of high cost items include additional time to make more accurate consumption forecasts and better network planning decisions.

(Above). 10 MW gas-fired NovaPower generators at Traralgon.

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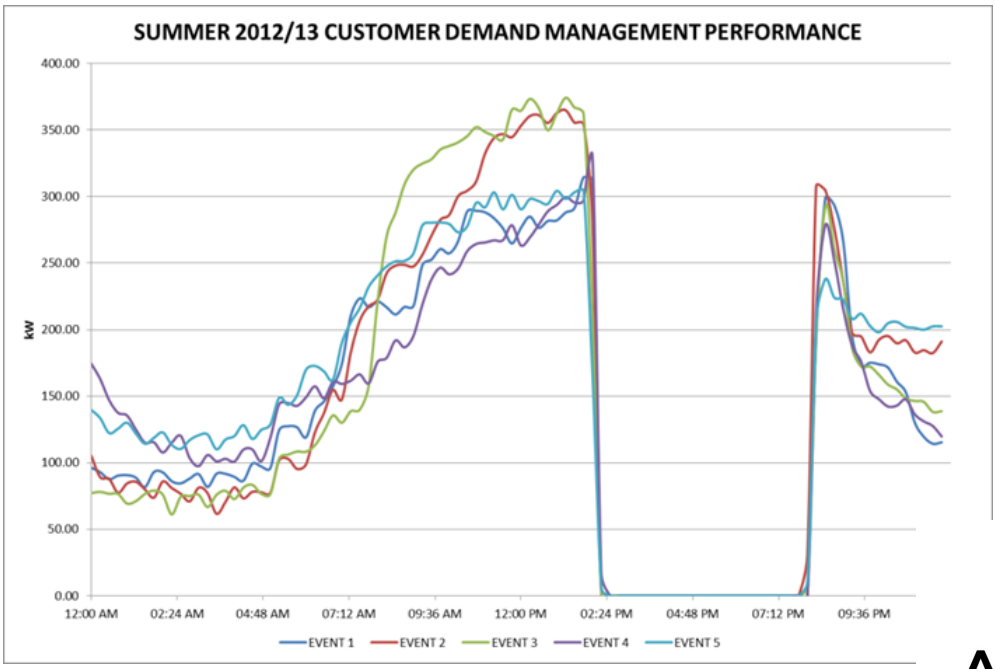
Mobile generation comprises containerised diesel generation. It is a highly flexible resource that can be deployed and relocated where needed in the distribution network within short timeframes. It provides a high level of reliability and long duration of network support, but with higher fixed costs than demand management options such as commercial and industrial customer demand response strategies. In 2013, AusNet Services purchased a fleet of four mobile generators in preparation for summer peak demand. The fleet was successfully deployed to reduce peak network demand in : Euroa, Phillip Island and Corryong.

Above. Two sets of 1MW diesel generators and transformers supporting our network in Euroa.

Commercial and Industrial (C&I) Customer Demand Response is an approach where large electricity users are contracted to support the network by reducing demand when required. Customer Demand Response offers a lower cost than most other network support options. However, reliability of response is limited, due in part, to the voluntary nature of these DM contracts and the fact that business imperatives may at times take precedence. The potential number of hours of network support is also limited. Overall, C&I Customer Demand Response represents a limited resource that is specific to a particular network area. As such, this option may only be sufficient to mitigate, rather than eliminate network capacity constraints.

The graph below shows a DM customer's network energy consumption. In 2012, we successfully negotiated an agreement with a poultry farmer for them to use their diesel generators, rather than draw power from the grid during peak demand periods, in return for network support payments. Over the 2012/13 summer period (Dec-Mar), this customer reduced network demand on five separate occasions by disconnecting from the network and running their generators.



The above graph profiles a customer's network energy consumption as they switched to diesel generation.

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4.
Energy Storage

Energy Storage using batteries currently involves high capital costs, but is expected to become cheaper in the future. (Regulatory constraints currently exist for network businesses in using energy storage systems). For energy storage to be effective at residential level, installation of a large number of systems is required.

AusNet Services is conducting energy storage trials at both network and residential levels.

The Grid Energy Storage System (GESS) trial involves a 1MWh battery array connected to the distribution network. We are also trialling 10 residential battery and solar power systems.

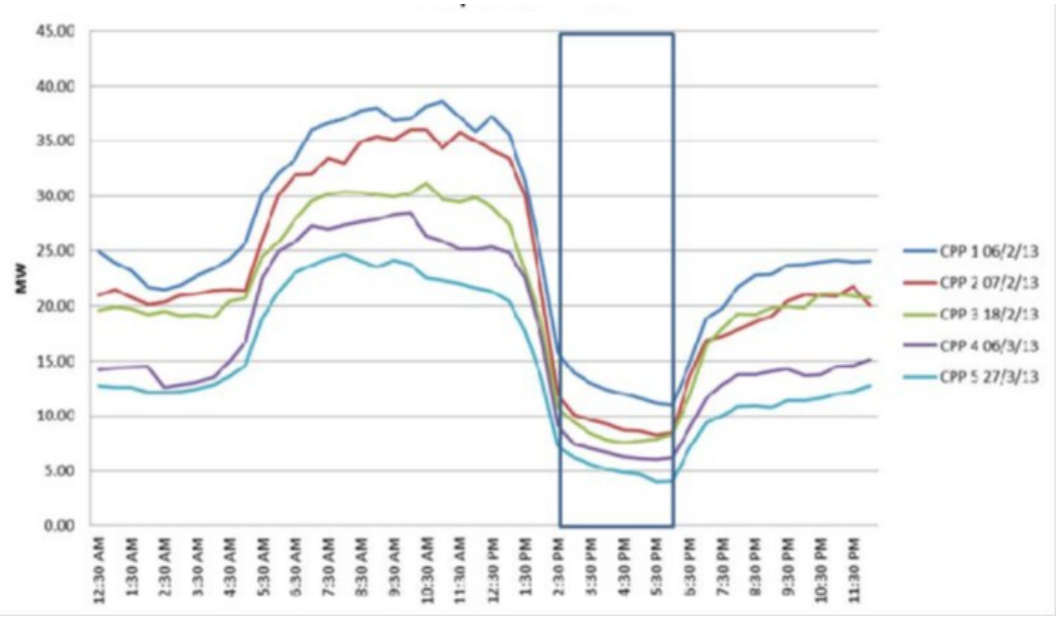
Both trials are funded by the regulatory Demand Management Innovation Allowance.

Our objectives are to understand how energy storage can effectively and economically manage peak demand, improve power quality, and provide benefits to customers.

$ 5.
Tariff Strategies

Tariff strategies have proven a cost effective form of demand management. However, reductions in demand are not targeted to constrained areas of our network, reliability of customer response is limited and challenges exist in identifying critical peak demand days far enough ahead of occurrence. In 2011, Critical Peak Demand (CPD) tariffs were introduced for large customers using in excess of 160Mh per annum. Analysis undertaken in 2013 indicated that a 2.5% reduction in peak demand was achieved across the network (42MWh); 67% of customers responded to the CPD tariff (1,333 of 1,977 customers); 181 customers reduced demand by over 40% and some customers cut demand completely, (usually by switching to generators).

Response profile: commercial and industrial customers with > 40% reduction in energy consumption 2013



The above graph shows network energy consumption from 180 customers who reduced consumption by more than 40 per cent during a critical peak period (CPP).

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4. Demand Management: Learnings and Summary

What have we learnt about demand management?

Technical and economic trade-offs are required

Demand management (DM) solutions have very different characteristics to network solutions, requiring a careful assessment of trade-offs between all options. For example: network options are usually well known, reliable and long-life, whereas DM options tend to be less well known, less reliable and of shorter life.

An emerging demand response market

Compared to some overseas markets, such as certain states in the USA, the Australian market for demand response services is relatively small. However this market is growing, and beginning to offer an increasing range of network-focussed demand response solutions. This should help networks to capture a greater number of future demand management opportunities.

Customer readiness

Demand response is a change in mindset for customers which can be difficult to overcome. Some customers also have negative pre-conceptions regarding network businesses which can form another barrier to engagement.

Opportunities with small customers

Until the recent introduction of smart metering, demand response from small customers has been impractical. Smart meters now offer the required data capability and communications channels to enable small customers to take part in demand management programs.

Summary of our demand management program.

- **Compared to traditional network augmentation investments, targeted commercial and industrial demand management offers increased flexibility at equal or lower cost than augmentation.**
- **Load reduction and storage options have limited network support durations.**
- **Optional price-based strategies are cost effective but offer lower reliability than options such as generation.**
- **Currently, our levels of experience differ across various demand management options as we continue to investigate and deploy new techniques.**

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5. Benefits of New Data Technology (Smart meters)

Smart meter technology offers a range of benefits that result from the greater operational efficiency they can provide. This section outlines the benefits that can be derived from various smart meter data opportunities or analytical capabilities.

These benefits include (i) improved public safety, (ii) better network planning and (iii) better network operation.

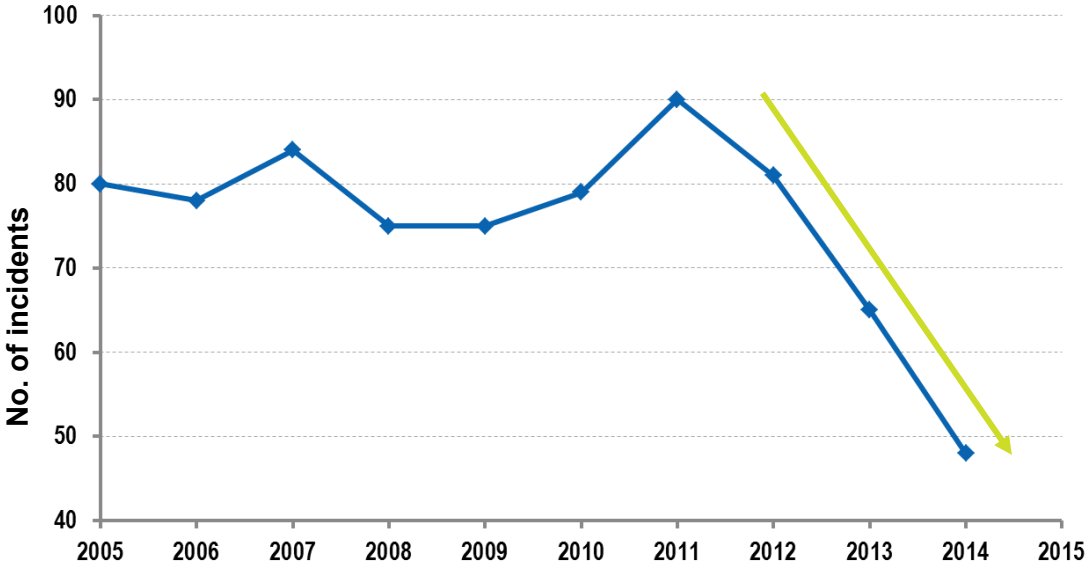
i. Smart meters are improving public safety

AusNet Services smart meters are helping reduce the risk of electric shock. (see graph below). By providing near real time load data, as well as information on the state of network assets and network performance, smart meters enable detection of poor earthing or loss of neutral, load unbalance and peak loading risks.

In the 16 months to August 2014, 850 repair jobs were actioned by AusNet Services as a result of smart meter data and analytics. 630,00 AusNet Services customers are now protected by smart meters.

Fewer electric shock incidents

Electric shock incidents 2005-2015 - 35 per cent reduction



The above graph shows a significant reduction in electric shock incidents since the introduction of smart meters led to improved fault detection.

Increased detection of potentially dangerous connections

(left) Smart meters are enabling the detection of electricity connections such as the example shown here, that may result in serious accidents.

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ii. Smart meters are enabling better network planning

Smart meters provide detailed load profile data and support network connectivity models for our low voltage electricity distribution network. This information provides a foundation for better network planning. It allows us to make more accurate decisions about levels of network investment required, which helps minimise unnecessary spending. Data and analytics from smart meters allows us to better manage substation over load failure risks, develop more accurate energy consumption forecasts and provide better notification of planned outages.

With the current growth in residential solar power and potential growth in electric vehicles, smart meters will help our planners to better integrate these distributed energy resources into the network.

More accurate information about zone substation loads

The above diagram shows how smart meters enable better network planning. The distribution substation transformer is shown as the green square in the centre. The coloured lines represent the low voltage electricity phase at each property.

Detailed information such as this is allowing better calculation of network loads and therefore, better planning.

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iii. Smart meters are improving the way we operate our network

Smart meters improve the way we run our network by providing network data at near-real time. This allows a level of monitoring and control of voltage that would not have been feasible before the introduction of smart meter technology.

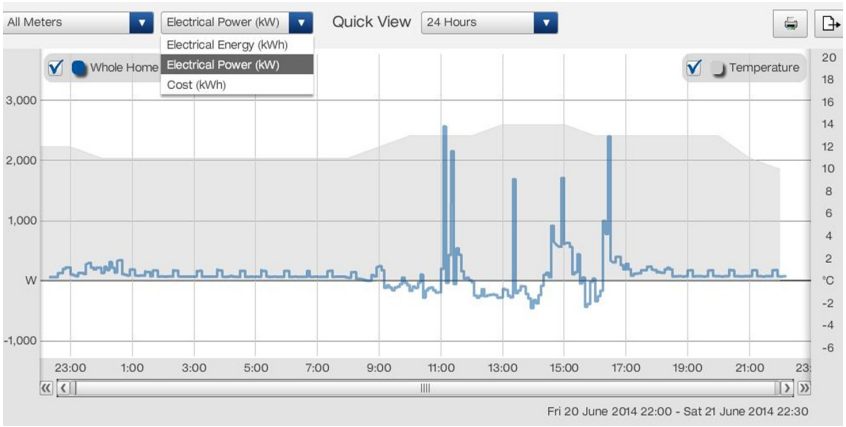
Real time will also allow us to visually represent power outages and restoration on an individual customer basis.

For the customer, better network operation means improved power quality, rapid and effective outage scheduling and response, and access to accurate, up-to-date energy usage information via our online customer portal ‘myHomeEnergy.’

Detailed, accurate power supply monitoring

The above diagram shows one way in which smart meters are improving network operations. Voltage is monitored at an individual customer level in near real time, allowing better management of electricity supply and faster detection and location of outages, which means faster restoration of power.

Empowering customers



Smart meters are empowering our customers by providing access to comprehensive energy usage information via a customer portal. The myHomeEnergy portal gives customers access to data from their smart maters, such as that shown above. This data includes tariffs, costs and consumption, and solar power exported shown in half-hour intervals and typically updated four times a day. This enables customers to make more informed decisions about their energy use.

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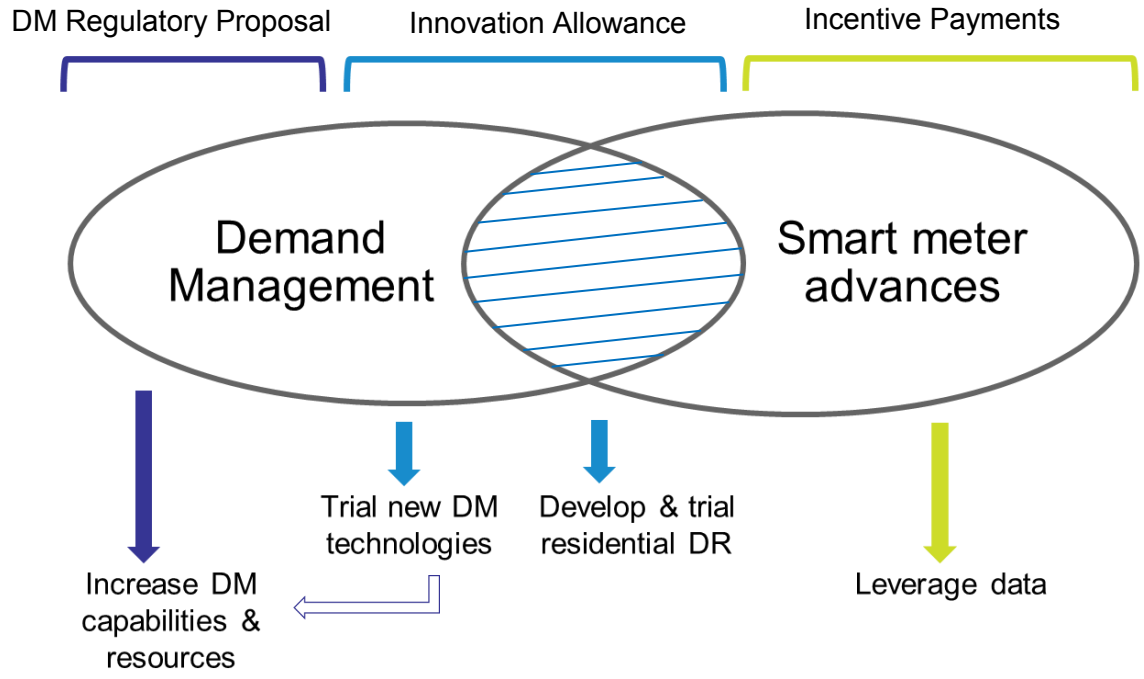
5. Future Plans

The diagram below outlines AusNet Services' future plans for demand management and smart meter advances. We plan to increase our demand management resources and capabilities and trial new technologies in this area at both commercial and residential levels. Advances in smart meters will enable us to develop and trial residential demand management, with the aim adding this new area to our range of demand management options. We also aim to leverage the data capabilities of smart meters.

AusNet Services five-year plan: demand management and smart meter advances



Demand Management Innovation Allowance

To boost demand management, we plan to propose an increase in the demand management allowance. In order to accelerate priority projects, we are aiming to increase the allowance to $10million.

The table below lists the demand management innovations that we have identified as priorities for development across the next five years.

Proposed demand management innovations

Residential Demand Response
Community peak demand incentive trial
Voluntary load control pilot & trial: air-con, pool pumps
Commercial and Industrial Demand Response
Management & integration platform to optimise Demand Response
Automation trial to improve reliability
New Technologies
Commercial trial of residential battery storage
Investigate remote community mini-grids and Stand-Alone Power Systems
Space heating and cooling technology
Distribution network modelling with smart grid control