Demand Management Innovation Strategy

TransGrid

Demand management innovation strategy

Including a proposal for a demand management innovation allowance from 1 July 2014 to 30 June 2019

Contents

1 Executive Summary

Demand management presents a compelling value proposition for electricity consumers. Thoughtful application of demand management can reshape the demand profile and allow cost-effective deferral or avoidance of investment in network capacity and in network measures to ensure reliability and security of supply. Demand management also provides a more 'granulated' approach to delivering network services, allowing network planning to be responsive to changes in demand forecasts. As a result, consumers generally can benefit from the consequent reduction in network costs in their electricity bills and even individually through participation in demand management themselves.

Innovation in demand management is expected to deliver sustainable benefits to electricity consumers in the long term. By reducing peak demand and optimising the changing supply and demand mix, demand management can allow network businesses like TransGrid to reduce network charges for consumers through the deferral and avoidance of network investment.

'Demand management' is a broad term used to refer to any deliberate change to the amount of electricity demanded from the network, and encompasses two distinct areas:

- **demand response**, 'a short-run decision to reduce energy consumption in response to a specific event' (for example, load shedding in response to a network constraint, or bringing embedded generation online), and
- **energy efficiency**, referring to 'the use of less energy for the same activity or level of output, or increasing the level of output from the same amount of energy'[1].

There are significant barriers to the uptake of demand management to defer or avoid investment in the network

The demand management market is in its infancy in Australia. On the customer side, large businesses are uncertain about how best to reduce their peak electricity use, and residences remain unaware of the importance and ultimate benefits of demand management. On the network side, the full potential of innovation in demand management is yet to be realised and key technical considerations are still unclear, such as the link between energy efficiency efforts and peak demand reduction.

TransGrid has an understanding of how to successfully procure demand management, as well as the attendant barriers to uptake. TransGrid has a proven track record – 350 megawatts procured in the Newcastle – Sydney – Wollongong area for summer 2008/09 to defer network augmentation investment, and 40 megawatts procured in the Sydney CBD in the summer of 2012/13 to mitigate network operational risk. However, numerous requests for network support proposals have been left unmet by the market. Demand management to

[1] P.11, CSIRO, 'Powering Sydney's Future – Energy efficiency'. This report will released during the launch of TransGrid's engagement on the Powering Sydney's Future project, expected in June 2014.

defer transmission network investment needs to be available at the right time, in the right place, and of a sufficiently large quantum.

In its 2009 to 2014 regulatory control period TransGrid took significant steps towards unlocking the potential for demand management in NSW. Using the demand management innovation allowance (DMIA) permitted by the AER, TransGrid partnered with universities to understand consumer behaviour, and with distribution businesses to test broad-based demand management projects with residences and small- and medium-sized businesses. TransGrid also developed its own demand management project, iDemand, to educate consumers about the importance of reducing peak demand and to contribute to wider demand management research. The DMIA projects demonstrated that lack of information about peak demand was a significant barrier to demand management projects, that there is untapped potential for energy efficiency measures by large businesses, and that the lack of open, transparent information to market about demand management opportunities is inhibiting its uptake.

TransGrid proposes demand management innovation targeting collaboration, market understanding and development, and technology trialling from 2014 to 2019

TransGrid is seeking to build on its foundational demand management innovation work by again seeking a DMIA. By combining knowledge from its 2009 to 2014 DMIA projects with experience seeking demand management for network support, TransGrid's aim is to develop the demand management market to provide greater benefit to consumers.

TransGrid's demand management innovation activities will work towards the following key objectives:

- facilitate a flexible demand management marketplace
- develop and grow the demand management market
- pinpoint key drivers of peak demand in NSW in order to better source demand response
- understand the electricity use and behavior of large consumers, in order to surface their potential to provide demand management
- test and apply large-scale demand management tools and techniques, and
- identify and leverage the transmission-specific contribution to the demand management ecosystem.

To meet these objectives, TransGrid proposes projects in three key focus areas:

- **Collaboration**. TransGrid proposes projects to improve consumer understanding of demand management, to capture synergies across different industry participants' demand management activities, and to reduce regulatory barriers to demand management uptake. TransGrid's role in the supply chain means that TransGrid has close relationships with the market operator, generators, distributors and large electricity consumers as well as a unique, holistic view of the NSW electricity network itself. As such, TransGrid is well placed to encourage collaboration on an industry approach to demand management.

- **Market understanding and development**. The demand management market is still maturing. To improve understanding of the market, TransGrid proposes projects such as analysis of key drivers of peak demand, and surveys of businesses' energy behaviours and demand response capacity. To help develop the market, TransGrid proposes a number of projects, the cornerstone of which is a geospatial integration of demand response and network constraints. This project would bring together potential demand management providers and anticipated network constraints over the planning horizon in a map-style format. TransGrid considers that this service would go some way to addressing the informational barriers to uptake of demand management in NSW as well as facilitating an automated demand response mechanism.
- **Technology trialling**. Overcoming practical barriers to application of demand management tools and technologies is the final key focus area of TransGrid's DMIA proposal. Proposed projects range from capturing the untapped energy efficiency potential in large businesses' space heating and cooling systems to trialling large-scale storage solutions. In particular, TransGrid proposes focusing on larger consumers and grid-scale solutions to capture the latent demand response capability in both areas and to best leverage TransGrid's position in the electricity supply chain.

To fund the projects in these three key areas, TransGrid is proposing a total of $18 million across the five-year 2014 to 2019 regulatory control period. This is a substantial increase from the $5 million allowance for the 2009 to 2014 control period, reflecting feedback from consumers and TransGrid's commitment to demand management innovation. Each project would be contingent on an opportunity test and a value test to ensure that the line of sight between the demand management innovation objectives and the project outcomes is clear, and that the project is expected to deliver net benefits to consumers.

Consumers and policymakers are calling on network businesses to commit to demand management. TransGrid is dedicated to increasing demand management uptake in NSW.

Consumers support TransGrid increasing its investment in demand management innovation, on the understanding that reducing electricity use through demand management can allow for long-term savings on network costs. TransGrid engaged an independent customer research company to consult with consumer advocates, large energy consumer representatives and a representative sample of residential consumers and small- and medium-sized businesses in November 2013. On demand management, sentiment was clear and compelling, with consumers endorsing a mooted $2 million per annum increase in investment.

TransGrid's Board and Executive are committed to ensuring that demand management is part of 'business as usual'. An allowance dedicated exclusively to demand management innovation is crucial for TransGrid to unlock the demand management potential of NSW and the ACT.

2 The case for demand management

TransGrid is committed to supporting demand management activities. Improved management of electricity demand is in the long-term interest of electricity consumers where it provides a cost-effective way to reduce the need for investment in the electricity network and therefore reduce overall network charges for electricity consumers.

'Demand management' is a broad term used to refer to any deliberate change to the amount of electricity demanded from the network, and encompasses two distinct areas:

- **demand response**, 'a short-run decision to reduce energy consumption in response to a specific event' (for example, load shedding in response to a network constraint, or bringing embedded generation online), and
- **energy efficiency**, referring to 'the use of less energy for the same activity or level of output, or increasing the level of output from the same amount of energy'[2].

The current low electricity demand growth environment is a prime opportunity to boost demand management innovation and procurement. Demand management options for addressing network needs are particularly cost-effective in a low demand growth environment where a small forecast growth in demand may be best met by a relatively inexpensive demand management solution rather than a higher capacity network solution.

This section considers the external drivers for innovation in demand management, TransGrid's own commitment to demand management, TransGrid's role in the National Electricity Market's demand management ecosystem, and the business case for a targeted 'demand management innovation allowance' in TransGrid's revenue allowance.

2.1 The demand management ecosystem

'Demand management' is a broad term used to refer to any deliberate change to consumers' electricity consumption. When a consumer is reacting to an external driver, this demand management activity can be thought of as 'demand side response', or 'demand response'.

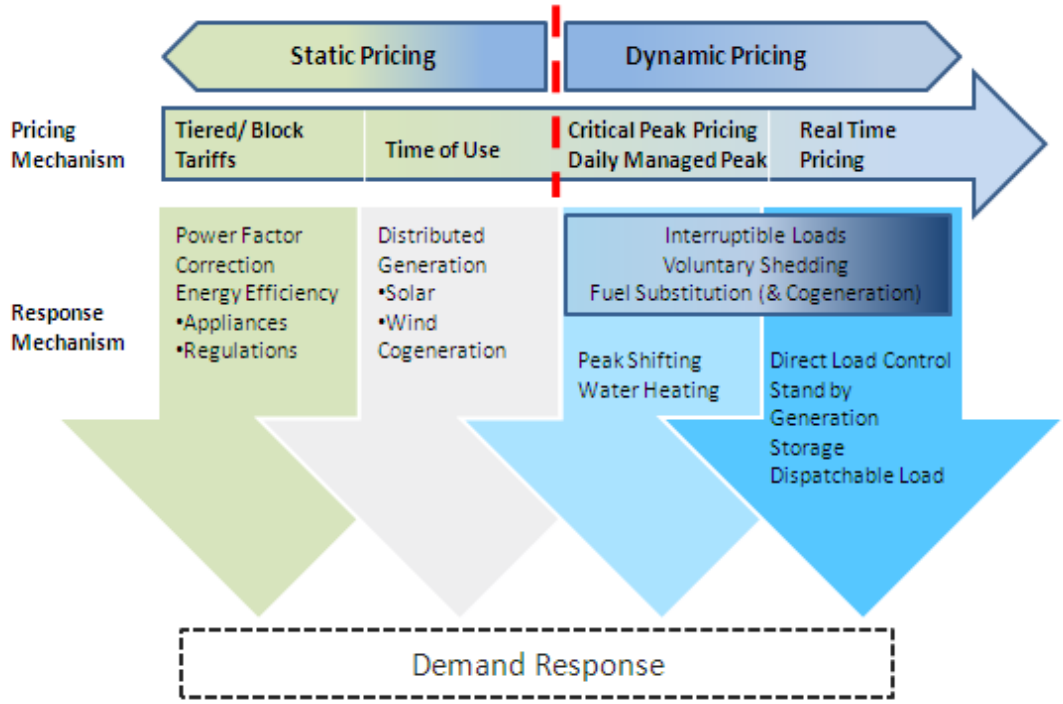
Demand management is increasingly being used to manage peak demand on the electricity network and therefore reduce the need for network investment, however the embryonic nature of the demand management market has so far contributed to limited application.

The demand response ecosystem can be framed by thinking about the different available response mechanisms and the pricing mechanisms that might drive them, as shown in Figure 1 below. This framework can be used to contextualise different demand management projects, although it doesn't capture the emerging complexity of the ecosystem as smaller consumers increasingly participate in the energy delivery and demand response process (due to the onset of smart grid investment at the distribution level and the Australian Energy

[2] P.11, CSIRO, 'Powering Sydney's Future – Energy efficiency'. This report will released during the launch of TransGrid's engagement on the Powering Sydney's Future project, expected in June 2014.

Market Commission's dedication to increasing demand side participation in the market, as per the Power of Choice review).

Figure 1 The demand response ecosystem



Using the underlying pricing/incentive framework shown in Figure 1 provides a view of where a number of programs exist largely based on a historical view of the industry aligning with various pricing mechanisms. Initiatives range from those typically classed as energy efficiency as applied to small residential customers: the impact only being reflected through a standard accumulation meter, billed quarterly and a tiered block pricing tariff (no real feedback loop); through to larger customers with interval metering and the ability to respond closer to real time.

TransGrid uses demand side response as network support[3] to provide a viable alternative to network investment to meet a network need, for example to defer the need for capital expenditure to augment the transmission network to meet a forecast increase in demand.

2.2 Regulatory and policy drivers

The National Electricity Rules specify that TransGrid must consider non-network options (such as demand management) when undertaking the regulatory investment test for

[3] National Electricity Rules version 60 defines a network support agreement as 'An agreement under which a person agrees to provide one or more network support and control ancillary services [NSCAS] to a Network Service Provider, including network support services to improve network capability by providing a non-network alternative to a network augmentation'. A network support and control ancillary service is a service 'A service with the capability to control the active power or reactive power flow into or out of a transmission network to address an NSCAS need'.

transmission (RIT-T). The RIT-T is a public consultation process and must be undertaken whenever the most expensive credible option to address an identified network need is estimated to cost more than $5 million. The regulatory framework is designed to incentivise network businesses to seek cost-effective non-network options to defer capital expenditure.

TransGrid's statutory, social, environmental and commercial objectives under the *Energy Services Corporations Act 1995* combine to mean that TransGrid should undertake to minimise the impact of its network where it can otherwise meet its transmission service obligations. Cost-effective delivery of non-network alternatives to network investment serves to minimise the impact of TransGrid's network.

Finally, policymakers and commentators have made clear that network businesses are expected to boost their use of demand management in order to minimise network charges to consumers.

Potential economic benefits of demand response

'The economic potential for demand management[4] arises because it can:

- avoid an inefficiently high rate of peak demand growth, delaying the need for network augmentation and reducing the size of peak-specific network investments
- improve the utilisation (and productivity) of supply side capacity by shifting the timing of electricity use and reducing the gap between average and peak consumption — achieving allocative efficiency
- decrease investment in costly peak-generation and reduce generation costs by reducing reliance on higher cost peaking supply (such as open cycle gas turbines)
- improve competition and reduce the ability of an individual generator to exercise market power in the wholesale market during congestion at peak periods (Borenstein 2005; Borenstein and Holland 2005; Bushnell 2005; Joskow and Wolfram 2012)
- improve supply reliability, including increasing load shedding options and assisting with the restoration of power after loss
- reduce volatility in demand (and wholesale prices) allow operational efficiencies for network businesses, including from advanced metering infrastructure, which enables remote access to consumption data, assists with more timely and less costly disconnection and reconnection, and improves network planning and detection of outages
- in the short term, provide scope for some consumers to receive reduced electricity bills and, in the longer term, could slow the rate of growth of future electricity bills for all consumers.'

Pp. 353-354, Productivity Commission 2013, *Electricity network regulatory frameworks,* Report No.62, Canberra.

2.3 Consumer support

Consumers are calling on network businesses to increase their use of demand management and therefore network investment requirements. In late 2013, TransGrid consulted with consumers about its 2014 to 2019 revenue proposal and received extremely strong support for a step-change increase of $2 million per year in TransGrid's operating expenditure, to be

[4] In this excerpt the Productivity Commission uses 'demand management' to refer to demand response – that is, 'peak-focused' demand management activities, excluding energy efficiency and energy conservation.

dedicated to finding ways to reduce electricity demand[5] and subsequently benefit consumers through reduced network charges.

In 2013 TransGrid consulted with consumers on its draft revenue application for 2014 to 2019. In November, three consultations were held:

- a consumer advisory panel (attended by advocates for consumers)
- a large energy users roundtable, and
- deliberative forums with consumers in the Sydney CBD, Parramatta and Wagga.

During the November 2013 consultations TransGrid gauged sentiment towards TransGrid investing in demand management innovation, with the following findings as reported by the market research company engaged to facilitate the consultations:

> 'Consumer Advisory Workshop participants were the most interested in TransGrid's non-build efforts, with around three-quarters saying they did not feel it was doing enough in this area. Large Energy User Roundtable participants also felt that TransGrid should be doing more than it was proposing.
>
> Some members of the Consumer Advisory Workshop were interested in knowing more about what TransGrid does to assess non-build options for each project.
>
> …
>
> In response to strong support for TransGrid to do more work in this area, TransGrid gave a presentation on this issue to residential and [small and medium enterprise] SME consumers. TransGrid asked if they would support increasing its operating expenditure by $2 million each year over five years to invest in ways to reduce energy demand and potentially, the amount that will need to be spent on new infrastructure. They were told that this would equate to an average of 25 cents per household per year. Using a scale of 0 to 10 where 0 means not at all acceptable and 10 means extremely acceptable,75% gave a score above the neutral point of five, with almost two thirds (63%) giving a rating between eight and 10.
>
> Generally residential and SME participants were positive about TransGrid's efforts to avoid building new infrastructure and its efforts in this area contributed to improved perceptions of the organisation. However, it was clear that lack of understanding about peak demand impacted responses. The concept of demand management was well received but some were worried that it represented an unfair burden on industry and that it could constrain future growth. Conversely, there was a lot of interest in learning more about smart meters and what individuals could do to use less electricity. There was also strong interest in TransGrid's pilot battery storage project and the potential this gave to increase use of renewable energy sources and allow households or communities to move off the grid.
>
> Overall participants felt that potential benefits to both the future of the electricity system and, for some, the environment as well, could be well worth an investment that most regarded as trivial.'
>
> P.11, Newgate Research, 'Summary of consultation on five-year plan' report, March 2013

[5] p.11, Newgate Research, 'Summary of consultation on five-year plan' report, March 2013.

2.4 TransGrid's role

TransGrid's Board and Executive are fully committed to demand management. Two of TransGrid's current corporate initiatives demonstrate this commitment:

- continuing to be proactive in the promotion of demand management and non-network alternatives, and
- developing a greater understanding of electricity consumer behaviour and future usage intentions.

TransGrid procures demand response as network support to reduce network loading at critical times. That is, demand response is a non-network alternative used to meet an identified network need. TransGrid promotes non-network options to defer or avoid capital expenditure on network options to meet a need, wherever the non-network alternative is prudent and cost efficient.

As the market for provision of demand response as network support is embryonic, TransGrid's focus has been on development of the market and securing network support to address network needs (targeted network support) where it is feasible and cost effective to do so.

TransGrid has previously been successful in securing targeted network support.

- TransGrid identified a need and secured approximately 350MW of network support in the Newcastle-Sydney-Wollongong area in 2006.
- TransGrid & Ausgrid joint planning identified a need for network support for the Sydney inner metropolitan area. TransGrid secured network support to cover 40MW for operational risk mitigation over the summer of 2012/13.

Currently, TransGrid uses a process taking into account the amount and location of network support required and the feasibility of delivering non-network alternatives in time and within budget to assess if a request for proposals is to be issued. With the introduction of the National Electricity Rules requirement to indicate in the transmission annual planning report if and when requests for proposals are to be issued, TransGrid has developed a list of criteria to assist this decision making process.

Factors considered in developing the criteria include:

- Outcomes of the joint planning process with distribution network businesses and directly connected customers on initial assessment of the potential and feasibility of non-network alternatives to meet an identified need or relieve an emerging constraint.
- The amount of capital investment able to be deferred and its commercial value.
- The length of deferral that is possible and feasible.
- The amount of work required to issue and respond to a request for proposals. This is not inconsiderable in terms of defining the constraint, preparation of the request for proposals, assessment of offers by proponents, commercial considerations and the

administration of the agreements with the network support providers. Similarly, responding to a request for proposals can be a considerable burden to proponents.

- The size and location of expected demand management required. This also takes into account the materiality and usefulness of the information and the degree to which there are feasible demand management projects likely to come forward.
- The time horizon – that is, how long does TransGrid have to make the decision to commit to a solution? Sufficient time must be allowed from the decision as to whether to issue a request for proposals or not, to the time of a system support investment decision having to be made.

When considering the feasibility of implementing non-network alternatives over network alternatives, the following factors are taken into account:

- economic efficiency as in the RIT-T
- technical performance of the non-network alternative to ensure applicable reliability standards are met
- risks associated with non-network alternatives, and quantification of those risks in terms of impact on TransGrid's delivery of network services, and
- commercial assessment including financial analysis.

The current and future energy landscape is characterised by modest growth in demand and energy. As a result, the case for consideration and implementation of demand management (non-network options) is in many ways more compelling. As load forecasts have moderated, the starting points for future growth have generally been lower and the rate of increase (growth) also lower. TransGrid and the wider industry must take this opportunity to develop, trial and implement effective and commercially viable non-network solutions to managing demand.

2.5 Demand management innovation value proposition

In its 2009/10 – 2013/14 revenue application to the Australian Energy Regulator, TransGrid proposed an allowance of $1 million per annum to develop and investigate innovative demand management responses to emerging constraints in the transmission network. This allowance was to build on work already undertaken jointly with Ausgrid on the Demand Management and Planning Project between 2003 and 2008, and to extend it to include all NSW/ACT distribution businesses.

The AER considered that it was prudent and reasonable for TransGrid to investigate opportunities for efficient non-network alternatives to network augmentations and noted that demand management incentive schemes were included as part of the regulatory framework for distribution businesses. Overall, the AER determined that the demand management allowance reflected the efficient costs that a prudent operator in the circumstances of TransGrid would require.

To date, TransGrid's strategy has not been to limit the research projects undertaken to a specific area of network support but rather to incorporate as broad a scope as possible to assist in:

- understanding various types of network support technology, including merits and drawbacks
- understanding barriers and constraints to broad-scale uptake of network support initiatives.
- exploring alternative approaches to achieving demand reduction,
- analysing interrelationships to related areas such as energy efficiency, and
- identifying issues in the regulatory and policy framework.

TransGrid is proposing that the demand management innovation allowance be continued in its 2014 to 2019 regulatory control period. Consumers, policymakers and the regulator expect that TransGrid will seek demand management as network support, however without innovation in the demand management market (and its application by networks), this goal is highly unlikely to be fully realised.

Investment in demand management innovation can deliver benefits to electricity consumers by allowing deferral or avoidance of transmission network investment, and therefore reducing the network charge component of electricity bills. At present, the biggest potential constraint on TransGrid's network is in the metropolitan Sydney area (being considered through the 'Powering Sydney's Future' project). Network support is likely to be a viable option for deferring the investment in the network to alleviate the constraint, and the outcomes of this demand management innovation strategy are expected to support this deferral. TransGrid is also proposing to undertake an active demand response 'market development' program as part of that project by procuring 'pre-emptive' network support.

In addition, the benefits of demand management innovation are not constrained to reduction of transmission network prices. Demand management has the potential to reduce costs throughout the electricity supply chain by reducing the need for investment in generation capacity and possibly in distribution network capacity. This in turn should flow through to savings for consumers.

TransGrid's findings from past demand management network support activities are summarised in Section 3 below. These findings have allowed TransGrid to target its proposal for a demand management innovation allowance for the upcoming regulatory control period, and this proposal is provided Section 4.

3 TransGrid's demand management experience

The first two sections below explore in detail TransGrid's demand management insights to date – in Section 3.1, findings from the 2009 to 2014 demand management innovation allowance, are listed, and in Section 3.2 TransGrid's findings from attempting to procure network support are reported.

Finally, in Section 3.3, the barriers to demand management uptake are summarised and TransGrid's findings so far are pulled together to lay out a roadmap for TransGrid's future exploration of demand management innovation.

3.1 Findings from 2009 to 2014 innovation allowance

During its 2009 to 2014 regulatory control period, TransGrid used the demand management innovation allowance to undertake projects in three broad areas:

- joint load reduction trials and research projects through partnerships with distribution network businesses
- implementation of the latest technology in demand reduction solutions
- gaining an in-depth understanding of industrial, commercial and residential energy consumers.

In summary, TransGrid's 2009 to 2014 DMIA activities indicate that:

- consumers' lack of trust in the electricity industry is a barrier to implementation of demand management projects, although willingness to participate increased after consumers learnt about the impact that reducing peak demand has on network charges and other energy users
- commercial businesses may not be fully exploiting energy efficiency opportunities because of lack of understanding of technical opportunities and mismatch in incentives acting on owners and tenants
- early and clear information about network support opportunities could contribute to greater uptake of network support, and
- industry collaboration and understanding of demand management ecosystem is needed, to allow synergies to emerge and to prevent duplication of efforts.
- TransGrid's role in the demand management ecosystem is different to that of the distribution businesses.

Findings from individual projects are listed in Table 1 below.

Table 1 Key findings from DMIA 2009 to 2014 projects

Project	Key findings
Direct control of air conditioners (CoolSaver) with Endeavour Energy	• Direct control of air conditioners can successfully reduce peak demand • The cost of peak demand reduction is very high compared to TransGrid's most recent network support procurement, due to need for marketing and customer education • Difficult to quantify the potential market (ie customers with appropriate air conditioner units • Evidence of pre-cooling before event, and 'bounce-back' after the event
Peak time rebate (PeakSaver) with Endeavour Energy	• Evidence of pre-cooling before event, and 'bounce-back' after the event • The product was generally not attractive to energy efficient customers • The cost of peak demand reduction is very high compared to TransGrid's most recent network support procurement, due to need for marketing and customer education
DM programs with industrial and commercial customers with Endeavour Energy	• Cost of program is economic (using TransGrid's most recent network support procurement as the baseline) • There is opportunity to reduce commercial and industrial demand and total energy usage through education and energy auditing
Social marketing and education with Endeavour Energy	• Largely positive feedback about installation of residential energy monitors – that they were fun, easy to use, provided education benefit
Energy efficiency awareness campaigns with Endeavour Energy	• Increased understanding of how best to communicate demand management benefits to end users-
Energy and demand audits with industrial and commercial consumers with Essential Energy	• Low initial take up rate • Project is due to finish June 2014
Dynamic control of small hot water cylinders with Ausgrid	• Take-up rate is challenging on a moderate marketing budget. • Personally addressed letter is more effective than a personally addressed marketing piece. • Amount of financial incentive, or level of subsidy, is only one of many factors affecting outcome. • Strong sales support is needed to prevent registrations from dropping away. • Install costs need to come down further for broad based deployment. (AS 4755 compliance may help with small dynamic control cylinders). • Small cylinders (<100L) show good tolerance for dynamic control
Subsidised off peak connections for electric hot water with Ausgrid	• Take-up between 1 - 3% following one-off mail out of letters outperformed more expensive mail pieces • Follow up phone calls doubled the take-up rates • Small hot water systems - $50 not large enough incentive • Off Peak connections - $99 and $199 achieved similar results

Project	Key findings
	• Potentially high dropout rates for programs that require meter installations (one third for more attractive offers and two thirds for less attractive offers)
Improved power factor of commercial customers with ActewAGL	• The project is expected to bring 2,000 kVA in demand reduction through improvement in power factor • Project is due to finish June 2014

iDemand	• Project due for completion September 2014. Intended outcomes are to:
	  • educate electricity consumers about the importance of reducing peak demand
	  • facilitate research opportunities and market development for demand management in Australia
	  • advocate for awareness and understanding of demand management among TransGrid's staff, and
	  • promote increased demand management uptake in Australia.

Demand management 'triage database' to identify network support options (with work commissioned from Oakley Greenwood)	• Consideration of how best to approximate demand response potential using secondary data • Difficulty gathering information due to lack of data availability and distribution network businesses' privacy concerns
Demand management industry collaboration forum	• Very positive feedback from industry attendees at the forum
Co-managing home energy demand with RMIT University	• Lack of customer understanding of peak demand, industry and appliance energy usage prevents demand management uptake • When householders understand peak demand issues, they demonstrate a willingness to participate in demand management initiatives, and adopt a collaborative relationship with utilities. • Positioning electricity as a limited resource for short periods of time resonates with the successful positioning of water as a precious and restricted resource during the recent drought.
Analysis of peak electricity demand in NSW with the University of Technology, Sydney	• Ongoing. Early findings point to the value of end use modeling and similar techniques for understanding recent structural breaks in the forecasting models.
Impact of demand reduction program on transmission network planning with University of Queensland (UniQuest)	• Considerable demand response potential in different sectors (residential, industrial, commercial, etc.) within NSW
Sponsorship of Research Conversazione with the University of Sydney	• Promotion of innovation in the demand side of the energy industry
Low energy high rise project with the Warren Centre for Advanced Engineering	• There is significant potential for energy savings in commercial buildings

3.2 Findings from previous demand management procurement

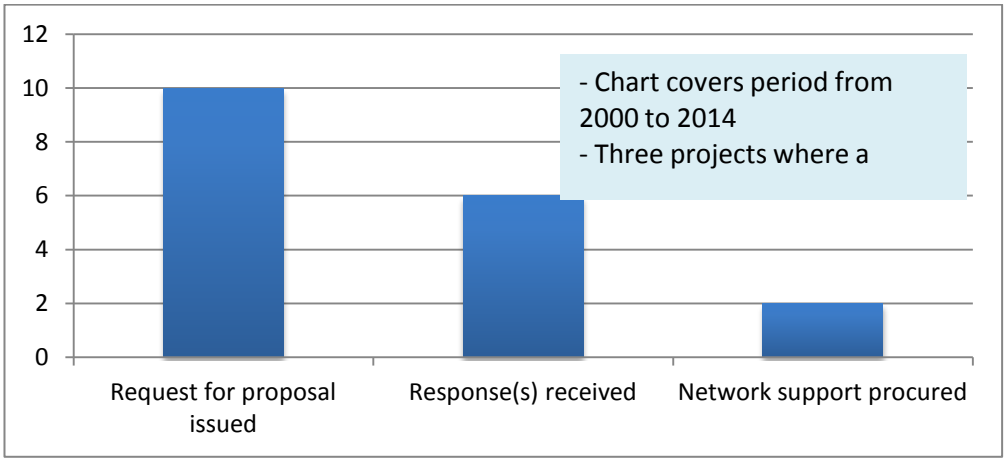
TransGrid's experience seeking network support from the market as part of capital works deferral demonstrates the limited ability of the current demand response market to deliver network support options. In summary, this experience with going to market for network support indicates that:

- there is significant room for development of the demand management market
- potential network support proponents need early, clear signals about opportunities, and
- TransGrid must engage effectively with the community and relevant stakeholders.

Since 2000, TransGrid has issued a number of requests for proposals (RFPs) for network support to avoid or defer network investment, with the following results:

- North/west NSW 2011 – one proposal, suspended due deferral of decision by mining company in Gunnedah/Narrabri basin. RFP 63/11
- South Coast (Nowra) 2011 – Two responses for small capacity, then both withdrew. RFP 62/11
- Far North Coast 2010 – one response : not financially efficient cost. RFP 51/10
- Mid-North Coast of NSW – 2009 : EnerNOC : 4MW. Project deferred. RFP 130/10
- West & Central West NSW : 2007 – No firm proposals NO RFP- enquiries by Energy Response (EnerNOC's predecessor)
- South West of NSW - mid 2000 : No response
- NSW Central Coast – early 2000's: No response
- Western Area of NSW - 2000 ; No response
- Newcastle-Sydney-Wollongong area – 2006 : Network support agreement signed with 3 service providers for 350MW for summer 2008/09. RFP 104/06
- Sydney Inner Metropolitan Area 2009 – successful network support agreements with EnerNOC and Ausgrid (40MW) for summer 2012/13. RFP 105/09.

Figure 2 Responses to TransGrid requests for demand response proposals



These results emphasise the fact that for demand response to be effective as network support for the transmission network, it must be:

- In the right place. The response needs to occur in the area of network constraint, if support is to be provided at a sub-optimal location its magnitude must be greater.
- At the right time. The response must occur at the time the network is under the most pressure to be effective; and
- Of a sufficiently large magnitude (megawatts).

In 2013 TransGrid commissioned an independent investigation into its own public consultation process, using four recent projects as case studies[6]. Several findings and recommendations were particularly focused on whether TransGrid had appropriately considered demand management options as an alternative to network investment:

- Finding 4: TransGrid gave little or no consideration to public involvement in, or communication of, project need and non-network alternatives.
- Finding 5: TransGrid consults communities too late in the project lifecycle after key decisions have been made.
- Finding 12: People want to be involved earlier in project planning, receive more detailed project information, and have access to TransGrid staff on the ground.

3.3 Targeting TransGrid's demand management innovation activities

TransGrid's learnings about demand management indicate that innovation activities should now be targeted in the following areas:

- facilitating the growth of the demand management market, in part through open and transparent planning in collaboration with external stakeholders
- gaining a deeper understanding of the demand management marketplace
- better understanding the peak demand profile in NSW, for example the link between energy efficiency and peak demand
- investigating large-scale solutions to facilitate demand management, including the role of storage
- the transmission-specific contribution to the demand management ecosystem, and
- improved understanding of the larger-consumption customers (commercial, industrial and agricultural) and their potential provision of demand management
- boosting engagement about demand management with the community and other stakeholders.

[6] RPS, 'TransGrid review of public consultation final report', December 2013.

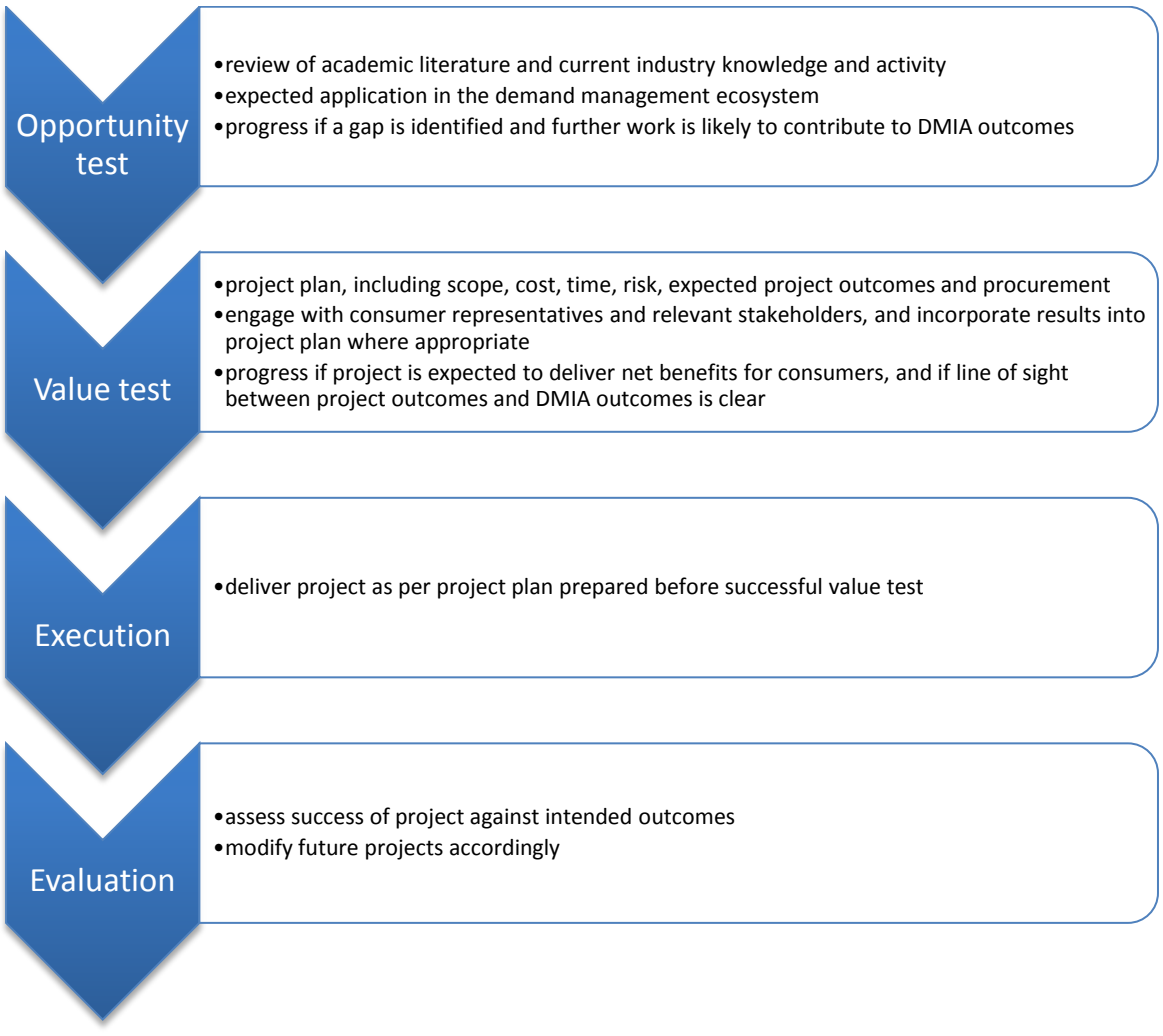
4 2014 to 2019 DMIA proposal

TransGrid proposes to undertake demand management innovation activities from 2014 to 2019 in three key areas: collaboration, market development and technology trialing. Section 4.1 provides TransGrid's proposed gated decision process for undertaking DMIA projects, and Sections 4.2 to 4.4 consider proposed DMIA projects in each of the three key focus areas. Proposed investment figures are provided in a separate attachment.

4.1 Innovation project assessment process

The demand management ecosystem is in flux as policies, technologies, consumer demand and sentiments continue to change. Based on its foundational demand management innovation activities, TransGrid has an understanding of where future efforts should best be expended. TransGrid considers that it is too early to lock in which projects would best address the three focus areas in the 2014 to 2019 regulatory control period. As such the projects considered in Section 4 would be subject to cost-benefit analysis and a gated decision process (shown in Figure 3) before they are undertaken, and alternative projects would be considered if they are found to have value.

Figure 3 Demand management innovation project proposal assessment process



4.2 Collaboration

As described in Section 2, the barriers to demand management implementation include lack of information for consumers and lack of a consistent and holistic approach from industry stakeholders. Moreover, there appear to be significant regulatory barriers to the wider use of network support by network businesses, for example the incentive regime applied to network investment. These issues are likely to be preventing preventing industry from capturing synergies across the supply chain in order to ensure an appropriate level of demand management occurs and consumers reap the benefits through reduced regulatory prices.

TransGrid proposes using its 2014 to 2019 DMIA allowance to collaborate with industry, consumers and policymakers. Four proposed projects are considered below.

4.2.1 Collaborative forum

As the transmission network in NSW, TransGrid could potentially be the industry voice or leader on the approach to demand management in NSW. This is because:

- TransGrid has a unique role in the supply chain, with close relationships with the market operator, generators, distributors and large electricity consumers
- TransGrid has experience in procuring network support, and
- TransGrid has access to a wealth of information about the electricity network and demand profile in NSW, and a unique bird's eye view of the system that could allow capture of synergies and prevention of duplicative work.

With the 2009 to 2014 DMIA TransGrid hosted two demand management innovation forums. These forums hosted the NSW and ACT distribution businesses, and universities which collaborated with TransGrid for the DMIA.

A key success factor in the adoption of demand management principles and the establishment of the various trials in New South Wales has been through collaboration of all parties involved.

The concept of the forum is to provide organisations with an opportunity to update the industry on their demand management programs and research initiatives. Essentially, the forum is a venue for TransGrid and the distribution businesses to explore the way forward for opportunities to cooperate and collaborate in demand management. It also provides an opportunity for industry stakeholders to meet in person, exchange ideas and experiences.

For 2014 to 2019, TransGrid proposes expanding the forum concept to support collaboration among all stakeholders – network businesses, expert bodies, consumer representatives, and others. Given the number of participants in the supply chain for the National Electricity Market, it is crucial that all stakeholders work together to decide on the best path forward for deploying demand management in the market.

4.2.2 Residential consumer education

Both trials and research have shown that there remains a significant task ahead in educating consumers about the benefits of demand management. Research carried out by RMIT University as part of TransGrid's 2009 to 2014 DMIA activities identified that consumer understanding of and trust in the electricity industry is lacking and therefore may provide further challenges to implementing trials on a large scale. The research also outlines the inadequate consumer understanding of peak demand and its impact on the electricity network. Fortunately, consumers have shown a willingness to participate in demand management initiatives once they understand peak demand in terms of a limited resource that has detrimental effect on the health of other energy users (for example blackouts in hospitals and nursing homes due to stress on the network).

As the residential sector contributes greatly to peak demand, it is crucial to explore how best to overcome the barriers to widespread uptake of demand response during peak periods .

TransGrid intends to develop educational material for residential consumers about how to reduce electricity use at times of peak, how best to take part in demand management programs, and about the benefits delivered by widespread adoption of demand management.

4.2.3 Large consumer engagement

In 2014 TransGrid will continue to pursue its 'Top 50 customers initiative' to engage with the largest electricity consumers in NSW. TransGrid would like to engage with customers who are larger users of electricity to ensure we understand their perspective on electricity supply issues such as price, reliability, and risk. We would like to better understand customer loads, their demand profile, where they are connected on the network and how their electricity usage is reflected through the network.

Closer engagement with large consumers will be important for adding to the repertoire of demand response and energy efficiency activities undertaken by TransGrid. ClimateWorks interviewed industrial electricity consumers in 2013, finding that industrial consumers across Australia could potentially deliver 3.1 gigawatts of demand response. This would be equivalent to almost half of the energy used by these consumers at times of system peak[7].

4.2.4 Regulatory options for treating demand management

Demand response is currently treated either as an operating expenditure network support allowance in a network business' revenue proposal, or as part of the capital expenditure allowance where the support has been used to defer a previously-approved capital expenditure project. In practice, both methods are often contingent on the option already being highly certain before funding can be secured – potentially at odds with the nascent nature of the demand response market.

[7] P.3, ClimateWorks, 'Industrial demand side response potential. Technical potential and factors influencing uptake. Initial findings and discussion paper', February 2014.

As such, TransGrid intends to explore and propose options for improving the regulatory framework as it applies to transmission businesses' use of demand management. One such option could be an incentive scheme analogous to the scheme that applies for distribution network businesses. Another option, as proposed for the 'Powering Sydney's Future' project, could be the introduction of 'pre-emptive' network support arrangements designed to boost the demand response market in a given constrained area.

4.3 Market understanding and development

TransGrid's experience has shown that there can be difficulty sourcing demand response from the market at the right time, in the right location, or in the right quantum.

Gaining a better understanding of the demand management marketplace and facilitating its growth is crucial for ensuring that demand response is available in the right place, at the right time and at the right quantum.

Three projects to progress this objective are proposed below.

4.3.1 Spatiotemporal integration of demand response and network constraints

Targeted demand response – in the right time, the right place and the right amount – is of most value to TransGrid for deferring or avoiding network investment. A major obstacle in the investigation and assessment of targeted demand response is lack of reliable and accurate geospatial and temporal information about demand management resource availability. Seeking out this information adds time, cost, uncertainty and duplication of effort to the investigation of these resources.

The Demand Management Triage Database

TransGrid commissioned Oakley Greenwood Pty Ltd to develop a demand management Triage Database as part of its 2009 to 2014 DMIA expenditure. The database is intended to assist in quickly determining whether there is a sufficient demand response within a given load area to warrant further investigation of a non-network option to meet a network need. The intent was for the database to be a valuable asset in non-network option planning for all network businesses in NSW and the ACT.

The Triage Database is capable of including demand response information at the aggregate level, with information regarding the type and amount of non-network resource available within a specified geographic area. The database was designed to be used for both transmission and distribution purposes. The demand response resources are categorised by type (for example interruptible load or standby generation) and by ANZSIC (Australian and NZ Industry classifications) and/or other customer classification schemes, subject to the ability to match that data to consumption and load profile information and the requirement of maintaining customer privacy. The database is structured to allow it to be updated with additional information over time, so that its usefulness can be improved as the industry learns more about the demand-side capabilities of end-use customers.

Currently, the database is populated with data from TransGrid's previous demand response investigations for the Sydney CBD area, and with data from the Australian Energy Market Operator. Unfortunately, the full original scope of the database has not been realised due to problems with data confidentiality, data integrity and privacy concerns. These issues and possible solutions are discussed in Section 4.3.2 below.

The next step –spatiotemporal integration of network constraints and demand response

To progress the development of the market, TransGrid has come to the opinion that the information in the Triage Database would be best leveraged by integration with network constraint information. In doing this, there would be opportunity to provide increased transparency about TransGrid's network planning in order to facilitate the growth of the market.

The development of a widely accessible network supply and demand management map would go some way to addressing barriers to uptake of network support options in NSW. TransGrid envisages this map to display network constraints and demand response both spatially (that is, geographic location) and temporally (that is, showing both current constraints and availability, and known future constraints and availability). Making this information more transparent would allow TransGrid to better assess the network support market as network needs are identified, and would allow external demand response providers to have clearer sight of upcoming constraints.

Close collaboration with the distribution businesses will be a key factor to the success of this project, given their intimate knowledge of local demand response options and the distribution networks.

TransGrid proposes the mapping method for three key reasons:

- it allows open, transparent access to information about network constraints and demand response options
- it provides a 'demand response marketplace' where, for example, network businesses such as TransGrid can quickly assess the potential for demand response as network support
- it has the potential to align with the ultimate automation of demand response processes.

'automated demand response (ADR) typically involves minimal or no manual intervention and has substantially improved the efficiency, cost effectiveness, reliability, and speed of peak reduction and grid balancing. More than 37,400 sites across the world were enabled for ADR in 2013, and ADR-enabled sites are expected to reach more than 151,000 sites by 2020, Navigant predicts…'

Navigant Research, 17 January 2014, www.navigantresearch.com

4.3.2 Primary data sourcing for demand management

Problems sourcing data for the Demand Management Triage Database

Whilst we have been working with the NSW distribution businesses to develop a mechanism to obtain an appropriate level of data for the Triage Database discussed in Section 4.3.1 above, due to complexities surrounding data ownership, privacy and security within the NEM, at this stage only selective data has been available, from projects previously undertaken by TransGrid, and so intended the full scope of the database has not been reached..

TransGrid has investigated secondary data sources to determine if their accuracy and integrity is sufficient to be able to make decisions of the nature required, and it is apparent that a direct approach to customers is likely to yield the most accurate information. TransGrid knows from experience in successfully seeking non-network alternatives through a request for proposals that this approach can be successful. However, in this case the network support parameters are often well defined, typically including:

- service area as defined by towns and post-codes, including effectiveness factors
- years when network support is required
- magnitude of network support required
- peak period as defined by season, day of the week, and time of day
- expected number of support event during a season
- expected duration of each support event
- notice required to activate network support event
- trigger conditions for support event (conditions of use)

TransGrid would like to merge these two approaches (use of primary data and secondary data) to develop an approach that would be able to:

- specify key project areas
- develop network support parameters for project areas
- engage directly with consumers mainly being commercial and industrial customers, and
- report on available network support capacity.
- identify if detailed investigation is required at a site outside the scope of this project (e.g. determine cost of equipment upgrades or permanent changes to customers' facilities or operations).

Acquiring more data for the spatiotemporal integration of network constraints and demand response

TransGrid intends to continue investigating how best to develop a reliable state-wide dataset for demand response.

This data collection would be scoped to accommodate the changing supply-demand balance of the network. As the Californian operator of transmission and electricity markets (California

ISO) identified in its 2013 demand response and energy efficiency roadmap, the kind of information needed about these resources is related to their 'flexibility' or 'dispatchability'[8].

'Anticipating the magnitude, type, timing and geographic distribution of these rapidly growing [demand response] resources is as critical as solving the challenges of short-term and long-term forecasting of load variability as large numbers of resources inject energy into literally thousands of locations on the grid. The ISO is preparing for the challenges because the environmental and sustainability benefits are enormous. We also believe the new resources can be blended into the current grid composition without compromising reliability.'

California ISO (operator of the Californian transmission grid and electricity market), 'Demand response and energy efficiency roadmap: Maximising Preferred Resources', December 2013.

4.3.3 Understanding peak demand

Stronger understanding of what contributes to peak demand would allow better targeting of demand management activities. Although top-down and bottom-up forecasts are developed each year by AEMO and the distribution businesses, the links between the two remain unclear. However, understanding the broad (top-down) peak demand trend and the key user-side parameters that affect it (targeted bottom-up) is key to leveraging the potential of the demand response market.

For its 2009 to 2014 DMIA activities TransGrid engaged academics from the UTS Engineering faculty to assess the key drivers of key demand. This work is still continuing, due to finish by June 2014.

In its 2013 'Demand response and energy efficiency roadmap' California ISO, the operator of the Californian transmission grid and markets, notes that accounting for energy efficiency and demand response impacts in transmission upgrades is 'a critical need', particularly their impacts on both the demand and supply sides of the market[9].

TransGrid proposes now focusing on the interaction between demand response, energy efficiency, embedded generation and peak demand. In particular, unpacking the relationship between energy efficiency and peak demand would allow energy efficiency activities – for example auditing with large consumers discussed in Section 4.4.1 – to be targeted where they will best reduce peak demand on the network and therefore reduce overall network costs.

[8] P.11-12, California ISO, December 2013, 'Demand response and energy efficiency roadmap: Maximising preferred resources'.
[9] P.5, California ISO, December 2013, 'Demand response and energy efficiency roadmap: Maximising preferred resources'.

4.3.4 Understanding changing supply

Part of TransGrid's demand management innovation focus will be on the potential for demand management to allow reliability and power quality standards to be met as the penetration of renewable energy sources on the grid increases.

CSIRO is proposing to develop a simulation tool to evaluate the impact of high-penetration intermittent solar generation on power quality in different network topologies using high-resolution solar data. There is scope for TransGrid to contribute to this process, and possibly others, to help develop an accurate simulation tool that will aid TransGrid and the distribution businesses to better understand integration of large-scale solar generation on the network.

4.4 Technology trialing

Demand management technology trials fall into three broad categories:

- broad-based programs targeted at residential consumers, or small- and medium-sized businesses
- programs targeted at large consumers (commercial, agricultural and industrial)
- 'grid scale' solutions, including battery storage

TransGrid focused largely on broad-based programs in its 2009 to 2014 demand management innovation activities (jointly with the distribution businesses). A number of useful findings were made about barriers to uptake of demand response programs, as discussed in Section 3. However, TransGrid considers that the 'large and lumpy' nature of transmission investment (and therefore transmission network support requirements) necessitates that the focus in future should be on large consumers and large-scale technologies – as does TransGrid's place in the electricity supply chain.

Tentative projects in each of the categories are listed below.

4.4.1 Broad-based trials with distribution businesses

Generators, large electricity consumers and distribution businesses are directly connected to TransGrid's network. Residential consumers and the majority of commercial businesses are not. TransGrid's place in the electricity supply chain makes it difficult to undertake broad-based demand management programs directly with consumers.

TransGrid's practice so far has been to partner with distribution businesses in the area of broad-based demand management. Demand reduction trials involving voluntary load shifting (by giving price signals to customers) and load shifting through direct load control (for example control of air conditioners and small hot water heaters) have shown promising results for broad based implementation. However, some trials have had very small take up rates (1-5%). This may have been due to factors such as distrust, lack of understating of peak demand or unattractive financial incentives. Consumers have also repeatedly expressed skepticism towards trials involving smart meters. This fear of the smart meter is also something that needs to be addressed, as it is a theme recurring in independent trials and research efforts. The key issue moves beyond the revenue collection, privacy and

security aspects which feature strongly in reports, as the smart meter is the enabler of key principles which underpin demand management – the ability to understand when the peak is occurring in order to participate in a program at the most basic level.

This stream of work will focus on overcoming barriers to broad-based demand management programs. As stated above, many of these barriers are based in consumer access to information and understanding of the peak demand problem. Future work needs to continue to build upon existing programs to provide an evidence based platform for the development of more effective engagement strategy involving education, marketing and an enhanced consumer experience. TransGrid will continue to seek partnerships with distribution businesses to undertake this work.

4.4.2 Energy efficiency (auditing) with large consumers

There remain significant opportunities for energy savings with large consumers. The key focus of TransGrid's engagement in this area will be research how best to target energy efficiency measures at reducing peak demand rather than overall energy consumption.

Space heating and cooling is likely to be the energy use where gains can be made, as found in the research TransGrid commissioned from the Warren Centre as part of the Demand Management and Planning Project, and research from the CSIRO. For example space heating and cooling contributes to almost half of the electricity consumption in the City of Sydney local government area[10].

The project would be undertaken in collaboration with experts in commercial and industrial business energy auditing.

4.4.3 Investigation of innovative demand management systems

As part of its 2009 to 2014 DMIA funding TransGrid initiated a demand management research project called iDemand. Due for completion in September 2014, iDemand comprises an installation of battery storage, solar panels and energy efficient lighting at TransGrid's Western Sydney office, as well as a website for facilitating engagement and further research into peak demand reduction. The specific objectives of the iDemand project are to:

- educate electricity consumers about the importance of reducing peak demand
- facilitate research opportunities and market development for demand management in Australia
- advocate for increased awareness and understanding of demand management among TransGrid's staff

[10] Pitt & Sherry 2012, referenced in the CSIRO's 'Powering Sydney's Future – Energy efficiency' paper. This report will released during the launch of TransGrid's engagement on the Powering Sydney's Future project, expected in June 2014

TransGrid proposes continuing to use the iDemand project to investigate demand management through partnership with research bodies. The University of Sydney's engineering faculty has identified potential research areas using the data available from the iDemand project, including:

- investigate pv / battery storage interaction to optimise pv / grid / battery / load relationships
- develop algorithms for optimal use of batteries storage to shift load at different times throughout the year, and
- investigate possible use of the system for electric vehicle charging.

There will also be opportunity to collaborate with industry using the iDemand project. For example, a commercial body has approached TransGrid proposing the use of the iDemand system to test the economic case and technical barriers to providing ancillary services to the market using battery storage.

Finally, TransGrid intends use the iDemand system to experiment with how best to use of battery storage to provide grid support, namely peak shaving and power quality support. Although out of scope in the initial phase of the project due to timing constraints, integration of iDemand with TransGrid's SCADA system will help develop better market understanding and confidence in using automated energy storage technologies that can respond to demand management signals, and demonstrate how to take advantage of high NEM prices in a commercial setting. Expansion of the planned website to include ability to dispatching the battery in manual mode in response to a market signal or for dispatching for ancillary services purposes will allow this experimentation.

4.4.4 Energy storage selection, sizing, placement and operation

Energy storage has big potential in the area of demand management. In addition to the storage research project included in TransGrid's network capability improvement parameter action plan (NCIPAP) as part of the revenue application for 2014 to 2018, TransGrid will undertake other projects focused on overcoming technical and operational barriers to using storage as a part of demand management in NSW.

CSIRO has recently applied for funding for two projects considering the optimization of energy storage selection, sizing, placement and operation. TransGrid proposes partnering with the CSIRO to undertake these projects and apply the project findings to the planning of the transmission network in NSW.

Attachment A Proposed investment for 2014 to 2019 DMIA projects

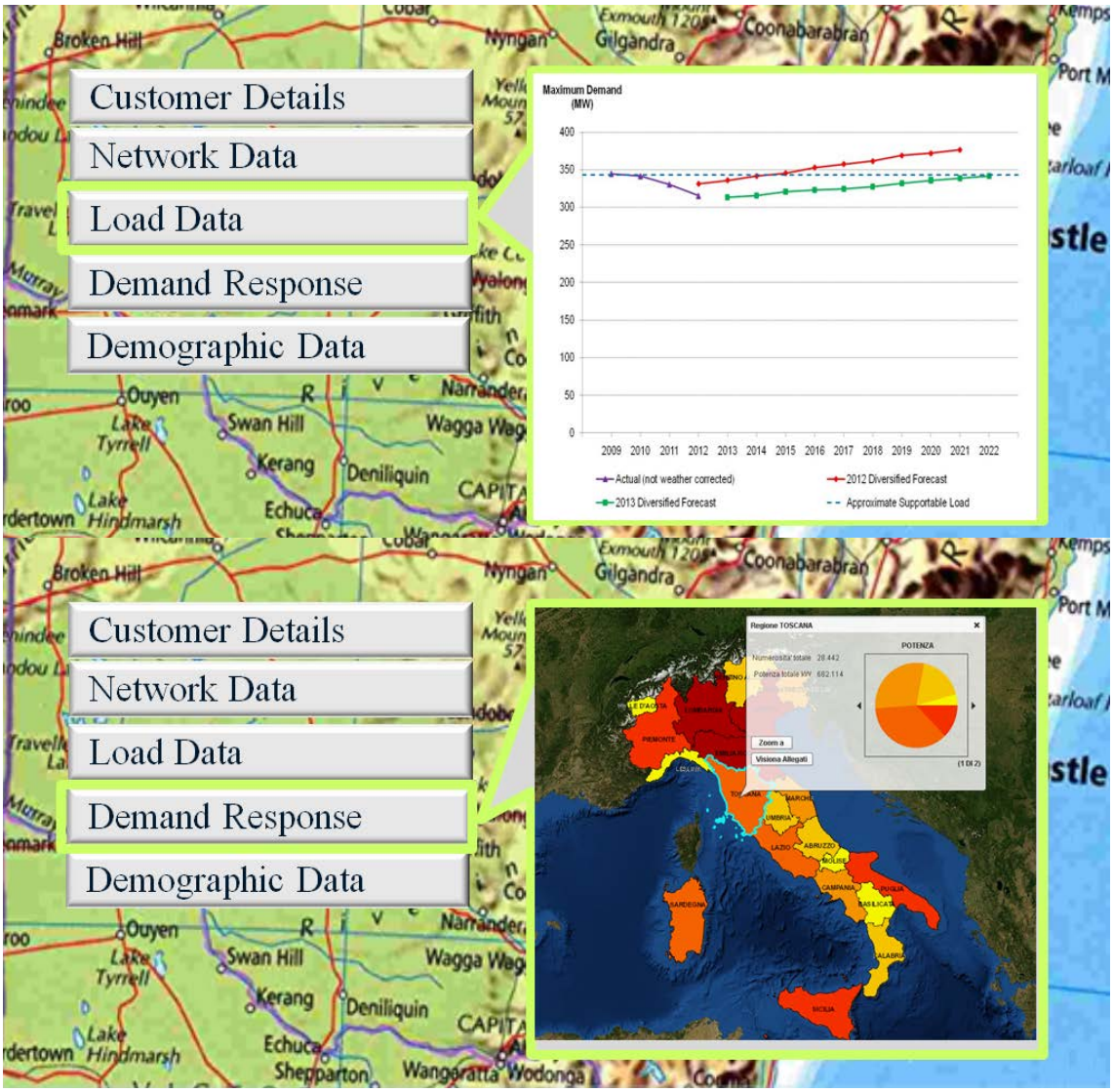
Proposed investment in TransGrid's proposed demand management innovation activities is shown in Table 2 below. Before being undertaken, every project would be subject to the gated decision process provided in Section 4.1 (Figure 3) of the demand management innovation strategy.

Table 2 Proposed investment for 2014 to 2019 DMIA funding ($2014)

	2015 ($m)	2016 ($m)	2017 ($m)	2018 ($m)	2019 ($m)	Total ($m)
Collaboration						
Expanded DM collaborative forum to wider stakeholder group	0.10	0.10	0.10	0.10	0.10	0.50
Residential consumer education	0.10	0.15	0.23	0.26	0.26	1.00
Large consumer engagement	0.10	0.15	0.23	0.26	0.26	1.00
Options to incentivise DM	0.12	0.12	0.12	0.12	0.12	0.60
Other collaboration	0.10	0.10	0.10	0.10	0.10	0.50
Market understanding and development						
Spatiotemporal integration of demand response and network constraints	0.25	1.25	1.50	1.50	0.50	5.00
Primary data sourcing for DM	0.20	0.30	0.46	0.52	0.52	2.00
Understanding the peak	0.18	0.26	0.40	0.46	0.46	1.75
Understanding impact of variable generation (including CSIRO)	0.10	0.10	0.10	0.10	0.10	0.50
Other market understanding and development	0.05	0.05	0.05	0.05	0.05	0.25
Technology trialling						
Energy efficiency (auditing) with large consumers	0.10	0.15	0.23	0.26	0.26	1.00
Large scale innovative DM systems (incorporating iDemand, microgrids)	0.40	0.22	0.27	0.31	0.31	1.50
Energy storage selection, sizing, placement, operation (including CSIRO)	0.10	0.10	0.10	0.10	0.10	0.50
Broad-based trials with distribution businesses	0.15	0.23	0.35	0.39	0.39	1.50
Other technology trialling	0.08	0.08	0.08	0.08	0.08	0.40
Total ($m 2014)	**2.12**	**3.36**	**4.31**	**4.61**	**3.61**	**18.00**

Attachment B Spatiotemporal map of demand response and network constraints

Figure 4 Indicative content for spatiotemporal map of demand response and network constraints



[Indicative demand resource map is an Italian solar resource map available at http://atlasole.gse.it/atlasole/]