Demand Management Innovation Allowance Submission

2015-2016 Report to the AER

August 2016

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Contents

1 Introduction

This submission has been prepared under the Demand Management Innovation Allowance (DMIA) scheme applied to Ausgrid by the Australian Energy Regulator (AER).

Under Section 3.1.4.1 of the AER's final determination for The Demand Management Incentive Scheme for the ACT & NSW 2009, Ausgrid is required to submit an annual report on expenditure under the DMIA for each regulatory year. The annual report must include:

1. The total amount of the DMIA spent in the previous regulatory year, and how this amount has been calculated.
2. An explanation of each demand management project or program for which approval is sought, demonstrating compliance with the DMIA criteria detailed at section 3.1.3 with reference to:
   a) the nature and scope of each demand management project or program,
   b) the aims and expectations of each demand management project or program,
   c) the process by which each project or program was selected, including the business case for the project and consideration of any alternatives,
   d) how each project or program was/is to be implemented,
   e) the implementation costs of the project or program, and
   f) any identifiable benefits that have arisen from the project or program, including any off peak or peak demand reductions.
3. A statement signed by a director of the DNSP certifying that the costs of the demand management program:
   a) are not recoverable under any other jurisdictional incentive scheme,
   b) are not recoverable under any other state or Commonwealth government scheme, and
   c) are not included in the forecast capital expenditure (capex) or operating expenditure (opex) approved in the AER's distribution determination for the next regulatory control period, or under any other incentive scheme in that determination (such as the D–factor scheme for NSW).
4. An overview of developments in relation to projects or programs completed in previous years of the next regulatory control period, and any results to date.

Accordingly, this submission details DMIA projects undertaken by Ausgrid in the 2015/16 financial year.

2 Governance

2.1 DMIA spending in 2015/16

There were ten (10) ongoing DMIA projects under implementation and three (3) new projects under development for which we incurred costs in 2015/16. Ausgrid's submission identifies claimable costs incurred totaling $599,692. All costs incurred were a part of operating expenditure (opex) budget.

Actual costs incurred are collected from project codes in Ausgrid's SAP reporting system. The amounts claimed are those booked to each project in the applicable year. Costs include research and development of projects, implementation costs, project management and other directly related costs.

2.2 Compliance with DMIA criteria

Information addressing items 2 a, b, d, e and f from Section 3.1.4.1 of the AER's final determination for The Demand Management Incentive Scheme for the ACT & NSW 2009 are found in the progress update for each individual project detailed in Section 4 and 5. Item 2c of Section 3.1.4.1 is addressed in Section 2.2.1 below.

2.2.1 Project selection process

Ausgrid has developed templates & guidelines for the development and implementation of projects or programs under the DMIA allowance that seek to investigate non-network alternative to reduce demand and defer network investment. When opportunities are identified for new projects, Ausgrid uses the following methodology when assessing projects for funding under the DMIA allowance:

1. **Concept Stage**: For new concepts, approval for project research and development is carried out by the Manager – Demand Management & Forecasting who ensures that the proposed project meets the funding criteria specified under the DMIA Scheme. This component of the project is defined as a Concept Stage 1 project.
2. **Development Stage**: Where early stage research and development indicates a potential viable demand reduction solution, the project is approved to proceed to the Development Stage 2 where a project proposal for a full trial is prepared. Approval to proceed to Stage 2 is by the Manager – Demand Management & Forecasting. The project proposal is prepared according to the Ausgrid DMIA template and guidelines, including additional criteria specified by Ausgrid (repeatability, suitability to geographically specific network constraints, and potential to be cost effective ($/kVA)).
3. **Implementation Stage**: The project proposal is reviewed by the Manager – Demand Management & Forecasting to ensure it meets the funding criteria specified under the DMIA Scheme and checks are also made to ensure that budget projects costs are within the DMIA allowance. After consideration of the available DMIA budget, proposed projects will be selected for inclusion in the DMIA program and recommended for authorisation at the appropriate delegation level. Projects approved to proceed to a full trial are defined as Stage 3 projects.

2.3 Statement on costs

In submitting this program for inclusion in the DMIA Scheme, Ausgrid confirms that the program costs:

- are not recoverable under any other jurisdictional incentive scheme;
- are not recoverable under any other State or Commonwealth Government scheme;
- are not included in the forecast capex or opex approved in the AER's distribution determination for the next regulatory control period; and
- are not eligible for recovery under the D-Factor Scheme.

3 DMIA project summary

Project	2015/16 Actual Cost (excl GST)	Year initiated
New projects (initiated in 2015/16)		
Solar and battery customer research	$8,513	2015/16
DMIA stakeholder engagement	$10,581	2015/16
Winter air conditioner load control	$11,753	2015/16
New projects sub-total	**$30,847**	
Existing projects (initiated prior to 2015/16)		
Load control of small hot water systems	$24,698	2010/11
Subsidised controlled load connections	$25,287	2011/12
AS4755 air conditioner and pool pump load control	$72,915	2012/13
Newington grid battery	$65,108	2013/14
Controlled Load 2 summer scheduling	$27,572	2013/14
Customer power factor correction	$106,140	2013/14
CBD embedded generator connection (Phase 2)	$1,767	2013/14
CoolSaver Maitland	$205,673	2014/15
Non residential energy efficiency	$20,151	2014/15
Pool pump demand study	$19,534	2014/15
Existing projects sub-total	**$568,845**	
TOTAL	**$599,692**	

4 New projects

4.1 Solar & battery customer research

4.1.1 Project nature and scope

This project involves approaching a large sample (10,000 to 20,000) of our customers to participate in a survey about solar and battery systems to understand the purchasing motivations and potential future uptake of solar and battery systems. Both residential and non-residential customers will be invited to participate in the survey as well as existing solar and non-solar customers.

4.1.2 Project aims and objectives

The primary objective of this research is to better understand customer motivations for purchasing and installing solar and battery systems that might be used to manage peak demand and reduce network investment.

4.1.3 Implementation plan

Phase 1 – Customer survey

The first phase of the project will be to implement an online customer survey of 10,000 to 20,000 customers. Detailed design of the survey questions will be conducted within this project phase including engagement with key customer stakeholder groups.

The primary target group will be customers with existing solar systems including both residential and non-residential customers. The trial will also target customers who have not yet invested in a solar or battery system to understand potential motivations for installing a solar and/or battery system in the future.

To increase response rate to the survey several additional strategies will be considered including potential for partnering with a research organisation or local council stakeholders in a joint letter, and/ or various forms of incentives.

A more detailed sampling design will also be developed in this phase of the project.

Phase 2 - Follow up focus groups and qualitative research

The online survey will provide quantitative information about customer's motivations for purchasing and installing a solar or battery storage system. However, it is envisaged that more detailed qualitative information would be useful to better understand some of the purchasing motivations of customers. It is planned to conduct up to 4 focus groups in Sydney and Newcastle to obtain deeper insights into customer's motivations for purchasing a solar and/or battery system. More detailed design will be required in this phase and answers to the survey will help to finalise direction. As a starting point, it is envisaged that three residential groups (solar SBS, solar non-SBS and non-solar) and one non-residential group (solar) would be a good balance. However, this may change depending on outcomes from phase 1 results.

4.1.4 Results

Project is at the preliminary design stage, so there are no results at present.

4.1.5 Summary of actual and projected costs

A summary of the actual project costs incurred in 2015/16 is shown below. Due to the conditional nature of phase 2, projected costs for the 2016/17 year have not been estimated at this stage. All costs incurred for this project are categorised as opex.

Actual and projected project costs:

Budget Item	2015/16 Actual	2016/17 Projected	Total Projected
Project research and development	$8,513	TBC	TBC
Total (excl GST)	**$8,513**	**TBC**	**TBC**

4.1.6 Project progress & identifiable benefits

Up until the end of June 2016 the main progress made has been in the research and development stages of the project.

This project is research only, therefore it is not expected to achieve any material peak demand reductions. The trial activities do not form part of a deferral of a real network need.

4.2 DMIA stakeholder engagement

4.2.1 Project nature and scope

This project will formally consult with Demand Management (DM) stakeholders to identify new and innovative DM solutions for potential Ausgrid Demand Management Innovation Allowance (DMIA) trials.

While informal discussions with electricity networks, key DM providers and stakeholders has provided important input into Ausgrid's DMIA program to date, there has been no formal engagement. To canvas the views of a broad range of stakeholders, it is proposed to engage through a formal consultation process.

4.2.2 Project aims and objectives

The primary objective of this project is to discover new and innovative DM solutions which might form potential cost effective demand management solutions for deferral of network investment.

A secondary objective of the stakeholder consultation will be to directly engage with DM stakeholders more broadly on Ausgrid's future demand management plans, DM decision making process and DM innovation research outcomes.

4.2.3 Implementation plan

To ensure that stakeholder views are effectively canvassed, a range of consultation techniques will be investigated. The project is planned to be conducted in two phases.

Phase 1 – Preliminary stakeholder engagement

The first phase of the project will involve preliminary engagement activities, including informal discussions with stakeholders and a survey of DM stakeholders on key issues around the Demand Management Innovation Allowance (DMIA) such as views on the past, present and future projects conducted under this scheme. This phase will include a stock-take of demand management innovation projects conducted by Australian networks to assist in informing stakeholders.

The main objective of phase 1 is to canvas views from stakeholders on their preferred format of future engagement activities and to draw out the key issues for stakeholders with respect to the DMIA.

Phase 2 – Detailed stakeholder engagement

The results from Phase 1 will largely influence the scope of Phase 2 engagement activities and which may include the publication of a consultation paper, promotion via social and traditional media, web-based and in-person seminars and workshops or other techniques or tools.

The use of a consultation paper to solicit community views is a common technique employed by the energy industry (AEMC, AER etc) and would be well understood by key stakeholders. Similarly, in-person or virtual workshops or seminars are widely used by the industry and might encourage participation, allow a more informal channel for stakeholders to be informed of the context in which their views would be considered, and allow for an early interchange of information.

Stakeholder's views on technology and approaches will be welcomed, along with more general views including methods to improve consultation, areas of interest, specific areas of exclusion, and comments on the barriers/ limitations encountered to date.

A more formal stakeholder engagement approach in Phase 2 would include the consolidation of results and the public reporting of the findings from the project.

4.2.4 Results

No formal results at this stage.

4.2.5 Summary of actual and projected costs

A summary of the actual project costs incurred in 2015/16 is shown below. As progress is at an early stage, projected costs for the 2016/17 year have not been estimated. All costs incurred for this project are categorised as opex.

Actual and projected project costs:

Budget Item	**2015/16 Actual**	**2016/17 Projected**	**Total Projected**
Project research and development	$10,581	TBC	TBC
Total (excl GST)	**$10,581**	**TBC**	**TBC**

4.2.6 Project progress & identifiable benefits

Up until the end of June 2016 the main progress made has been in the research and development stages of the project.

This project is research only; therefore it is not expected to achieve any material peak demand reductions in itself. The trial activities do not form part of a deferral of a real network need.

4.3 Winter air conditioner load control

4.3.1 Project nature and scope

This project involves making a winter air conditioner load control offer to existing demand management trial participants who are currently taking part in the Central Coast CoolSaver trial (see Section 5.3). This leverages previous DMIA project activities and load control equipment already in place for these customers.

Currently there are 54 participants in the Central Coast trial area and 80% of 40 survey respondents from the 2015/16 survey indicated that they used reverse cycle air conditioners as their primary heating source. In addition, 74% of survey respondents indicated they would participate in a winter season air conditioner load control program, with 23% being unsure if they would participate.

The project is intended to run during Winter 2016 with an offer made to participants in June 2016.

4.3.2 Project aims and objectives

The main rationale of the project is to test the viability of a residential winter peak demand reduction program focused at reducing the electrical load from air conditioners used for heating. Approximately 20% of Ausgrid's zone substations are winter peaking and a further 30% have similar summer and winter utilisation factors.

There are currently ten zone substations with over 80% utilisation of their winter firm capacity which also have a >50% residential annual consumption from customers supplied by that zone. This indicates that a residential demand management solution in winter would have potential applicability in certain parts of the Ausgrid network.

The main objectives are to:

(1) Understand the customer response and acceptance to an offer for reducing the electrical input power of their reverse cycle air conditioner to reduce winter peak demand

(2) Measure and verify the peak demand reductions achieved per customer during winter

4.3.3 Implementation plan

Ausgrid would email customers in the Central Coast trial and offer a Winter 2016 program offer.

The offer structure for the winter period will be the same as for the preceding summer, which is $50 or $100 per participant (depending on whether the participant has 4-10kW or 10+kW unit) for a maximum of 8 peak event dispatches, with $10/$20 being deducted each time the participant chooses to override a dispatch event.

The winter period for the project would run from June to August 2016.

4.3.4 Results

Ausgrid emailed the existing Central Coast participants in mid-June with the offer.

As of the end of June 2016, 27 customers out of a potential 54 (50%) had accepted the offer. The trial period officially began on Monday 27th of June 2016; however no peak event dispatches had been initiated to end of June.

4.3.5 Summary of actual and projected costs

A summary of the actual project costs incurred in 2015/16 is shown below, as well as projected costs for the 2016/17 year. All costs incurred for this project are categorised as opex.

Actual and projected project costs:

Budget Item	**2015/16 Actual**	**2016/17 Projected**	**Total Projected**
Project research and development	$11,753	$50,000	$61,753
Total (excl GST)	**$11,753**	**$50,000**	**$61,753**

4.3.6 Project progress & identifiable benefits

Up until the end of June 2016 the project had been developed, scoped and approved. The customer take up rate had been determined.

As the trial is relatively modest in scale, there are not expected to be any material peak demand reductions achieved from this project. The trial activities do not form part of a deferral of a real network need.

5 Existing projects

5.1 Load control of small hot water systems

5.1.1 Project nature and scope

Heating water for showers, laundry and washing makes up more than a third of an average household's energy use and has the potential to increase peak demand for electricity. There are about 1.5 million households connected to Ausgrid's network and hot water supplies for these homes are heated fully or partially (e.g. solar hot water) by either electricity or natural gas. As of June 2015, there were about 0.5 million households with a storage hot water system supplied from a controlled load connection (tariffs Controlled Load 1 and 2) and about 0.6 million with a gas heated hot water system. For these 1.1 million households, electricity supply is either controlled to avoid impacting peak demand or not supplied by electricity.

The remaining 0.4 million households use some form of electric hot water supply which has the potential to increase peak electricity demand. Some of these systems are medium to large size electric storage, solar boost or heat pump systems that are eligible for a Controlled Load tariff but where the customer has not chosen a controlled load tariff. These customers are the subject of a separate DMIA study; please refer to Section 5.2.

The majority of these systems would not be eligible for one of the existing controlled load tariffs due to their size (e.g. small electric storage hot water tanks of less than 100 litres). This project is aimed at trialing a load control option for those customers using small hot water systems not currently eligible for a controlled load tariff.

5.1.2 Project aims and objectives

The primary objective of this project was to verify the technical and financial viability for the load control of small and medium sized hot water cylinders not currently eligible for a controlled load tariff. Specific objectives can be summarised as follows:

(a) To determine a dispatchable control regime for application to small hot water heaters that provides satisfactory customer service and reductions in relevant peak demand.

(b) To determine the proportion of customers for whom this would likely be acceptable, and what level of marketing effort would be needed to achieve various take-up rates. Also to test the relationship between the take-up rate and the size of reward offered.

(c) To determine the level of diversified demand reduction per customer referenced to typical zone substation peak demand characteristics.

(d) To accurately estimate the costs of such a program for local, commercial implementation.

5.1.3 Implementation plan

The main elements of the project implementation plan are summarised below:

1. **Pilot (Phase 1)**: The concept of the pilot is to trial control of small hot water cylinders at approximately ten customer's premises. This pilot will test the workability of controlling such cylinders and will be demonstrated by the customer experience. Assuming the majority of installations pass the customer experience test then additional data from the trial will be evaluated in terms of, demand impact, metering profiles – pre and post control, percentage of time reset button used, etc. Phase 1 will also include having the data read and analysed for 30 random cylinders that have dedicated interval meters installed as part of a previous research project. This data will be used to provide an initial view of the load profile and diversity of usage of continuously supplied hot water cylinders, is the basis of analysis of the potential for control and design of the control regime, and provides an element of the control group for analysis of impact of control on coincident demand. Some of these customers may become members of the larger trial.
2. **Market Research (Phase 2)**: Assuming that the pilot trial meets customer acceptability requirements, the next stage is to conduct survey / market research to refine product offerings. Typically a market survey would be undertaken to better understand the potential take-up rate, what reward structure would be required and how sensitive the take-up rate would be for the reward structure.
3. **Larger Trial (Phase 3)**: Where the results of the pilot trial are positive, and the results of the market survey indicate that a satisfactory take-up rate could be achieved, then a larger trial will be undertaken to further prove the product viability as well as establish better information on performance and cost structure. This trial would cover up to 100 participating customers and as far as possible mimic the product, including enabling communications to the devices, realistic dispatching, and recovering meter data. Following this element, results will be analyzed and any issues arising from the trial will be addressed to determine how and if a further trial should proceed.

4. **Full Scale Trial (Optional Phase 4)**: A final optional phase is to undertake a full scale trial comprising about 1,000 participating customers to provide statistically significant results. Such a trial would also test all operational aspects as well as technical aspects of an actual deployment.

As reported in Ausgrid's DMIA submission to the AER for 2012/13, it was decided that there was insufficient justification to progress to Phase 4.

5.1.4 Results

The implementation activities were completed in previous years, results can be found in the previous Ausgrid DMIA reports from 2011/12 to 2014/15.

The focus in 2015/16 was on closing the project out, notably through:

- Removing small hot water system meters and switches from customers' premises that were difficult to contact
- Finalising contractor payments and closing contracts
- Performing final data analysis and reporting

The final report for this project is published as a consolidated hot water report with the subsidised controlled load connections project (see Section 5.2) and Controlled Load 2 summer scheduling project (see Section 5.5) on Ausgrid's website at www.ausgrid.com.au/dm.

5.1.5 Summary of actual and projected costs

A summary of the actual project costs incurred in 2015/16 and previous years is shown below. All costs incurred for this project are categorised as opex.

The phase 1 and 2 parts of the project were in collaboration with Transgrid, the transmission network service provider, considering the potential demand management benefits for the whole electricity network. Transgrid provided funding to conduct activities for the first two phases of the project.

This project was closed at the end of 2015/16 with no further expenditure required.

Actual project costs:

Budget Item	2010/11 Actual	2011/12 Actual	2012/13 Actual	2013/14 Actual	2014/15 Actual	2015/16 Actual	Total Actual
Actual Ausgrid Expenditure	$15,296	$91,102	$120,463	$20,642	$7,027	$24,698	$279,228
Actual Transgrid (phase 1 & 2 only)	$0	$27,000	$0	$0	$0	$0	$27,000
Total (excl GST)	**$15,296**	**$118,102**	**$120,463**	**$20,642**	**$7,027**	**$24,698**	**$306,228**

Transgrid has been invoiced for phase 1 and 2 only. Phase 3 operations are funded 100% by Ausgrid.

5.1.6 Project progress & identifiable benefits

The project has provided significant knowledge and learning on the cost structure of undertaking such a demand management technique. A key outcome from the project is that it has identified that typically small to medium hot water cylinders can withstand a reasonable amount of control. This point was not clearly understood prior to the trial. When the AS4755 interface is introduced for small to medium hot water cylinders, Ausgrid would revisit this approach to identify the cost effectiveness of controlling AS4755 compliant hot water cylinders in order to defer network investment.

During 2015/16 the main project progress was the completion of the phase 3 activities. Due to difficulties in contacting some of the participants, the completion of the trial was delayed such that final analysis of the trial data and completion of the final report occurred in 2015/16. The final report for this project is published as a consolidated hot water report with the subsidised controlled load hot water connection trial (see Section 5.2) and Controlled Load 2 summer scheduling trial (see Section 5.5) on Ausgrid's website at www.ausgrid.com.au/dm.

As the trial was relatively modest in scale and temporary in nature, there are no permanent, material peak demand reductions achieved from this project. The trial activities did not form part of a deferral of a real network need.

5.2 Subsidised controlled load connections

5.2.1 Project nature and scope

It is estimated that there are up to 100,000 electric hot water systems in houses across Ausgrid's distribution area that are currently connected to continuous electricity supply but could potentially be connected to controlled load supply. These systems include electric storage, solar and heat pump models which can contribute up to 600 watts to winter peak demand and 200 to 300 watts to summer peak demand each year.

The subsidised controlled load connection project was aimed at encouraging customers to connect eligible electric hot water systems to controlled load electricity supply by providing a connection subsidy. The implementation of the project initially included two phases; a market research phase and a customer trial including direct marketing of a subsidised Controlled Load connection offer to customers in four different areas of the Ausgrid network area.

A third phase of the project commenced in 2014/15, involving the collaborative development of a pilot project with NSW Land and Housing Corporation (LAHC) to market a subsidised connection offer to NSW Housing tenants.

5.2.2 Project aims and objectives

To develop & demonstrate marketing approaches that will achieve high take-up rates of conversion of electric hot water systems from continuous supply to controlled load electricity supply for the purposes of reducing peak demand in specific network locations. This demand management technique also has significant potential to reduce household energy bills.

5.2.3 Implementation plan

The initial project included two major phases of work in the implementation plan:

1. **Phase 1:** Market research to determine why large systems are not currently connected to controlled load and what barriers need to be overcome for customers to move them to Controlled Load supply. This research was used to refine estimates of market size, marketing messages for customers, demand savings and determine take up rates for various price points.
2. **Phase 2:** A market offer of a subsidised Controlled Load connection for eligible households with existing large electric hot water systems (over 100 litres) not connected to controlled load. For most customers, a flat fee of $99 or $199 was offered for this service, which included the meter and installation, wiring and documentation.
3. **Phase 3:** Subsidised Controlled Load connection pilot offer to NSW Housing tenants. This phase involves the trial of a collaborative approach to customer acquisition so as to reduce program costs and improve cost effectiveness. In this phase, Ausgrid and NSW LAHC shared property and hot water system data to better identify eligible households.

5.2.4 Results

Phase 1 and 2 results can be found in the previous Ausgrid DMIA annual reports from 2011/12 to 2013/14. Phase 3 results can be found in the Ausgrid's 2014/15 DMIA annual report.

The focus in 2015/16 was on completing the final analysis and reporting. The final report for the subsidised controlled load connection project is published as a consolidated hot water report with the load control of small hot water systems trial (see Section 5.1) and Controlled Load 2 summer scheduling trial (see Section 5.5) on Ausgrid's website at www.ausgrid.com.au/dm.

5.2.5 Summary of actual and projected costs

A summary of the actual project costs incurred in 2015/16 and previous years is shown below. All costs incurred for this project are categorised as opex.

The Phase 1 and 2 parts of the project were in collaboration with Transgrid, the transmission network service provider, considering the potential demand management benefits for the whole electricity network supply chain. Transgrid provided funding to conduct activities for the first two phases of the project.

This project was closed at the end of 2015/16 with no further expenditure required.

Actual project costs:

Budget Item	2011/12 Actual	2012/13 Actual	2013/14 Actual	2014/15 Actual	2015/16 Actual	Total Actual
Phase 1 & 2: Ausgrid expenditure	$79,007	$35,818	$0	$0	$0	$114,825
Phase 1 & 2: Transgrid	$12,000	$95,000	$0	$0	$0	$107,000

expenditure						
Phase 3: Ausgrid expenditure	$0	$0	$10,602	$23,379	$25,287	$59,268
Total (excl GST)	**$91,007**	**$130,818**	**$10,602**	**$23,379**	**$25,287**	**$281,093**

5.2.6 Project progress & identifiable benefits

The project has provided significant knowledge and learning as to the cost structure and practical issues associated with the marketing of such a demand management technique. The trial has indicated that this approach to reducing peak demand is viable but more likely as a long term broad based approach rather than for specific near term constraints due to the low take-up rate and likely resultant low volume of demand reductions.

Final analysis of the trial data and completion of the final report occurred in 2015/16. The final report for the subsidised controlled load connection project is published as a consolidated hot water report with the load control of small hot water systems trial (see Section 5.1) and Controlled Load 2 summer scheduling trial (see Section 5.5) on Ausgrid's website at www.ausgrid.com.au/dm.

As the trial was relatively modest in scale, there are no material peak demand reductions achieved from this project. The trial activities did not form part of a deferral of a real network need.

5.3 AS4755 air conditioner and pool pump load control

5.3.1 Project nature and scope

Air conditioners and pool pumps are the largest residential appliances with no load control option currently available to customers and offer the greatest potential for residential demand reductions. The summer peak demand from residential air conditioners and pool pumps for the Ausgrid network area is estimated to be 1300-1700 MW and 70-100 MW respectively. The focus of this trial is to test low cost direct load control options that are independent of a smart meter interface.

The voluntary adoption of the AS4755 interface standard (framework for demand response capabilities and supporting technology for electrical products) by a number of air conditioner and pool pump manufacturers and the development of commercially available demand response enabling devices (DREDs) has substantially lowered the cost to introduce load control to these appliances.

The project explores the potentially cost effective method of controlling residential air conditioners and pool pumps using AS4755 compliant devices and how this solution could form a component of demand management programs.

The project scope is considered to be complementary to existing and proposed trials by other Australian DNSPs.

5.3.2 Project aims and objectives

The primary objective of the trial is to test a minimum of two communication platforms and associated Demand Response Enabling Devices (DREDs) by which AS4755 compliant appliances can be controlled.

Secondary objectives of the trial include testing of the customer acquisition options to determine take-up rate and acquisition costs, to trial various dispatch methods and monitor customer acceptance and satisfaction and to measure and verify the peak demand reduction potential from air conditioner and pool pump direct load control.

5.3.3 Implementation plan

The project initially consisted of a research and development stage, followed by the two main implementation phases.

1. **Phase 1** of the project included testing and verification of the two communication platforms to be used for the trial through laboratory testing and a pilot with a small number of participants. The pilot and lab testing included establishment and testing of the dispatch systems and protocols as well as development of the Demand Response Enabling Devices (DREDs) to be used. A secondary objective in phase 1 was to test customer acceptance of the appliance control with a controlled group of participants (small pilot).
2. **Phase 2** of the project involves a customer trial which includes testing and development of techniques to identify and sign up participants from the general public (with around 100 participants planned), determine take-up rates and acquisition costs, further verify the communication platforms and DREDs, determine the response rate from customers to reduce demand and monitor customer acceptance and satisfaction.

5.3.4 Results

Phase 1 – technology pilot, technology development and customer response

The Phase 1 pilot was mostly completed during Summer 2012/13 with a small number of participants recruited to test the new DRED technology. The Phase 1 work included development of a prototype SMS DRED that utilises the publicly available mobile phone telecommunications network. Results from the Phase 1 part of the project have been reported in the previous Ausgrid DMIA report for 2013/14. These participants were incorporated into the Phase 2 customer trial.

Phase 2 – CoolSaver customer trial in Lake Macquarie and Central Coast areas

Phase 2 of the project is a customer trial, with the aim of testing a product offer with customers for direct load control of AS4755 compliant air conditioning systems, including the testing of the two signal receiver communications platforms (ripple signal and SMS communications). Participants in the trial areas were recruited to participate from December 2013 to early February 2014 with the trial originally planned to occur over two summer periods (Summer 2013/14 and Summer 2014/15).

The acquisition of 68 customers with SMS DREDs in the Central Coast trial area, and 40 with ripple DREDs in the Lake Macquarie trial area was completed and 2013/14 and is detailed in the previous Ausgrid DMIA report for 2013/14.

Due to a paucity of sufficiently hot days, whereby the temperature was forecast to exceed 32ºC, only three demand reduction dispatches were carried out during the 14/15 summer period. The details can be found in the previous Ausgrid DMIA report for 2014/15. Due to the lack of high demand days to effectively test customer response, the trial was extended to include the 2015/16 summer period.

See table below for details of peak event dispatches during the 15/16 summer period:

Date	Day	Start	Finish	Mode	Max. Daily Temp (ºC)	Overrides
20/11/15	Fri.	16:00	20:00	DRM2 – Central Coast DRM3 – Lake Macq.	40.8 40.4	0 3
26/11/15	Thu.	14:00	18:00	DRM2 – Central Coast	39.0	5
12/01/16	Tue.	15:00 15:30	19:00 19:30	DRM2 – Central Coast DRM3 – Lake Macq.	34.5 36.9	0 0
14/01/16	Thu.	14:00 14:30	18:00 17:40	DRM2 – Central Coast DRM3 – Lake Macq.	39.9 39.5	6 0
25/02/16	Thu.	15:00 15:00	19:00 19:00	DRM3 – Central Coast DRM3 – Lake Macq.	39.0 39.0	6 0
10/03/16	Thu.	15:00 15:00	19:00 19:00	DRM2 – Central Coast DRM3 – Lake Macq.	29.7 31.9	0 0

Diversified demand reductions for the 15/16 summer were analysed and estimated to be 1.12kW in Central Coast area and 0.57kW in Lake Macquarie area.

Customers were surveyed after the conclusion of the 14/15 summer period with responses being generally positive about their experiences throughout the trial. However, it was not clear at that point whether or not the customer experience would remain as positive during a summer period with extended periods of very hot weather and more peak event dispatches. Customers were surveyed again after the 15/16 summer period. See table below for a snapshot of the responses, comparing the two summer periods:

	Summer 14/15		Summer 15/16	
	Central Coast	**Lake Macquarie**	**Central Coast**	**Lake Macquarie**
Response rate	53%	52%	75%	76%
Rated as a very positive experience (8+ out of 10)	98%	99%	79%	85%
Experienced slight or no difference to cooling	95%	90%	58%	89%
Found override feature useful	54%	N/A	45%	N/A
Participated due to financial incentive	50%	33%	58%	50%

The offer was extended for the 16/17 summer period in order to build a more accurate and reliable dataset with regard to:

- Override rates and customer response during extended high temperature periods
- Diversified demand reductions
- Program participation retention/dropout rate (year to year):
  - Central Coast: dropout rate from 2014/15 to 15/16 was 17%
  - Lake Macquarie: dropout rate from 2014/15 to 15/16 was 13%

5.3.5 Summary of actual and projected costs

A summary of the actual project costs incurred in 2015/16 and previous years is shown below, as well as projected costs for the 2016/17 year. All costs incurred for this project are categorised as opex.

This project is expected to be completed in 2016/17.

Actual and projected project costs:

Budget Item	2012/13 Actual	2013/14 Actual	2014/15 Actual	2015/16 Actual	2016/17 Projected	Total Projected
Project research and development	$18,666	$0	$0	$0	$0	$18,666
Implementation Phase 1 – Pilot, lab testing and Demand Response Enabling Device (DRED) development	$140,342	$0	$0	$0	$0	$140,342
Implementation Phase 2 – customer trial and DRED development	$16,000	$585,715	$83,708	$72,915	$40,000	$798,338
Total (excl GST)	**$175,008**	**$585,715**	**$83,708**	**$72,915**	**$40,000**	**$957,346**

5.3.6 Project progress & identifiable benefits

In addition the progress and benefits identified in the previous Ausgrid DMIA reports for 2013/14 and 2014/15, this trial has:

1. continued to test the consumer response to peak demand response dispatch events through the 15/16 summer
2. gathered further load reduction data from households to indicate the effectiveness of the dispatches
3. gathered further customer feedback on their experiences of participating in the trial
4. gathered data about participant drop-out rates which will assist with future prediction of the longevity of demand reductions gained through such programs

Measurement and verification of the results from the summer 2015/16 period for both trial areas is in progress, and the trial has been extended to continue through to March 2017 to collect a further summer of customer response results. Interim results from the trial have been published on Ausgrid's website at www.ausgrid/dm with further updates published when available.

At this stage there are no material peak demand reductions achieved from this project. The trial activities have not been part of a deferral of a real network need.

5.4 Newington grid battery trial

5.4.1 Project nature and scope

This project investigated the potential benefits of using battery storage as a means for reducing peak demand on the network. This project investigated how a network grid-side battery can be operated reliably and effectively for summer peak reduction purposes and to potentially improve power and supply quality parameters of the network. Another area of importance was an assessment of the reliability and performance of battery storage devices during the hotter summer months as well as the optimum battery management and control methodologies.

5.4.2 Project aims and objectives

Primary objectives:

(a) Summer peak reduction network benefits: To trial the control and scheduling methodology of the grid battery during the hotter summer months to reduce summer peaks in the local area

(b) Summer battery performance and reliability: To test the grid battery performance during the hotter summer months when battery performance may be more adversely affected by temperature.

Secondary Objectives:

(c) Renewable load smoothing (Solar PV): Simulate using the battery to store renewable energy generation from local solar systems.

(d) Power quality issues: To further test the power quality benefits of installing a grid battery in an urban network.

(e) Customer benefits: To test the potential customer benefits of installing a battery to reduce customer energy bills for a typical larger customer (e.g. demand and peak energy charges).

5.4.3 Implementation plan

The Newington grid battery was planned to be installed as part of the Smart Grid Smart City (SGSC) program but due to difficulties with securing a lease agreement for installation of the battery at the preferred site location, it was not installed under this program. All trials under the SGSC program ended in September 2013.

The grid battery project continued as a Demand Management Innovation Allowance (DMIA) project from October 2013. The issues around securing a suitable site location that had plagued the SGSC program also delayed the installation and commissioning of the battery as part of the DMIA project. It was not until May 2014 that the grid battery was commissioned after Ausgrid was able to successfully negotiate a lease with the Sydney Olympic Park Authority (SOPA) at their Newington Armory precinct. The grid battery was connected to the low voltage network that is supplied by the same 11kV feeder that supplies most of the customers in the Newington suburb. This battery is a 60kVA/ 120kWh Lithium Ion battery system supplied under a lease agreement.

5.4.4 Results

The trial results showed that:

1) **It is possible to use a grid-connected battery storage system to reduce the load on a network asset on peak demand days.** The trial demonstrated that storage systems have the potential to be considered for demand management solutions when they become more cost effective and offer improved reliability. An important issue encountered in the trial was that the reliability of the whole battery storage system was compromised primarily due to control systems such as metering and communication devices. Battery storage technology is developing quickly and it is envisaged that the reliability issues encountered in the trial will be resolved.

2) **An important observation from the trial was the importance of battery storage capacity for use in demand management.** While peak demand periods can vary across a range of network needs, a solution which provides a short term reduction in the peak demand on a network asset should ideally have the potential to provide 4-6 hours of demand reduction. The battery used in this trial was capable of 2 hours at full power output, or 4 hours at 50% power output. Where a solution is only capable of shorter dispatch periods, networks would typically combine demand reductions from multiple sources to achieve the required reduction. This can lead to a higher cost and so such solutions might be at a cost disadvantage compared with alternative solutions.

   The energy storage capacity of battery systems can be optimised by using automated battery management functions which better utilise the available storage capacity by only discharging at partial power output to maintain network demand to a pre-set threshold. However, as was discovered in the trial, the use of remote measurement devices increases system complexity and a resultant higher risk of battery system failure.

3) **The battery leasing arrangement was a desirable feature for Ausgrid** as leased battery systems provided as part of a full service solution is expected to offer a lower cost solution when applied to a common one to three year deferral of a network investment.
4) **For battery storage systems to be used to achieve peak reduction, the ability to locate the battery in a specific geographic area that enables deferral of a network need is critical.** It was predicted that securing a site location for the battery system might be straightforward with few community concerns. However, our experience demonstrated that concerns from the local community can still introduce project delivery delays or the need to locate at less than ideal locations. Notably, visual impact concerns remained an issue to be addressed.

For further detail the full report on the trial has been published on Ausgrid's website at www.ausgrid/dm.

5.4.5 Summary of actual and projected costs

A summary of the actual project costs incurred in 2015/16 and previous years is shown below. All costs incurred for this project are categorised as opex.

This project was closed at the end of 2015/16 with no further expenditure required.

Actual project costs:

Budget Item	**2012/13 Actual**	**2013/14 Actual**	**2014/15 Actual**	**2015/16 Actual**	**Total Actual**
Project research and development	$7,115	$12,035	$0	$0	$19,150
Trial activities and reporting	$0	$246,991	$331,268	$65,108	$643,367
Total (excl GST)	**$7,115**	**$259,026**	**$331,268**	**$65,108**	**$662,517**

5.4.6 Project progress & identifiable benefits

Trial results have shown that grid based energy storage can be a viable solution to managing network demand once the product matures and energy storage prices lower . In addition to a lower cost per Megawatt-hour of storage capacity, improvements to system reliability will be required to compete with existing alternative demand management solutions.

Following completion of the Newington grid battery trial, Ausgrid has now assessed the reliability, performance and implementation issues for both grid and customer based battery storage. While the outcomes from both trials highlighted a performance gap in reliability compared with more mature demand management solutions, we expect that these issues will be resolved in the near future. And with battery costs forecast to decline significantly in the near term, cost competitiveness may not be far off.

The trial has also highlighted potential areas of future research, notably into customer attitudes to battery investment. For further detail the full report on the trial has been published on Ausgrid's website at www.ausgrid/dm.

As the trial was relatively modest in scale and temporary in nature, there are no permanent, material peak demand reductions achieved from this project. The trial activities did not form part of a deferral of a real network need.

5.5 Controlled Load 2 summer scheduling

5.5.1 Project nature and scope

Ausgrid currently has around 160,000 customers on their Controlled Load 2 tariff (Off Peak 2), predominantly controlling domestic hot water systems. This tariff was originally intended for shifting load outside of peak times in the winter period but summer peaks are becoming the predominant driver for much of Ausgrid's growth related network investment.

This project involves trialing a new summer load control schedule for summer peak reduction for customers with Controlled Load 2 tariffs. It was estimated that the existing Controlled Load 2 customer load contributed 20 to 25 MW of load during the 4 to 5pm time period on network peak days in summer.

5.5.2 Project aims and objectives

The main objective of the project was to investigate the potential issues and barriers for implementing a summer scheduling regime for Controlled Load 2 customers across the whole network. Potential barriers include:

(a) **Customer response** due to customers having less hours of electricity supply for their controlled load 2 electricity supply during the summer months. The hot water demand requirements during the summer months is less than the winter months due to temperature effects (water and ambient air) and it is envisaged that this will not be a significant issue, but is an important aspect to be tested as part of the trial. However, in some cases other approved loads such as heating, charging or pumping loads may have been connected to the Controlled Load 2 tariff. Any changes to the control schedule during the summer will adhere to the terms and conditions of the Controlled Load 2 tariff, but may affect customer's expectations of how the control should be scheduled. Customer complaints through our call centre will be assessed to determine the impact on customers.

(b) **Load control operational issues** due to changing of the scheduling for summer and then back to a regime for the rest of the year. For example, a summer schedule could be implemented between 1 November to 31 March and a winter/ shoulder season schedule for the rest of the year. Operational issues also include how to implement the "summer" and "rest of the year" load control schedule with the existing load controllers for all areas of the network.

(c) **Measure the peak demand reduction** achieved from the schedule change and use to estimate the peak demand reduction potential across the Ausgrid network.

5.5.3 Implementation plan

The project was initially proposed to consist of two phases:

1. **Phase 1 (2013/14)**: Phase 1 of the project was to test a summer schedule of Controlled Load 2 load control in two to three parts of the Ausgrid network area over the summer 2013/14 and 2014/15 periods. The trial areas were chosen by targeting specific summer peaking zone substation areas with high levels of Controlled Load 2 customers.
2. **Phase 2 (2014/15 and beyond)**: Where the Phase 1 outcome demonstrates potential viability, and further research is warranted, a Phase 2 trial would be implemented across further parts of the Ausgrid network, focusing on areas where different operational or customer issues may be encountered.

5.5.4 Results

The phase 1 part of the project was successfully completed during 2013/14 and results published in the 2013/14 DMIA annual report. The phase 2 part of the project was successfully completed during 2014/15 and results published in the 2014/15 DMIA annual report.

Analysis and reporting of the project results continued in 2015/16 and the final report for the Controlled Load 2 summer scheduling trial is published as a consolidated hot water report with the load control of small hot water systems trial (see Section 5.1) and subsidised controlled load connections project (see Section 5.2) on Ausgrid's website at www.ausgrid.com.au/dm.

5.5.5 Summary of actual and projected costs

A summary of the actual project costs incurred in 2015/16 and previous years is shown below. All costs incurred for this project are categorised as opex.

This project was closed at the end of 2015/16 with no further expenditure required.

Actual project costs:

Budget Item	2012/13 Actual	2013/14 Actual	2014/15 Actual	2015/16 Actual	Total Actual

Project research and development	$1,343	$0	$0	$0	$1,343
Phase 1 – Trial in 2 to 3 areas	$0	$100,531	$71,540	$27,572	$199,643
Total (excl GST)	**$1,343**	**$100,531**	**$71,540**	**$27,572**	**$200,986**

5.5.6 Project progress & identifiable benefits

The project implementation was completed in the 2014/15 and project analysis and reporting was completed in 2015/16.

During 2014/15 the revised summer controlled load schedules were implemented for 28 zone substations across the lower Hunter region of the Ausgrid network (Newcastle load area) with an estimated demand reduction of about 4 MW across the entire area. Where appropriate, the solution would be considered a viable and very low cost option for reducing peak demand so as to defer network investment.

Further analysis was performed during 2015/16 indicating that across the whole Ausgrid network the summer afternoon peak reduction that could be achieved by changing the load control schedules is estimated to be 18 MW.

The demand reductions were on average 140 kW per zone substation and up to 300 kW reduction for zones with a higher penetration of Controlled Load 2 customers. The amount of demand reduction per zone would be considered small in terms of the total demand requirements needed for a typical network deferral. However, the solution is very low cost and would be considered to be a cost-effective option as part of a suite of demand management options used to address a network deferral project where the need was during the summer afternoon period of 2.30pm to 6pm.

The final report for the Controlled Load 2 summer scheduling trial is published as a consolidated hot water report with the load control of small hot water systems project (see Section 5.1) and subsidised controlled load connections project (see Section 5.2) on Ausgrid's website at www.ausgrid.com.au/dm.

The trial activities did not form part of a deferral of a real network need.

5.6 Customer power factor correction

5.6.1 Project nature and scope

Power factor correction (PFC) is recognised as a highly cost effective technique for lowering the peak demand in electrical infrastructure. The power factor is defined as the ratio of real power to apparent power. The real power, or active power, is measured in watts and represents the work provided at the load (e.g. light, motor etc). The apparent power is measured in volt-amperes (VA) and due to the resistance, inductance and capacitance of the load, can be greater than the real power.

An example of a device which has a power factor less than 1 is a motor. Where the power factor is less than 1, the network infrastructure must be sized larger to deliver the apparent power.

Correcting power factor at customer premises lowers the peak demand in kVA and reduces the electrical infrastructure requirements for networks. Ausgrid and many other networks use a kVA demand or capacity charge in their medium-to-large customer tariffs to reflect this cost and encourage customers to address poor power factor.

Encouraging customers to install power factor correction equipment is an established method for reducing peak demand and deferring network investment, but less is known about the level of customer response to various incentive levels and the customer response for a range of customer sizes (energy use) and types.

Although power factor correction is commonly a cost effective investment by businesses, there remains a significant technical potential demand reduction available from customers. Looking only at customers supplied from low voltage and charged on a tariff with a kVA demand charge (about 13,000 customers), there is a technical potential of 160 MVA in demand reductions from these customers. For these customers, although their tariff penalizes them with higher bills when they have low power factor, the costs savings alone are insufficient to encourage investment.

There have been numerous studies detailing the range of barriers to investment in more energy efficient equipment. Reports such as the Productivity Commission's 'Private Cost Effectiveness of Improving Energy Efficiency' and the Prime Minister's Task Group on Energy Efficiency have detailed barriers such as a lack of information, skills gaps, behavioural factors and split incentives. This trial aims to explore ways to clear these barriers so as to improve the effectiveness and efficiency of future power factor correction programs for network deferral projects.

5.6.2 Project aims and objectives

The objectives of this PFC program are to:

1. Commence a Power Factor Correction (PFC) campaign which is as cost effective as possible and which will assist larger customers to improve their power factor.
2. Incrementally refine PFC sales, marketing and procurement approaches with the aim of identifying the optimal program design.

5.6.3 Implementation plan

The proposed program will include the following elements:

1. Analyse customer billing and connection data to determine the power factor correction opportunity for each customer exposed to a kVA demand charge.
2. Contact customers in person and by phone, email, letter and/or other identified mechanism.
3. Trial alternative approaches which may improve the cost effectiveness of program delivery.
4. Explore opportunities to leverage service provider's relationship with customers to increase the implementation of PFC at customer sites.

5.6.4 Results

In 2014/15, the trial tested a facilitated approach whereby customers were individually identified, contacted and managed on a case by case basis. This approach sought to improve both awareness of the investment opportunity and information provision to educate customers on the issue and how they could lower their bills using power factor correction. The results from this approach can be found in the previous Ausgrid DMIA report for 2014/15.

In 2015/16, the trial transitioned to an alternative approach which used a lower cost facilitation model. This approach targeted customers across distinct areas within the Ausgrid network by completing the following tasks:

1. Divided trial areas into four groups – this created distinct customer groups on which to test varying approaches
2. Identified all customers with installation potential and an estimated payback of under 10 years – previous power factor correction initiatives had assumed that customers would only pursue a solution when their power factor was below 0.9 and their payback period was 3 years or less, this may have led to some opportunities being neglected

3. Developed customer letters to mail out – these serve as the initial point of contact with the customer and need to be crafted to call the customer to action
4. Developed the site specific power factor report, plus the tool to generate customised reports for individual sites – this report provides the customer with the useful information about their supply and potential savings and is designed to help the customer approach the market and procure power factor correction services
5. Launched the PFC Service Provider register – this register is a resource for customers and provides a list of service providers offering power factor correction services
6. Developed and launched customer registration web page – this allows customers to register their details and receive a site specific power factor report from Ausgrid
7. Updated customer support web pages – these aim to address common customer concerns and questions
8. Engaged mail house to send out customer packs – this coordinated all the customer contact details and information packs to be sent to approximately 1,100 customers

Approximately 1,100 customers across the trial areas were contacted via letter explaining the potential savings of power factor correction. The following variations were introduced to test their effectiveness:

- Customer provided with a complimentary site specific power factor report (Pro: critical information directly available for customer to see potential savings and act upon, Con: unable to track customer behavior or follow up)
- Customer invited to register details and be sent a complimentary site specific power factor report (Pro: customer provides details for trackability and information gathering, Con: extra step for customer, may inhibit action)
- Notified PFC service providers (on the register) of calculated installation potential and number of customers contacted in zone areas (Purpose: to leverage the sales and marketing capability of service providers in the market by highlighting the installation – and hence, sales - potential in such a way that does not compromise customer privacy)

The zone substation areas were divided into four groups and the variations applied as per the table below.

Group	Letter	Invite to register online	Power factor report provided	PFC service providers notified
1	✓	✓		
2	✓	✓		✓
3	✓		✓	
4	✓		✓	✓

The intention is to determine the quantitative difference in uptake rates between:

A) Groups 1+3 and 2+4, to gauge the effect of introduction of additional sales channels through the PFC service providers.
B) Groups 1+2 and 3+4, to gauge the effect of providing the site specific power factor report as opposed to inviting customers to register.

At the end of 2015/16, the letters and site specific power factor reports had been prepared and the mail house engaged in readiness for the mail out in early 2016/17.

5.6.5 Summary of actual and projected costs

A summary of the actual project costs incurred in 2015/16 and previous years is shown below, as well as projected costs for the 2016/17 year. All costs incurred for this project are categorised as opex.

This project is expected to be completed in 2016/17.

Actual and projected project costs:

Budget Item	**2012/13 Actual**	**2013/14 Actual**	**2014/15 Actual**	**2015/16 Actual**	**2016/17 Projected**	**Total Projected**
Project research and development	$18,859	$11,355	$0	$0	$0	$30,214

Project implementation	$0	$64,151	$264,636	$106,140	$75,000	$509,927
Total (excl GST)	**$18,859**	**$75,506**	**$264,636**	**$106,140**	**$75,000**	**$540,141**

5.6.6 Project progress & identifiable benefits

2014/15 concluded with a clear indication of customer response to the “high facilitation” approach, which is described in detail in the previous Ausgrid DMIA report for 2014/15.

2015/16 saw a transition to a contrasting “low facilitation” approach, which aims to test whether it is possible to achieve greater kVA reductions at lower marginal cost through widespread targeting of customers with a concise contact and follow up strategy. This strategy will aim to provide succinct information and website materials with a clear pathway for customers to access expertise and services from the market, rectify their power factor and lower their electricity costs. It will also aim to test different levels of involvement from PFC service providers with the aim of creating a market led approach that allows Ausgrid to leverage the service providers’ sales channels to assist with driving uptake while not compromising customer privacy. Many of the tasks have been completed in preparation for this with results to be recorded and analysed in 2016/17.

When available, results from the trial will be published on Ausgrid’s website at www.ausgrid/dm.

Peak demand reductions achieved from this trial have been modest in scale at about 1-2 MVA. The trial activities have not been part of a deferral of a real network need.

5.7 CBD embedded generator connection

5.7.1 Project nature and scope

It has been identified in numerous studies that embedded generation can defer or avoid the need for network augmentation investments by reducing peak demand. In addition, connection applications for the installation of cogeneration plant using natural gas fired generators are increasing.

To optimise potential benefits for both the customer and the network, the generators should be able to operate in parallel with the Ausgrid network. However because of the configuration of the electricity network in the Sydney CBD (triplex system), parallel operation can cause particular technical issues which are prohibitively expensive to resolve using current approaches.

Fault levels on the Sydney CBD triplex system are generally high due to the high load densities, high capacity network assets, and a high capacity source. In many situations, the existing fault level is close to the specified fault duty limit of both network assets and customer equipment such that there is not a significant amount of fault duty “headroom”. The connection of embedded generators results in an additional contribution to the fault level, and can often result in equipment fault duty limits being exceeded. Fault limiting approaches such as changing network topology, changing the point of connection, or installing fault level mitigation equipment are possible, but are only useful in limited circumstances and also relatively expensive. This factor has been the most common reason that embedded generation projects proposed for connection to the CBD system have failed to proceed or are smaller in scale.

The development of a technically feasible, economic, and practical connection solution is likely to promote a greater uptake of embedded generation in the Sydney CBD and other similar network locations. This in turn could defer or avoid the need for network capital investment by expanding the extent to which embedded generation can play a role in network support during peak demand periods.

5.7.2 Project aims and objectives

The aim of the project is to develop, design and test an alternative embedded generator connection in the Sydney CBD that is cost effective and addresses the potential fault level issues which are currently a barrier to their widespread uptake in these types of network locations.

Further, the proposed solution should be applicable to typical generator sizes in the majority of CBD locations and be substantially less expensive than current solutions.

5.7.3 Implementation plan

The implementation plan included two main components:

1. **Phase 1**: Consideration and analysis of the network design options to enable connection of generators at 11kV level while addressing the fault level and feeder imbalance issues, and identification of the preferred approach and conceptual design of the preferred option.
2. **Phase 2**: Identification of suitable site and installation of alternative embedded generator connection including detailed connection design. Monitoring and verification of connection to verify utility as demand management resource.

5.7.4 Results

Phase 1 of the project is complete and results have been reported in the previous Ausgrid DMIA reports. The preferred design for the auto switching scheme is comprised of three main features:

a) Logic functions in a PLC within the distribution substation

b) Control mode switches on the circuit breakers on the LV side of the distribution transformers at the distribution substation

c) Integration of status and control signals from the Sydney CBD triplex network and embedded generation.

The conceptual design showed that an embedded generator can be connected in such a way that installation costs are minimized, yet with no adverse impacts on the network or customer reliability. Although there are significant issues which would need to be resolved before the proposed solution could be implemented, the conceptual design and the costing provide sufficient basis for ongoing work.

Phase 2 began in 2014, with work on the detailed design. This initial stage involved defining the relay requirements, and completing the relay allocation. A trial site was identified, field inspection conducted, and an engineering brief drafted. Detailed design work is now substantially complete. The capex funded component of the program has been progressing, however there has been little expenditure from DMIA funding in 2015/16. Implementation of the auto switching scheme at the trial site is scheduled to occur in 2016/17, subject to trial site scheduling restrictions and resource availability.

5.7.5 Summary of actual and projected costs

A summary of the actual project costs incurred in 2015/16 and previous years is shown below, as well as projected costs for 2016/17.

As this project involves upgrading Ausgrid network equipment, it has both capex and opex expenditure components. The DMIA opex costs for this project are detailed below. Only opex expenditure has been allocated to the DMIA.

Actual and projected DMIA opex project costs:

Budget Item	**2011/12 Actual**	**2012/13 Actual**	**2013/14 Actual**	**2014/15 Actual**	**2015/16 Actual**	**2016/17 Projected**	**Total Projected**
Phase 1 – Design options and conceptual design	$39,251	$714	$548	$0	$0	$0	$40,513
Phase 2 – CBD connection trial		$5,726	$99,612	$37,130	$1,767	$50,000	$194,235
Total (excl GST)	**$39,251**	**$6,440**	**$100,160**	**$37,130**	**$1,767**	**$50,000**	**$234,748**

5.7.6 Project progress and identifiable benefits

The use of embedded generation is a common method for reducing network demand so as to defer network investment and so verification of this approach can clear a barrier to greater volumes of embedded generation in the Sydney CBD network. Where field testing verifies the approach, this arrangement can offer a business as usual connection to the triplex network for future customers and so ensure that in future, sites are ‘generator ready’ with no material additional costs to connect. When available, project results from the trial will be published on Ausgrid’s website at www.ausgrid/dm.

No peak demand reductions have been achieved from this project to date. The trial activities do not form part of a deferral of a real network need.

5.8 CoolSaver Maitland Program

5.8.1 Project nature and scope

Phases 1 and 2 of the CoolSaver trial (see section 5.3) has confirmed the technical viability of both the ripple and SMS signal receiver solutions, and there has been a positive customer response to the product offering. The remaining barrier to achieving a commercially ready demand management product is the lack of a viable low cost customer acquisition model.

The experiences of Energex in Queensland indicate that a retailer led acquisition model is viable where the product offer is available to a large metro area. But, it is not clear whether such an approach would be sufficiently attractive to retailers and air conditioner manufacturers where the offer area is bounded geographically to align with emerging network constraints.

This project will identify a trial area to investigate an alternative approach that will aim to leverage the initial purchase and installation of new compliant air conditioners and so lower the cost of customer acquisition and participation, whilst simplifying the process for customers.

5.8.2 Project aims and objectives

The project objectives are:

Primary

- Test lower cost customer acquisition models and their effectiveness and verify the viability of establishing new sales channels for the product through leveraging point of sale channels through air conditioner industry, installers and appliance retail stores.

Secondary

- To make a more informed decision about whether to proceed with either a ripple or SMS signal receiver solution for future demand management programs, including consideration of customer preference, cost and functionality.
- Explore whether customer takeup varies when dispatch override is offered as a product feature.

5.8.3 Implementation plan

Phase 3 of the CoolSaver project will focus on developing a low cost customer acquisition model. Secondary objectives will focus on refining the technology choice and customer offer. The primary actions are:

1. Identify appropriate supplier of DRED units and procure
2. Identify appropriate industry stakeholders including retailers, manufacturers and installers and develop engagement model
3. Identify trial target area
4. Develop and produce marketing materials
5. Identify and deliver necessary training for installers and retail staff
6. Develop and introduce fulfilment solution for marketing materials and DREDs
7. Coordinate efforts to recruit trial participants and monitor take up rates
8. Operate dispatches over summer period
9. Develop and operate program options such as advance notice of dispatch and override capability
10. Collect and analyse data - DRED data logs, customer meter data and participant surveys to determine demand reduction performance (quantitative), customer acceptance (qualitative) and technology performance
11. Report findings and conclusions

5.8.4 Results

2015/16 saw the launch of the CoolSaver Maitland program and the first summer season. It was very instructive in identifying the barriers to customer take up, but also included the following achievements:

- Finalised negotiations for the legal agreement with all industry participants, to arrive at a total of five (three retail stores and two specialist air conditioner supplier/installers)
- Established industry participant payment process
- Created and formalised training materials, including videos, made available for installers and sales staff

- Negotiated and established technical services (auditing, troubleshooting and training delivery) contract to ensure safety and quality
- Welcomed 27 customers to the program, who then participated in peak event dispatches in 2015/16
- Rewarded participating customers with cash reward amounts for summer participation
- Completed customer survey
- Met with industry participants to discuss program effectiveness and receive their feedback on the customer acquisition approaches

5.8.4.1 Customer acquisition

The following initiatives were deployed in the lead up to the 2015/16 summer period with the aim of maximizing customer acquisition through third party, market channels:

- In store marketing collateral was provided to retailers, including brochures, floor decals, posters and on unit 'wobblers'
- Training was provided to sales floor staff, including provision of a process pocketbook
- Installer training videos were created and posted online
- Cash incentives were made available to:
    - Customers – upon installation and for participation in peak event dispatches
    - Industry participants – for successful customer sign up and installation
    - Sales staff - for successful customer sign up and installation
- Website materials were made available, such as:
    - Eligible air conditioner makes and models
    - Information about how the program works and possible customer incentives
    - Information around how to join the program
    - FAQs
    - Industry participants (ie. participating retailers and installers)
- Face to face contact with industry participants to address concerns and questions and keep the program top of mind

A total of 27 trial participants were recruited to the program between August 2015 and May 2016. Of these, 9 were new units and 18 were existing air conditioner units. The split of air conditioner size was 8 units of 4-10kW in cooling capacity and 19 air conditioners with more than 10kW in cooling capacity. Of the 9 new units, 2 were sold at retail outlets while 7 were purchased from specialist air conditioning installers. This take up rate was well below expectation and is detailed in the table below showing sales as a proportion of overall sales up to the end of April 2016.

Industry Participant	**Sign ups from new sales**	**Total sales of AS4755 compliant units**	**% of total AS4755 compliant sales**	**Total sales of all AC units**
Retailer 1	2	247	0.8%	417
Retailer 2	0	110	0%	204
Retailer 3	0	43	0%	153
AC Specialist 1	8	102	8%	526
AC Specialist 2	0	Data not available	N/A	Data not available
TOTAL	10	502	2%	1,300

A customer mail out was undertaken in November 2015 in an effort to lift the customer take up rate among potential owners of existing units. This was done by targeting approximately 5,000 customers in suburbs that have shown significant growth in the last five years. It was assumed that the dwellings in these suburbs would have high rates of installed air conditioning. Customers were invited to register their interest and have their air conditioner assessed for eligibility, then were put in touch with an installer if eligible. Of the approximately 5,000 letters sent, there were 51 responses (1%), 23 of which (0.45%) were eligible, AS4755 compliant air conditioning units. This ultimately resulted in

13 (0.25%) completed installations. Of the 18 customers with existing air conditioning units, 13 were as a result of the direct mail out, the remaining 5 requested installation through participating installers of their own volition.

It became clear there were a number of barriers to customer take up, the main ones were identified as:

1. There are over 500 air conditioning units in 4-10 and 10+ kW range across 13 manufacturers which are compliant with the AS4755 standard, however there is an overall lack of standard control interfaces across the machines. Whilst many machines are technically compliant, this is only the case after an additional component is retrofitted to the unit. The technical features, installation procedure and price of these parts vary widely across the manufacturers and models. Analysis shows that 39% of the available compliant models require an additional component. While this is not particularly high, these models seem to be more popular, as 17 out of the 27 Maitland customers (63%) had air conditioning units that required an additional part to be installed for compliance. This creates complexity in the training, installation and quality control processes as the additional components need to be available in sufficient quantities when and where required, as well as being safely and effectively installed.
2. It was generally difficult to maintain a consistent approach to customer sales due to the nature of the retail sales environment. This was due to a number of factors including:
    - Generally high level of staff turnover in retail outlets
    - The offer had to compete with a lot of other priorities and sales offers within stores and was seen by staff and customers as overly complex
    - There were anecdotal reports that customer were suspicious of central control of air conditioners, especially by a DNSP
    - Different in store processes for staff briefing and information dissemination meant more facilitation was required at the store level than was originally anticipated
3. The incentive levels available to offer to industry participants and sales floor staff do not seem to be sufficient in order to consistently promote the program to customers

A key finding so far is that it is very difficult to drive customer uptake through third party sales channels while adequately managing the risk and providing a least cost solution. It appears that the amount of money such a program can provide to the third party facilitators (ie. retailers and installers) is not enough to make it worth diverting from their business as usual activities.

5.8.4.2 Peak event dispatches

See table below for details of peak event dispatches during the 2015/16 summer period:

Date	Day	Start	Finish	Mode	Max. Daily Temp (ºC)	Available participants	Overrides
14/01/2016	Thursday	2:00pm	6:00pm	DRM2	39.8	3	0
15/02/2016	Monday	2:00pm	6:00pm	DRM2	33.4	12	0
25/02/2016	Thursday	3:00pm	7:00pm	DRM2	40.0	13	0
3/03/2016	Thursday	3:00pm	7:00pm	DRM2	33.5	16	0
9/03/2016	Wednesday	3:00pm	7:00pm	DRM2	35.0	18	1
10/03/2016	Thursday	3:00pm	7:00pm	DRM2	34.5	12	0

Customers were surveyed after the conclusion of the 2015/16 summer period with responses being generally positive about their experiences throughout the trial. Some key insights from the survey found that:

- a high proportion of trial participants were satisfied with their overall experience in the trial with 84% rating their experience as being 8/10 or higher;
- just over half (53%) of the participants did not notice or only noticed a slight difference in their cooling experience during the power-saving activation periods; and
- the largest motivator for participants to take part in the trial was the monetary incentive (63%), then reduction in overall network charges (26%) followed by interest in new technology (11%).

Survey item	**Summer 15/16 - Maitland**
Response rate	90%
Rated as a very positive experience (8+ out of 10)	84%
Experienced slight or no difference to cooling	53%
Found override feature useful	58%
Participated due to financial incentive	63%

The offer continues over the 2016/17 summer period in order to build a more accurate and reliable dataset with regard to:

- Customer take up of the offer
- Customer retention/drop-out rate
- Customer response to peak event dispatches
- Diversified demand reductions

5.8.5 Summary of actual and projected costs

A summary of the actual project costs incurred in 2015/16 and previous years is shown below, as well as projected costs for 2016/17. All costs incurred for this project are categorised as opex.

This project is expected to be completed in 2016/17.

Actual and projected project costs:

Budget Item	**2014/15 Actual**	**2015/16 Actual**	**2016/17 Projected**	**Total Projected**
Project research and development	$6,635	$0	$0	$6,635
Project implementation	$436,897	$205,673	$120,000	$762,570
Total (excl GST)	**$443,532**	**$205,673**	**$120,000**	**$769,205**

5.8.6 Project progress & identifiable benefits

Project progress up the end of June 2015 can be found in the previous Ausgrid DMIA report for 2014/15. 2015/16 saw the public launch of the CoolSaver Maitland program, the implementation of its physical and administrative systems and the operation of its first summer season.

Results from and experience of the program so far suggest that customers have a positive view of the program once enrolled and participating, however there is significant difficulty in securing customer participation through third party sales channels. There are additional difficulties and risks with regard to safety and quality that must be managed throughout the installation and commissioning process. Experience so far suggests that this can be achieved within acceptable additional costs, provided customer acquisition is large enough to provide the necessary economies of scale.

When available, interim/final results from the trial will be published on Ausgrid's website at www.ausgrid/dm.

As the trial is modest in scale, there are no material peak demand reductions achieved from this project. The trial activities do not form part of a deferral of a real network need.

5.9 Non-residential energy efficiency program

5.9.1 Project nature and scope

Energy efficiency improvements have been widely acknowledged to have contributed to a slow down or decline in both electricity consumption and overall peak demand. Energy efficiency improvements of equipment that are normally operating at peak times will reduce both energy consumption and peak demand contributions from that equipment. Although energy efficiency improvements contribute to an overall reduction in peak demand, whether it makes a material difference for a specific network investment will depend on the characteristics of the network investment including customer types in that area (eg. commercial, industrial or residential), the end-uses that the energy efficiency improvements apply to (eg. lighting, heating/ cooling, refrigeration) and weather characteristics in that location (eg. summer or winter peak demand).

Demand management programs utilising energy efficiency improvements are relatively rare in Australia but have been successfully implemented by utilities in the past. One example is Ausgrid's Drummoyne demand management project in 2006-07 which offered free installation of compact fluorescent lights in residential homes to defer a network investment in a predominantly residential winter peaking area of the network. Other electricity utilities have conducted commercial and industrial energy efficiency programs to reduce peak demand but reported peak demand reductions and cost-effectiveness have varied considerably.

For Ausgrid's customers, about two-thirds of annual electricity consumption and 50-60% of system peak demand is due to electricity demand from non-residential customers. And at points on the network where residential customers comprise a smaller component of the demand, reductions from non-residential customers are likely to be critical to achieving a viable network investment deferral. For about 1/3 of Ausgrid's zones substations, residential customers comprise less than a 1/3 of the load and so are likely to offer only a small component of any demand reduction.

5.9.2 Project aims and objectives

The project objective is to trial alternative cost-effective methods of facilitating and/or incentivising non-residential customers to implement energy efficiency improvements that are additional to baseline energy efficiency activity and therefore result in additional peak demand reductions. One of the aims of the project will be to measure and verify the peak demand reductions achieved above baseline activity.

5.9.3 Implementation plan

The project was still being developed during 2015/2016. The first part of the project development was completed in 2014/15 which was to review the likely energy efficiency initiatives and programs that would provide the highest peak reduction potential for customers in different parts of the Ausgrid network area.

The second part of the project development involved engaging with government organisations that are running energy efficiency programs to explore the potential for leveraging these programs and channels and so identify least cost demand management solutions.

As at June 2016, no decision had been made whether to proceed to a project implementation stage. The project concept will be explored with stakeholders as part of the DMIA market engagement project (Section 4.2).

5.9.4 Results

As the project remains in development, no project results are available.

5.9.5 Summary of actual and projected costs

A summary of the actual project costs incurred in 2015/16 and previous years is shown below. Due to the conditional nature of the project, projected costs for the 2016/17 year have not been estimated. All costs incurred for this project are categorised as opex.

Actual and projected project costs:

Budget Item	**2014/15 Actual**	**2015/16 Actual**	**2016/17 Projected**	**Total Projected**
Project research and development	$18,565	$20,151	TBC	TBC
Total (excl GST)	**$18,565**	**$20,151**	**TBC**	**TBC**

5.9.6 Project progress & identifiable benefits

Up until the end of June 2016 the main progress made has been in the research and development stage of the project.

The review of previous commercial and industrial energy efficiency programs and initiatives completed during 2014/15 concluded that there was a high variability of cost-effectiveness for different energy efficiency initiatives. Preliminary findings indicated that a business lighting retrofit program would yield the highest potential peak reductions due to the widespread applicability of the initiative across different business types and the repeatability of the initiative across different areas of the Ausgrid network.

During 2015/16, discussions were held with the NSW Government (Office of Environment and Heritage) and the NSW Independent Pricing and Regulatory Tribunal (IPART) who administer the NSW Energy Savings Scheme (ESS). The purpose of these discussions was to explore opportunities where the NSW ESS could be leveraged in order to co-design a project using the ESS framework but which targeted peak demand reduction savings in certain geographical locations of the Ausgrid network. Furthermore, in order to proceed with a project, it was necessary to be confident that a methodology for measuring the effectiveness of a program could be developed. To address this concern, discussions around obtaining aggregated geographical information for Energy Savings Certificates were progressed. This would be a requirement for proceeding with the project to implementation stage.

More detailed analysis of different case studies and previous program data was also conducted. The objective of this analysis was to determine the potential range of peak demand reduction savings achievable per unit of energy saved for different lighting retrofit scenarios and technologies. The findings from the analysis showed that for office-based lighting a summer peak demand reduction of around 0.3 kW per MWh of annual energy savings was achievable. For example, for an office lighting retrofit that results in an estimated 100,000 kWh annual energy savings, the equivalent summer peak demand reduction would be estimated to be around 30 kW.

No identifiable benefits have yet been defined for this project. The trial activities do not form part of a deferral of a real network need.

5.10 Pool pump demand

5.10.1 Project nature and scope

Pool pumps are a large residential appliance with an estimated 180,000 pool owners in Ausgrid's network area. The summer peak demand from residential pool pumps is estimated to be between 50 to 150 MW across the Ausgrid network area. The intention of the project is to first assess the potential peak demand contribution and reduction potential from residential pool pumps in Ausgrid's network area by analysing customer interval meter data. If found to be significant a trial would follow targeted at offering an energy efficient pool pump rebate offer to a sample of customers.

5.10.2 Project aims and objectives

The first objective of the project is to determine the average summer peak demand contribution of pool pumps for a sample of Ausgrid customers with and without time-of-use (TOU) price signals. Based on these results the project would continue to an implementation trial with the following primary objectives:

(a) To test customer take up rates and marketing approaches for offering an energy efficient pool pump rebate in a selected trial area of the Ausgrid network.

(b) To measure and verify the diversified summer peak demand reduction achievable when an energy efficient pool pump (5-star or more) replaces a standard pool pump.

5.10.3 Implementation plan

The project was planned to be conducted in two phases:

Phase 1: Estimate the diversified load contribution of existing pool owners with and without TOU network tariffs using customer interval meter data and pool pump identification techniques. Based on the results of the pool pump diversified load analysis for Ausgrid customers a decision would be made whether to proceed to an implemented project or second phase of the project.

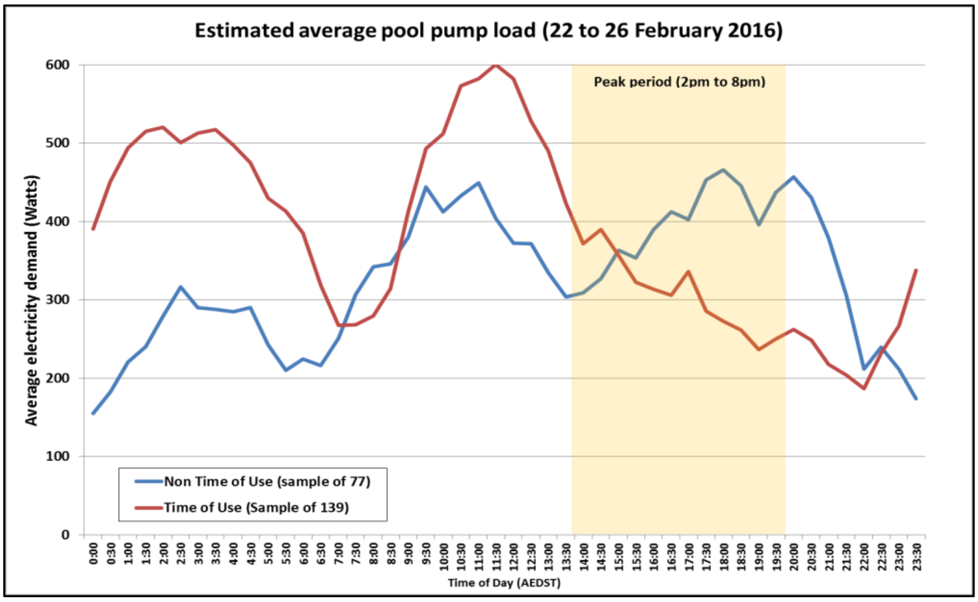
Phase 2: Energy efficient pool pump rebate offer to customers in a selected area of the Ausgrid network area for the purchase and installation of an energy efficient pool pump (5-star or greater). As part of the project, the demand reductions achievable across a sample of participants will be measured and verified.

5.10.4 Results

Summary of results from Phase 1

A pool pump identification technique and algorithm was developed internally which involved analysing 30-minute customer metering data. This technique was applied to 30-minute metering data for samples of residential customers with a pool on a network time-of-use tariff as well as customers with a pool on a network block (or flat) tariff. Previous analysis of data from customers with pools indicates that 40% of residential pool owners in Ausgrid's network are on time-of-use network tariffs with the remainder on a block (or flat) network tariff.

The data analysed was during the working week of 22 to 26 February 2016 when the system network peak occurred on the 25th February 2016. The diversified load profile of these pool pumps was estimated and shown in the below figure.



A summary of the key results from the phase 1 analysis were:

Block tariff customers (Non Time-of-Use): 77 customers

- The maximum electrical input power of the sampled pool pumps was estimate to be 1.25kW on average
- The contribution to summer peak demand was estimated to be about 400 Watts per customer on average between the 2pm to 8pm peak period. This diversified load at peak time was about 30-35% of the maximum electrical input power.
- The time of peak of the averaged pool pump load profile across the 77 customers occurred between 9am-12pm and 5pm-9pm.
- These figures broadly agree with past research studies conducted on customers in Ausgrid's network area with non TOU tariffs.

Time of Use tariff customers: 139 customers

- The maximum electrical input power of the sampled pool pumps was estimated to be 1.6kW on average
- The contribution to summer peak demand was estimated to be about 300 Watts per customer on average between the 2pm to 8pm peak period. This diversified load at peak time was about 15-20% of the maximum electrical input power.
- The time of peak of the averaged load profile across the 139 pool pumps occurred at around 11am.
- There was a clear difference in load profile and time of peak for customers on a network time-of-use tariff indicating that these customers are responding to the time-of-use pricing signals and on average are shifting their pool pump running times to be outside of peak times.

5.10.5 Summary of actual and projected costs

A summary of the actual project costs incurred in 2015/16 and previous years is shown below. This project was closed at the end of 2015/16 and no further expenditure is required.

Actual project costs:

Budget Item	2013/14 Actual	2014/15 Actual	2015/16 Actual	Total Actual
Project research and development	$8,450	$2,780	$19,534	$30,764
Project implementation	$0	$0	$0	$0
Total (excl GST)	**$8,450**	**$2,780**	**$19,534**	**$30,764**

5.10.6 Project progress & identifiable benefits

The results from the detailed analysis of customer metering data in phase 1 of the project has indicated that the diversified load contribution of pool pumps to Ausgrid's summer peak demand is around 300 to 400 Watts per pool customer during the peak period. This equates to a total summer peak demand contribution of 54MW to 72MW.

For a typical Sydney zone substation with a high penetration of pool owners of around 2,000 (eg. 25% of separate houses connected to the zone) the total contribution of pool pump load to summer peak demand for this zone substation would be around 600 to 800 kW. Assuming an optimistic program take-up of around 20% for an energy efficient pool pump installation rebate offer and an optimistic reduction in peak load of 80%, the total demand reduction potential would be around 100kW to 130kW.

Considering the low demand reduction potential and limited applicability of this demand management solution for a network deferral project it was decided not to proceed to Phase 2 and to close out the project during 2015/16.

There have been no peak demand reductions achieved from this project. The trial activities did not form part of a deferral of a real network need.