**PROJECTS FOR WHICH DMIA APPROVAL IS SOUGHT**

Projects for which approval is sought under the Demand Management Innovation Allowance (DMIA) for the 2010 – 2015 Regulatory Period comprise the following projects representing a total value of $3,210k.

1. DM - Smart Grid Tariff Trial (North Adelaide - $92k)

2. DSP Trial 2 (UMR - $449k)

3. DSP Trial 3 (Residential Load Profiles - $1154k)

4. DM – Bordertown Demand Management ($990k)

5. Grid Side Storage ($287k)

6. Future Network Modelling ($238k)

Out of the total $3,210k expended, some $1,777k relates to expenditure incurred in the 2014/15 fiscal year.

These projects formed part of a package of investigation aimed at informing SA Power Networks approach to introducing cost reflective tariffs. The use of such tariffs as a potential tool to temper peak demand growth as an alternative to network augmentation has been well documented, most recently in the AEMC’s draft rule determination *“National Electricity Amendment (Distribution Network Pricing Arrangements) Rule 2014, August 2014”*.

A tariff based on the learnings achieved from these trials has now been published as part of SA Power Networks 2014/15 Pricing Proposal and is proposed for broader roll-out over the 2015 – 2020 Regulatory Period.

**1. DM - Smart Grid Tariff Trial**

**1.1 Nature and scope of the project**

This trial was undertaken in order to investigate customer reaction to the application of a capacity based tariff, how customers might respond to this form of charge and what role in home displays (IHD) might play.

**1.2 Aims and expectations**

The aim of this trial was to determine customers’ acceptance, understanding and responsiveness to a capacity based cost reflective tariff. The trial also aimed to gauge what was needed in terms of both the technical support for the introduction of IHDs and the ongoing direct customer support required.

This was necessary as the further development of both the capacity tariff and the cost benefit associated with the introduction of capacity tariffs calls for an assessment of the real costs associated with their introduction and continuing application.

**1.3 The selection process**

The North Adelaide area was selected for the trial on the basis that it already had suitable metering that could monitor the behavioural response to the tariff. This had been installed for prior trials funded by ESCOSA (the jurisdictional regulator) in the 2005 – 2010 Regulatory Period. Customers were offered the opportunity to participate and, if in agreement, were selected to participate on the basis of their site being technically fit for purpose.

**1.4 Implementation of the project**

The project was implemented during the 2012/13 summer period with an initial letter drop seeking volunteers to participate in the trial. This was followed by the installation of IHDs in selected customers’ sites. Each site was visited by project team members who installed the IHD and explained the tariff and its operation. For each customer a ‘target capacity’ was set based on the maximum demand that would enable them to break even if they were to transition to a cost reflective tariff. Customers were thereafter provided with regular updates on their success in staying under the target capacity. These being in the form of graphical reports detailing the time of occurrence of maximum demand during the peak demand period.

**1.5 Implementation costs**

The implementation costs of $92k consisted of both hardware and human resources.

**1.6 Identifiable benefits**

The number of customers involved in the trial was not sufficiently large to make a statistically valid assessment of the demand reductions that may be available from the implementation of such a tariff, however, the trial provided valuable customer response and demand profiles that further informed the capacity tariff design and refined the timing and duration of the peak demand period for the tariff. Evaluation of customer behavioural responses also resulted in refinement to the implementation plan for the tariff.

**2. DSP Trial 2**

**2.1 Nature and scope of the project**

This trial built on the DM - Smart Grid Tariff Trial discussed in section 1, and was required in order to be able to understand, with a statistically valid sample, how many customers may be prepared to take up a capacity tariff, if the tariff were voluntary, and the likelihood of those customers being able to respond in ways that reduced their electricity bills.

Owing to the risks, costs and complexity associated with undertaking a ‘real world’ trial, it was decided to utilise a market research company to undertake an on-line survey to obtain these results. Such an approach would complement the learnings from the deep customer engagement undertaken in the tariff trial (above).

**2.2 Aims and expectations**

The key aims of the trial were to determine the proportion of customers willing to take up the tariff voluntarily and how (and if) their energy demand patterns might change should they wish to take up the offer.

**2.3 The selection process**

It was important that the sample enabled a statistically valid sample across a broad range of customer sizes, defined by annual energy use, aligned with those selected for Trial 3 (below). On this basis, a sample size across the Adelaide metropolitan area was set at n=800. This would comfortably provide sufficient data.

The customer tranches consisted of:

1. Customers using >7,500kWh (15.2% of households)
2. Customers using >5,000kWh and <7,500kWh (20.3% of households)
3. Customers using >2,500kWh and <5,000kWh (29.5% of households)
4. Customers using <2,500kWh (23% of households)
5. Customers using <5,000kWh and have a PV system installed (12% of households)

**2.4 Implementation of the project**

A web-based research platform was designed in order to compare reactions to the tariff across the five tranches. This survey was implemented by national research company UMR. The survey aimed to provide sufficient detail for households to make informed assessments while avoiding the situation where the research would implicitly convince the participants to participate by providing far more information than typical consumers could realistically digest.

SA Power Networks worked with UMR to develop a questionnaire wherein:

1. an assessment of current power usage, overall bill size and identification of households with likely high and low peaks of usage could be made;
2. an understanding of the relevance of peaks in usage to electricity costs could be provided;
3. a succinct description of the tariff offering could be expressed;
4. impressions of the tariff, and likelihood of volunteering to move to such a tariff could be communicated; and
5. testing the power of reasons for and against the tariff specifically to assess the communication challenges SA Power Networks may face.

A statistical analysis of the results was conducted which identified tariff acceptance overall and within each of the tranches.

**2.5 Implementation costs**

Implementation costs of $449k consisted of consultancy fees, project management and human resources.

**2.6 Identifiable benefits**

The data collected as a result of this trial has informed the design and implementation of the tariff which now forms part of SA Power Networks’ tariff schedule and informed SA Power Networks’ 2015 – 2020 Regulatory Proposal.

**3. DSP Trial 3 - Residential Load Profiles**

**3.1 Nature and scope of the project**

This project installed interval metering at selected sites within a representative metropolitan area which were identified as sites falling within the five customer tranches designated for tariff investigation discussed in section 2.

**3.2 Aims and expectations**

The aim of the trial was to collect interval data that would allow further tariff development and load profiling for the designated customer tranches. The impact of the introduction of a capacity tariff on different customer tranches is considered important to understand prior to a final tariff design being implemented. In particular, such data will enable analysis as to which customers’ bills might be higher or lower if the tariff were implemented and they did not alter their behaviour at all.

SA Power Networks only has type 6 meters installed in the vast majority of its customers’ premises and thus, only quarterly energy data is available. Interval data is required to determine customers’ peak demand characteristics, and thus the impact of cost reflective tariffs on customers’ bills.

**3.3 The selection process**

In order to inform the tariff design, the following tranches were identified and approximately 200 meters were installed in customers’ premises in each tranche:

1. Customers using >7,500kWh (15.2% of households)
2. Customers using >5,000kWh and <7,500kWh (20.3% of households)
3. Customers using >2,500kWh and <5,000kWh (29.5% of households)
4. Customers using <2,500kWh (23% of households)
5. Customers using <5,000kWh and have a PV system installed (12% of households)

**3.4 Implementation of the project**

Interval meters with communications functionality were installed at selected sites within the trial area. Provision of supporting back office systems and limited integration was established and data was collected on a regular basis for analysis with data tools and systems available at the time of the trial.

**3.5 Implementation costs**

To the end of the reporting period, $1,154k had been expended to establish the necessary field metering equipment and systems to provide data and maintenance of the metering equipment, with $262k of the total cost having been incurred in the 2014/15 Regulatory year.

**3.6 Identifiable benefits**

The data collected will enable analysis of tariff impacts on the designated customer tranches so as to further inform the capacity tariff design and potential transition issues. It will also form the base for future longitudinal analysis of customer energy consumption trends.

**4 DM – Bordertown Demand Management**

**4.1 Nature and scope of the project**

This project was undertaken in order to address the forecast network capacity constraint at the Bordertown 33/11kV substation and Keith-Bordertown 33kV sub-transmission line. The project involved the connection and on-going payment (for network support) of a 3rd party generator installed by Vibe Energy at Bordertown. This generator provides peak-lopping to defer the capital works to upgrade the network in the region.

**4.2 Aims and expectations**

The aim of this project was to defer the implementation of a network solution to address the forecast overload of the 47km 33kV sub-transmission line between Keith and Bordertown and overload of Bordertown 33/11kV substation. The project also aimed to provide learnings by undertaking a practical implementation of a non-network third-party solution to a network constraint.

**4.3 The selection process**

The third-party solution was selected through a formal Request for Proposals process under the ESCOSA Guideline 12 rules (since replaced by the AER RIT-D process). Vibe Energy’s proposal was evaluated in detail by applying the ESCOSA regulatory test with sensitivity analysis for varying load growths, construction costs, fuel costs, discount rates and value of customer reliability also being conducted. The evaluation showed the non-network solution to be the highest net-benefit solution to our customers.

**4.4 Implementation of the project**

The project was implemented during 2012 and 2013 with the Vibe generators available to provide network support prior to the 2013/14 summer. The project involved the design and construction of an 11kV connection for the third party generator at Bordertown 33/11kV substation. The project also involved the negotiation of a network services support agreement with Vibe Energy to provide the demand management solution. As part of this support agreement a monthly standby capacity fee is payable to Vibe Energy.

**4.5 Implementation costs**

The network services support agreement costs to date are $990k, with the total cost having been recognised in the 2014/15 Regulatory year.

**4.6 Identifiable benefits**

The ESCOSA Guideline 12 assessment of the Vibe Energy generator against a traditional network solution (upgrade the Bordertown 33/11kV substation and 33kV sub-transmission line) showed the third party generator to be the highest net benefit solution. The demand management solution provides the lowest cost technically feasible solution and provides customers with higher reliability than the alternate network solution.

**5 Grid Side Storage**

**5.1 Nature and scope of the project**

Energy Storage is being adopted by the electricity industry as an alternative for generation for deferral of network augmentation but with a large range of technologies available very little is known about the performance of these systems under Australian conditions and applications. In conjunction with the University of Adelaide and other partners SA Power Networks is undertaking a practical research study into the performance of energy storage systems across the likely applications within the distribution network.

**5.2 Aims and expectations**

With the increasing amount of Energy Storage System technologies and their applications this project will produce a mobile testing environment to further develop these technologies and to understand their use in Australian conditions. The project will create a knowledge base for industry and system developers whilst also providing for advanced training facilities on an operational system.

**5.3 Implementation of the project**

This project is being led the University of Adelaide with the syndicate comprising SA Power Networks, Solar Storage, ZEN Energy Systems and Power and Drive Solutions, with further funding support from the South Australian Government and the Energy Networks Association. In addition this project has attracted ARENA funding of $1.4 million to support the project.

The mobile testing platform will comprise a mobile testing unit approximately similar in size to a shipping container with 200KW inverter, associated control equipment and network protection and SCADA interface. This will include a Labview installation to provide comprehensive monitoring of the performance of both the inverter and any associated battery systems. This data will be made available as part of the Knowledge Bank. A second container will be deployed which houses the selected battery bank immediately adjacent the testing platform with suitable interconnections to the testing platform.

Initially this unit will be deployed within the SA Power Networks distribution system, it will be relocated interstate to test different conditions and network operations. As part of the project the unit will also operate within the testing environment at the University of Adelaide’s Thebarton precinct as well as on a larger commercial customer’s premises.

The project is in the initial design stage with industry consultation and peer review in progress.

Expected availability of the system for initial field trials is Q3 2016 where it will be deployed on a 11KV feeder after extensive testing at the Thebarton precinct. Subject to final design it is intended that this unit may also be suitable for deployment within the SWER network during 2017.

The system will be deployed on the distribution network to trial its performance when operating to provide peak shaving, voltage management and micro grid applications.

**5.4 Implementation costs**

The project costs to date are $287k, with all of this cost having been recognised in the 2014/15 Regulatory year.

**5.5 Identifiable benefits**

This project will provide insight into the suitability and performance of different technologies when utilised in the most likely scenarios for distribution network management and operation. The data collected and analysis undertaken will be freely available to industry and vendors. It will also determine situations whereby such solutions could be used in future to cost-effectively defer network upgrades.

**6 Future Network Modelling**

**6.1 Nature and scope of the project**

Energy Storage for residential installations is being proposed as a complementary technology for the renewable energy systems currently deployed within the distribution networks. The impacts of these systems will be driven to some extent by their sizing and ability to supply electrical capacity (kW or kVA) versus their energy stored (kWh). To further understand these impacts on the distribution network so as to allow network operations and design to accommodate these systems SA Power Networks has undertaken a comprehensive modelling project.

**6.2 Aims and expectations**

The modelling developed under this project identifies the most beneficial energy storage system for different customers based on their interval data records. It can also be applied at higher levels within the network to determine the optimal mix of distributed resources – for example at the distribution transformer or zone substation levels. This modelling will provide insights into the rate of take up of distributed energy resources based on the costs of those resources and the economic returns to the customer. It will also enable insights into the likely impacts on network load profiles.

**6.3 Implementation of the project**

Consultants were engaged to develop an Excel based modelling tool which has been further refined by SA Power Networks. This tool is undergoing final testing and validation before being used to assess specific customers and areas within the distribution network.

**6.4 Implementation costs**

The project costs to date are $238k, with all of this cost having been recognised in the 2014/15 Regulatory year.

**6.5 Identifiable benefits**

The project will provide insight into the potential scale and timing of distributed energy resource uptake, as well as the opportunity to reduce SA Power Networks’ investment in network assets as a result of increased embedded generation and storage.  Such opportunities could arise from reduced capacity requirements in greenfield situations or reduction in the size (capacity) of assets installed when asset replacements are undertaken.

**7 Overview of demand management projects completed in previous years**

The projects summarised below were undertaken using funds carried over from the 2005 – 2010 Regulatory Period in relation to a jurisdictional Demand Management allowance (provided by ESCOSA). They are incorporated within this report for completeness. More detailed reporting in relation to these projects is available on the SA Power Networks’ website:

<http://www.sapowernetworks.com.au/centric/industry/our_network/demand_management.jsp>

**7.1 Trial No I - DLC with AMI**

The trial developed and deployed Demand Response Enabling Devices (DREDs), which communicate via a smart meter. The trial expanded on pre cursor trials conducted during the 2005 - 2010 regulatory control period in that all functionality was retained from previous DRED prototypes but used more cost effective methods of DLC activation.

This trial used the Home Area Network (HAN) functionality within a smart meter. This function allows for two way telecommunications between the meter and wireless devices within the metered site. The HAN function uses ‘ZigBee’ as the preferred protocol and technology. ‘ZigBee’ is a low power mesh radio technology that was trialled but in addition to it ‘HomePlug’ (power line carrier) was also trialled to determine the efficacy of both communications protocols.

**7.2 Trial II – Network Monitoring Proof of Concept**

This trial aimed to prove the claims of technology vendors of their products in the context of Australian conditions. To facilitate this proof of concept process, the technology’s technical attributes was assessed for: operation in SA Power Networks’ grid; suitability for SA Power Networks’ infrastructure; performance under Australian operating conditions; enhancements required to improve performance/suitability; development of defined installation work methods; and further integration opportunities with existing SA Power Networks’ systems.

The ability to effectively provide real time monitoring of conditions at points on the electricity distribution system other than sub stations had previously been difficult to achieve. Recent advances in technology have provided the equipment to monitor the electrical conditions at strategic points and provide instantaneous feedback. This functionality may provide the ability to initiate demand response on the basis of real time network conditions. This will require some system enhancement and interfacing but the purpose of this initial phase was to prove the performance of the monitors and their suitability for SA Power Networks’ grid.

**7.3 Trial III - Defined Area Trial (North Adelaide)**

The trial aimed to test the further level of complexity to all aspects of monitoring demand management and DLC activation when scaled up to represent a broad roll out scenario of smart meters. It also aims to obtain detailed feedback from the substantial customer engagement called for in introducing demand management, AMI and an expansion of the DLC program to the broader community.

Specifically, the trial:

1. integrated AMI with the transformer monitoring units to provide automated demand response to network conditions;
2. evaluated customer’s acceptance of smart technologies both in their home and within the network infrastructure;
3. refined customer information, education and recruitment materials;
4. developed firmware for monitoring units to control DREDs via AMI;
5. evaluated autonomous operations for DLC;
6. evaluated integration with existing and new business systems;
7. evaluated communications technologies; and
8. used trial outcomes to establish standards for interaction with other technologies including protocols and installation procedures.

**7.4 Trial IV - Communications**

The trial was designed to inform on the identification and selection of telecommunications technologies to support demand side participation. The selection of 4G communications WiMAX was driven by the availability of a suitable wireless network and the general adoption of the telecommunications protocol by a large number of technology providers. This has led to 4G telecommunications modules becoming part of most technology development roadmaps from major vendors.

**7.5 Trial V - Technology Integration**

The trial integrated all of the technologies trialled above (ie sections 4.1, 4.2, 4.3 and 4.4) in order that the information received from the transformer monitoring equipment results in demand side participation control instructions being sent to the DREDs via the smart meters.

**7.6 Trial VII - Smart Grid Strategy**

SA Power Networks’ “2011-2026 Future Operating Model” identified the major business drivers that it believed would shape its future operating environment. These drivers relate to: policy and regulation; energy prices; customers and community; customer side technology; and network performance. SA Power Networks’ work on demand side management and the emergent smart grid made it clear that a smart grid strategy will impact on and be influenced by all of the above drivers.

This study was therefore intended to develop a smart grid strategy that will enable SA Power Networks to progress on its journey to an operating model as described in its “2011-2026 Future Operating Model” and expanded on pre cursor trials conducted during the 2005 - 2010 regulatory control period.

The study also took account of emerging and maturing technologies related to distributed generation, distributed storage and electric vehicles as well as the evolving regulatory environment and its impact on the “2011-2026 Future Operating Model”.

The work ultimately culminated in the development of two sub-strategies that will form key parts of SA Power Networks’ 2015 – 2020 Regulatory Proposal, being:

* The Tariffs and metering business case; and
* The Smarter Network Strategy.

These documents will be made publically available at the time of submission of the Proposal.

**7.7 Trial VIII – Operational Telecommunications Strategy**

The purpose of this project was to develop a telecommunications strategy to support the operation of SA Power Networks’ distribution infrastructure, giving consideration to potential future requirements for significant expansion in the number of intelligent electronic devices on the network, changes in telecommunications standards and 3rd party telecommunications offerings, and potentially, the introduction of smart meters.

**7.8 Trial IX - Demand Profile Study**

The trial aimed to better understand cost reflective tariffs and how, if at all, load profiles match billings and what adjustments could be made. The project had particular relevance to advancing SA Power Networks’ knowledge of aggregated demand profiles and whether the distribution of particular types of socio economic groupings plays a part in determining these profiles.

It also has value in assisting SA Power Networks’ future tariff structure planning to identify, where possible and applicable, the cross-subsidisation that exists across demand profile groupings and whether it could be reduced.

**7.9 Trial X - Energy Storage Technologies**

The trial aimed to evaluate the functionality and suitability of energy storage technology as a means of providing network support during times of peak demand. This trial builds on the pre cursor trials conducted during the 2005 - 2010 regulatory control period and included technologies such as: residential battery banks; and network connected battery banks. Residential battery storage is currently available but is too costly. The trial needed to investigate emerging products for their impact and to learn how to integrate them into the residential demand profile.

**7.10 Trial XI - Electric Vehicles**

The trial aimed to develop a smart grid strategy for the integration of electric vehicles and to evaluate their impact on the network not only as an additional load but also as a form of embedded generation. In considering the impact of electric vehicles on the network, this trial expanded on the Defined Area Trial (discussed in section 4.3) and the pre cursor trials conducted during the 2005 - 2010 regulatory control period.

For an electricity network, electric vehicles represent a two edged sword. They can assist with network capacity constraints via vehicle-to-grid (V2G) systems but can also pose a capacity risk if their electricity demand goes unmanaged on the network. The aim of this trial was therefore to combine the customer and transformer monitoring technologies from other trials in order to establish the impact of electric vehicle charging on the network. The trial also investigated the use of electric vehicles as distributed storage and simulated optimal strategies in using V2G technologies.

**7.11 Trial XII - Network Innovation Centre (NIC)**

This project comprised a search for a suitable combination of office, conferencing and warehousing areas in order to develop, test and demonstrate the new smart grid innovations that are being investigated.

The facility is a dual function environment that provides for not only trialling technologies but also for displaying projects and building the understanding of stakeholders with respect to the implications of new technologies. Now that the space is fully operational, open days are held by appointment. This creates an opportunity for showcasing the vision for the future of a ‘smarter’ network as well as hosting internal and external stakeholders, including staff, customers, suppliers, universities and government thus raising awareness of new technologies and preparing the community for future changes in the electricity landscape.

**8. Costs not recoverable**

Costs for the DMIA projects described above:

1. are not recoverable under any other jurisdictional incentive scheme,
2. are not recoverable under any other state or Commonwealth government scheme, and
3. are not included in the forecast capital or operating expenditure approved in the AER’s distribution determination for the regulatory control period under which the scheme applies, or under any other incentive scheme in that determination.

**9 Calculation of DMIA**

The total amount of the DMIA spent in the 2015 -2020 Regulatory Control Period is $3,210k. This amount equates to the total spend against the six projects for which approval is sought under the DMIA as detailed in sections 1 to 6 of this report. $1,433k of the DMIA was spent in the 2013/14 Regulatory year, while the remaining balance of $1,777k was incurred in the 2014/15 Regulatory year.

The costs associated with these DM trials have been separately captured at the individual project level in SAP, SA Power Networks’ integrated business management system. DMIA project costs are reported annually in the Regulatory Accounting Statements that form part of SA Power Networks’ response to the AER’s Regulatory Information Notice (Annual RIN). Actual cost information contained in these Regulatory Accounting Statements is also subject to independent external audit.