Power of choice – giving consumers options in the way they use electricity

Investigation of existing and plausible future demand side participation in the electricity market

Final Report for the Australian Energy Market Commission

16 December 2011

DISCLAIMER

Futura Consulting makes no representation or warranty as to the accuracy or completeness of the material contained in this document and shall have, and accept, no liability for any statements, opinions, information or matters (expressed or implied) arising out of, contained in or derived from this document or any omissions from this document, or any other written or oral communication transmitted or made available to any other party in relation to the subject matter of this document.

Futura Consulting

Suite 18, Alma Complex, 663 Victoria St

Abbotsford Vic 3067 Australia

Phone: +61 3 9429 0685 / Fax: +61 3 9427 0643
Email: jfazio@futuraconsulting.com.au
Email: bfulford@futuraconsulting.com.au

ACKNOWLEDGEMENTS

In preparing our assessment of DSP trials, pilots, and new initiatives, and the market conditions needed to enable these opportunities, Futura Consulting's project team met with, or called, representatives from network service providers, electricity retailers, regulatory agencies, and consumer advocacy groups.

We sincerely thank each of the individuals from these organisations for the time they allocated to us, and for the insights they provided to our analysis.

CONTENTS

1. EXECUTIVE SUMMARY 1
 1.1 INTRODUCTION 1
 1.2 STUDY OBJECTIVES AND WORK UNDERTAKEN 1
 1.3 STUDY APPROACH 2
 1.4 KEY FINDINGS AND RECOMMENDATIONS 2

2. INTRODUCTION 22
 2.1 STUDY CONTEXT 22
 2.2 OUR APPROACH TO THE STUDY 22
 2.3 LIMITATIONS ASSOCIATED WITH OUR ANALYSIS 24
 2.4 REPORT ORGANISATION 25

3. DEMAND RESPONSE CONCEPTS 26
 3.1 INTRODUCTION 26
 3.2 OVERVIEW OF DSP IN THE NEM 26

4. EXISTING LEVEL OF DSP AND OPTIONS IN THE NEM 40
 4.1 INTRODUCTION 40
 4.2 EVIDENCE OF DSP IN THE NEM 40
 4.3 ESTIMATES OF DSP QUANTITIES IN THE NEM BY MEASURE 44

5. DSP TRIALS AND PILOTS AND EMERGING INITIATIVES 56
 5.1 INTRODUCTION 56
 5.2 STOCKTAKE OF TRIALS AND PILOTS 56
 5.3 CASE STUDY RESULTS 58
 5.4 PEAK DEMAND REDUCTION POTENTIAL OF DSP PILOT MEASURES 84

6. MARKET CONDITONS TO ENABLE DSP OPPORTUNITIES 87
 6.1 INTRODUCTION 87
 6.2 PRICE SIGNALS AND FINANCIAL INCENTIVES 87
 6.3 METERING, ENABLING TECHNOLOGIES & COMMUNICATIONS INFRASTRUCTURE 92
 6.4 CONNECTION ARRANGEMENTS AND STANDARDS 94
 6.5 AWARENESS, EDUCATION AND INFORMATION 98
 6.6 MARKET, REGULATORY AND INSTITUTIONAL SUPPORT 101

APPENDIX A: STOCKTAKE OF CURRENT AND PLANNED DSP PILOTS AND TRIALS 105

APPENDIX B: DSP PILOTS AND TRIALS CASE STUDY PROFILES 114

1. Executive Summary

1.1 Introduction

Demand Side Participation (DSP) has the potential to add significant value to consumers by providing consumers with choices and opportunities to manage their electricity costs.

DSP can deliver benefits to the market in the more efficient utilisation of existing electricity assets while maintaining high levels of electricity service and reliability. Further, by managing consumers' demand for electricity, DSP programs provide a versatile resource that enables efficient future investment in supply-side infrastructure.

On 29 March 2011, the Ministerial Council on Energy (MCE) directed the Australian Energy Market Operator (AEMC) to investigate and identify what market and regulatory arrangements are needed across the electricity supply chain (including the rules, other national and jurisdictional regulations, commercial arrangements and market behaviours) to enable efficient investment in the operation and use of DSP in the NEM.[1]

1.2 Study objectives and work undertaken

Futura Consulting understands that:

> *"…the objective of this review is to identify opportunities for consumers to make informed choices about the way they use electricity, and provide incentives for network operators, retailers and other parties to invest efficiently so that there is increased confidence that demand and supply side options are given equal weight in satisfying the community's demand for energy services."*[2]

The specific tasks undertaken by Futura's project team to assist the AEMC in meeting its overarching objective were defined in the RFT for this study as follows:

- identify the existing and potential foreseeable DSP options that may enabled in the Australian electricity market;
  - quantify the current levels of DSP operating in the market by the type of actions being undertaken by consumer,
  - compile a stocktake of trials, pilots, and new initiatives, that have been completed recently, are underway, or planned for future implementation with a focus on identifying 'what worked' and 'what did not' to provide insights into future DSP options and measures that could be implemented in the NEM,
- assess the market conditions required to enable take-up of DSP based on programs currently implemented, the outcomes of the trials, pilots; and new initiatives; and feedback from industry stakeholders; and
- broadly identify market conditions needed but not currently in place, with comments on needed market and regulatory arrangements.

1 http://www.aemc.gov.au/Market-Reviews/Open/Stage-3-Demand-Side-Participation-Review-Facilitating-consumer-choices-and-energy-efficiency.html.

2 Ibid.

1.3 STUDY APPROACH

Futura's project team utilised its in-house databases and prior review and analysis of the technical, market, and economic, potential of demand response in the NEM to quantify the existing opportunity for DSP in the market. Discussions with representatives from the industry – retailers, network service providers (NSPs), third party DSP aggregators, the Australian Energy Market Operator (AEMO), and the Australian Energy Regulator (AER)– also informed this analysis. The stocktake of DSP pilots and trials, and development of case studies was derived from previous relevant consulting engagements, desktop research, and in-person and telephone interviews with industry representatives. Synthesis of the information obtained from the above sources formed the basis for; identifying the market conditions[3] needed to support DSP in the NEM, assessing which of those conditions are 'missing' at present, and putting forth potential solutions.

1.4 KEY FINDINGS AND RECOMMENDATIONS

The main findings from this engagement are summarised below.

1.5 DSP OPTIONS AND MEASURES AVAILABLE TO CONSUMERS IN THE NEM

DSP encompasses a range of actions that consumers can elect to use to manage their demand for electricity. These include strategies that focus directly on reducing consumption during peak load periods, and include curtailable load arrangements, direct load control (DLC), pricing and incentive options, thermal energy storage (TES), and peak demand limiting. Other strategies seek to reduce consumer's usage across the whole load curve; notably, energy efficiency and conservation options, fuel substitution, and power factor correction (PFC) measures.

If correctly targeted, these approaches can also be used to manage peak period loads effectively. Finally distributed resource options such as distributed generation (DG) and storage that interact directly with the power generation system can provide highly flexible sources of peak load demand management. Certain of these DSP measures have become business-as-usual (BAU) programs for market participants, while others are being trialled as pilot programs prior to full scale implementation. For the convenience of readers who are not familiar with these DSP options and measures, an overview of the key characteristics of each follows, along with a very brief commentary on their implementation status.

3 Market conditions have been defined by the AEMC as characteristics that need to be present in the NEM to enable electricity consumers, retailers/aggregators, NSPs, generators, and others to make and implement informed decisions, while recognising that it is the consumer who makes the final consumption decision.

1.5.1 Peak load management measures

Curtailable load arrangements (non tariff)

Curtailable load arrangements are based on flexibility in the operation of consumer's end-use equipment that allows electricity supply from the grid to be interrupted or reduced when requested. This capacity to reduce demand can be contracted by a customer to a retailer, NSP, or third party DSP aggregator who will then dispatch it to mitigate network capacity constraints, or to avoid energy purchases from the wholesale pool during price spikes. Alternatively, individual customers can elect to take-up a 'pool pass-through' contract with their retailer, monitor wholesale pool prices, and self-exercise the load curtailment to meet the business' internal operating and financial criteria.

Participants in curtailable load contracts decide voluntarily how much load to shed, and from what source. Typically, these would be processes whose operation can be deferred out of the peak dispatch period, or discretionary services that are not pivotal to the business' operations. An example of the former would be temporarily switching off a batch reactor in a chemical plant; while turning off or dimming warehouse lighting is an example of the latter.

Owing to the need for interval metering (two way communications is not needed) to verify load reduction quantities in response to dispatch events, DSP based on curtailable arrangements is predominantly provided by medium to large C&I facilities.[4]

Direct load control (DLC)

DLC is the remote switching of consumer's end-use appliances or equipment by a DNSP to manage consumers' electricity demand. Traditionally, the control functionality has been based on cycling strategies that automatically turn loads on and off for defined periods of time.

At one extreme DLC can be in the form of a total interruption to an end use for an extended period so that the entire load is moved out of peak hours. The existing arrangements that limit mains supply to hot water or slab heating in Victoria to the off-peak overnight period is one example of this approach. Alternatively, DLC can entail remote cycling or 'on-off' switching of large numbers of appliances in 'banks' for short periods of time ranging from minutes to hours. Hot water heating has been managed using short term DLC cycling strategies extensively in New South Wales and Queensland.

Economical off-peak controlled load tariffs have been used to encourage consumers to take-up DLC opportunities as their preferred option for end uses with this functionality.

More recently, DLC has involved load reduction trials of residential air conditioners, using the relatively 'newly developed' Australian Standard air conditioner interface (AS 47553.1).[5] Not only does this approach establish the requirements for the demand

4 This is the only sector in the NEM with the required interval meters installed on a large scale at present.

5 Standards Australia. *AS 4755.3.1-2008 Demand response capabilities and supporting technologies for electrical products - Interaction of demand response enabling devices and electrical products - Operational instructions and connections for air conditioners. 2008.*

response functionality of the appliance, it also increases the DLC options available to DNSPs and to consumers by enabling part load operation of end use appliances in addition to on and off cycling.

Pricing and incentives

There are a number of options that have been used to manage peak electricity demand by encouraging consumers to shift load from high priced peak periods to lower cost non-peak periods. To date, these strategies have been predominantly tariff-based.

The simplest measure is a time-of-use (TOU) tariff which is based on a pricing structure incorporating different unit prices for usage during different time periods over a day. Within the NEM, two (peak and off-peak) or three (peak, off-peak, and shoulder) time periods have been used depending on the region. An example of the relative usage charges for Ausgrid's PowerSmart Home three-part TOU tariff compared to the business' time invariant general use tariff is provided in Figure 1.

Figure 1: Illustrative example of Ausgrid's residential TOU tariff

Tariff	Usage Rate
Domestic all time	20.6 ¢/kWh for consumption up to 1,750 per quarter, 29.1 ¢/kWh for remainder
PowerSmart home	Peak period (2 pm to 8 pm weekdays) 40.6 ¢/kWh Off-peak period (10 pm to 7 am) 9.6 ¢/kWh Shoulder period (all other times) 16.4 ¢/kWh

Source: http://www.energyaustralia.com.au/nsw/residential/products_and_services/electricity/powersmart.

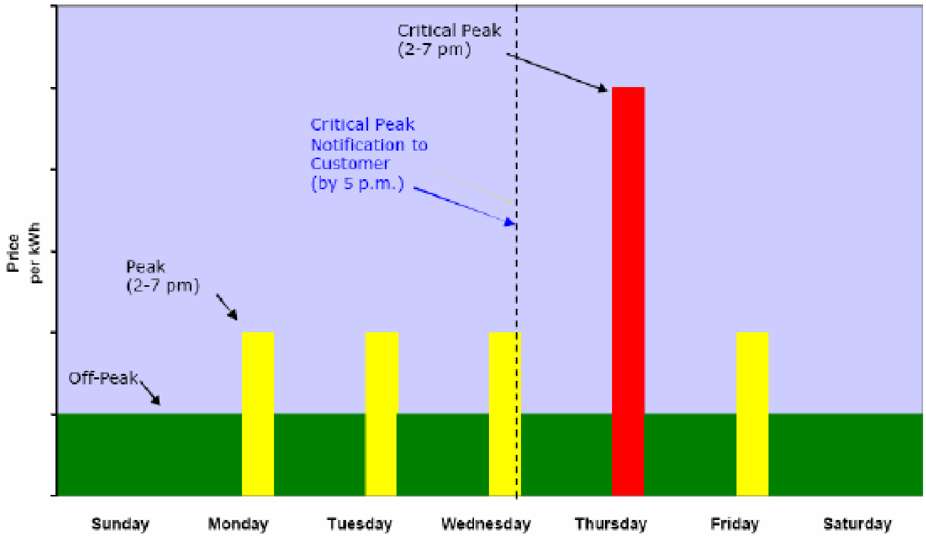
TOU tariff rates only reflect the *average* cost of generating and delivering electricity to customers during each of the daily time periods, rather than the network system peak demand periods that occur for a few hours each year.

STOU tariffs are a refinement to TOU pricing. In addition to differing daily unit price periods, STOU tariff rates account for changes in consumer's total demand for electricity by season. Typically consumption occurring in the daily unit price periods in summer and winter are charged at higher rates than at other times, reflecting higher seasonal electricity demands by customers for space heating and cooling.

DPP tariffs are much more highly cost reflective than TOU or STOU tariffs. They generally consist of a critical peak period (CPP) tariff, overlaid on a two-part TOU tariff. Prices increase significantly for the top few hours of peak demand each year during the critical peak periods, and can be in the order of over 10 to 20 times higher than the off-peak component of the underlying TOU tariff. Outside of critical peak price periods customers are charged less than their default flat-rate tariff to retain revenue neutrality on an annual basis. Because the timing of critical peak price is unknown and depends upon localised capacity conditions, participants are notified of forthcoming CPP dispatch events 2 to 24 hours ahead of time by the program proponent.

A schematic overview of the DPP approach is presented in Figure 2.

Figure 2: Illustrative example of the workings of a DPP tariff



Source: CRA International. *Dynamic Peak Pricing in California: Do Customers Respond?* 2007.

In home displays (IHDs) that provide consumers with near real time information about their electricity consumption, and costs, frequently are used as an 'enabling technology' with DPP (and other DSP measures).

DPP is a DSP option that is in the trial stage in the residential sector in the NEM at present, and has only recently been implemented as a full-scale program for C&I consumers.

Peak time rebates (PTR) are a variation of DPP tariffs that provide $ per kWh load reduction incentives to consumers in the form of a rebate (rather than exposure to high prices during CPP events). Therefore unlike DPP measures there is no penalty to participants if no load reduction is provided. The PTR approach is currently being trialed in New South Wales.

Thermal energy storage

A TES system shifts all or part of the load of an air conditioning chiller system in a commercial building or an industrial refrigeration plant out of daytime peak periods. This is achieved by producing chilled water, or ice, overnight in the off-peak period, and then storing the 'cooling energy' for use in space or industrial process cooling system the next day.

TOU or demand based tariffs that provide significant financial rewards are frequently used to offset the high capital costs of TES systems to encourage consumers to adopt this DSP approach.

Peak demand limiting

Peak demand limiting refers to automatically shedding loads when pre-determined limits are about to be exceeded. Loads are automatically restored when the demand is reduced sufficiently. Capacity or demand based tariffs with rate reductions are usually offered as an economic incentive to consumers to participate in peak demand limiting DSP programs. Peak demand limiting is at the trial stage in the NEM.

1.5.2 Whole of load management

Energy efficiency and conservation

Improvement in energy efficiency is defined as using less energy to achieve the same level of output, or improving the level of output from the same amount of energy.[6] In contrast, energy conservation occurs when less energy is used to provide a service but a lower level of work, or desired end-use output is delivered to the consumer.

At present, energy efficiency is being implemented in the NEM through a combination of Commonwealth and State government mandated approaches targeting large C&I consumers and retailers, as well as via advisory services to residential consumers. These initiatives are being complemented by voluntary energy efficiency initiatives delivered to customers by retailers and the DNSPs.

Trials and pilots using community based social marketing (CBSM) are also underway in the residential sector. The CBSM approach is an alternative to 'blanket' information campaigns, and focuses on establishing energy efficiency as a 'socially desirable norm' in the specific context of the local target community, and enhancing the perceived benefits of energy efficiency activities to consumers in the community.

Fuel substitution

Fuel substitution projects replace the use of grid supplied electricity to provide desired energy services, such as heating, with alternative fossil-based or energy sources, or perhaps renewable energy resources. Substituting solar for electricity in domestic water heating or gas for electricity industrial process heating are two frequently implemented examples of fuel substitution in the residential and industrial sectors, respectively.

Power factor correction

Power factor is a measure of how efficiently consumer's loads are using electricity supplied from the distribution network. Equipment such as motors and fluorescent lighting can result in poor power factors which, in turn, contribute to inefficient distribution networks in that equipment such as transformers and feeders are larger than necessary. These inefficiencies are passed along to consumers in the form of higher electricity costs. Capacitor technologies are a proven method of improving power factor, removing inefficiencies, and managing demand for electricity from medium to large facilities in the C&I sector.

6 Prime Minister's Task Group on Energy Efficiency. *Final Report*. 2010, p. 27.

1.5.3 *Distributed resources*

Distributed generation

DG, as defined for this review, is generation on the customer's side of the meter, and includes:

- standby generators, which can be used to provide peak load reduction through curtailable arrangements, installed in the premises of C&I facilities needing backup supply in the event of a loss of mains power;
- small scale renewables – notably PV installations in residential and small business premises; and
- cogeneration/technologies in large C&I facilities that simultaneously provide consumers with electricity and heat from one fuel source, and trigeneration which adds the third dimension of cooling to the energy services mix.

Because DGs are located close to the consumer load they serve, they can provide reliability benefits, and reduce network losses, in addition to managing consumer's demand for electricity.

Distributed storage

Distributed storage technologies can provide multiple benefits to the electricity grid. These opportunities range from network management during peak load periods, to smoothing out supply for intermittent generation, and providing back-up to improve supply reliability. Battery storage technologies are currently being trialled in the NEM. [7]

1.6 CURRENT STATUS OF DSP IN THE NEM

Estimates of the current status of DSP in the NEM are presented in the next two sections. Initially empirical and anecdotal evidence demonstrating some historical activity levels is presented. This is complemented by an analysis of the specific quantities of DSP in the NEM, referenced to the options and measures outlined in Section 1.5.

1.6.1 *Evidence of the operation of DSP in the NEM*

Reports from market participants, the AEMO, the AER, and regional regulators provide illustrative examples of the use and operation of DSP in the NEM over recent years. In overview:

- retailers confirmed that they will (and do) use DSP as a hedge against short term increases in wholesale pools prices providing the resource is of high quality (firm levels of capacity), and the transaction costs are lower than physical and financial hedges; however information on contracted quantities is commercially sensitive;

7 Whilst the discussion of distributed storage is restricted to battery technologies in this review, we acknowledge that other technologies such as compressed air, and flywheels are also being evaluated in terms of their grid management capabilities.

- a third party DSP aggregator, ENERnoc, has almost 20 MW of market non-scheduled generation within customer's premises for dispatch in curtailable arrangements;[8]
- the network service providers (NSPs) have been involved in developing DSP programs, for example;
  - over the 3 year period commencing FY2004/05 Ausgrid (operating as EnergyAustralia) and Endeavour Energy (operating as Integral Energy) expended some $6 million on 26 demand management (DM) programs, that resulted in deferral of approximately $30 million in planned capex and opex, and annual peak demand reduction totaling 95 MVA,[9]
  - Transgrid in the summer of 2008/09 procured 350 MW of network support to defer a major network upgrade (of which about one third was derived from DM),[10]
- AEMO in the 2011 Electricity Statement of Opportunities (ESOO) expects that there is just over 260 MW of contracted demand response, that can be deployed on request to meet system peaks in the NEM regions;
  - modeling of this resource by Futura's project team demonstrated the use of some 20 MW to 25 MW of DSP in the combined Victorian and South Australian region when pool prices reached the Market Price Cap of $12,500 per MWh,
- the AER's high pool price event investigations (>$5,000 per MWh) also provide evidence of possible demand response from consumers, for example;
  - in Victoria there was an apparent demand response of 300 MW following a five minute regional price spike to $9,999 per MWh in April 2010,[11] and
  - a regional price spike to $12,400 per MWh in Tasmania in August 2010, apparently elicited a demand response of up to 108 MW.[12]

1.6.2 Existing DSP measures and quantities in the NEM

In summary, our analysis suggests that there is approximately 2,900 MW of dispatchable and non-dispatchable DSP in the NEM, at present. As illustrated in Table 1, on the next page, the size and nature of the available load reduction capacity varies significantly between sectors, and the type of DSP measures implemented.

---

8 AEMO. *Registration and Exemption Lists.* 2011.

9 Independent Pricing and Regulatory Tribunal (IPART). *NSW Electricity Information Paper No 3/2008 - Demand Management in the 2004 distribution review: progress to date*. 2008.

10 http://www.transgrid.com.au/mediaweb/articles/Pages/TransGridholdslargesteverAnnualPlanningForum.aspx.

11 AER. *Prices Above $5000 MWh 22 April 2010*. 2010.

12 AER. *Prices Above $5000 MWh 7 and 8 August 2010.* 2010.

Table 1: Estimated MW and MWh of DSP in the NEM by option, measure, and sector

	Summer MW	Winter MW	Annual GWh
Peak load management			
Curtailable arrangements (C&I)	280	0	Not applicable
Direct load control			
• hot water DLC (residential)	1750	2500	Not applicable
• pool pump DLC (residential)	110		Not applicable
Pricing strategies[13]			
• dynamic peak pricing (C&I)	88		Not applicable
Thermal energy storage (C&I)	5		
Whole of load management			
Energy conservation and efficiency (mixed)	30[14]	30	8,965[15]
Fuel substitution (residential)	Impacts of electric storage hot water not quantified for this study		
Power factor correction (C&I)	46	46	0
Distributed resources			
Standby generation (C&I)	60	0	
Small scale PV (predominantly residential)	190	0	
Cogeneration/trigeneration (C&I)	Impacts on peak demand not quantified for this study		

Our analysis highlights that:

- while the residential and medium to large C&I sectors are providing DSP in the NEM to differing degrees, there is little evidence that the many small to medium enterprise (SME) consumers are being engaged in these activities, at present;
- the C&I sector offer the largest form of dispatchable peak demand response operating in the NEM, with some 340 MW in total deriving from curtailable loads and standby generators;

13 Although TOU tariffs have been available for all customer classes for a number of years, there has been little or no emphasis on their impact on residential or business consumers. A large scale 'trial' has been undertaken by Ausgrid, the results of which are presented in Section1.7.1.

14 Represents the peak demand reduction reported from Energex and Ergon Energy's C&I energy efficiency initiative.

15 Represents the energy use reductions from mandated Commonwealth and State government measures – peak demand impacts are not quantified for these programs.

- this outcome reflects the relatively low transaction costs ($ expended per kW of peak demand reduction obtained) for this form of DSP capacity,
- there is, however, some evidence that this resource may be under-developed in the NEM where it represents about 1% of system peak demand, as compared to about 4% in the Western Australia market,[16] and 6% in the California market,[17]
- in addition, the quantum of standby generator DSP resource is less than 1% of the total NEM-wide back-up generator capacity of some 1,000 MW, estimated by Futura's project team,[18]

* the largest single quantum of DSP in the NEM derives from legacy controlled off-peak hot water loads in the residential sector;
  - along with DLC of swimming pool pumps by Ergon Energy and Energex in Queensland, controlled hot water is the only widespread form of DSP in the sector at present,
  - this is driven by the pre-dominance of simple accumulation meters, which have no capacity to support DSP measures requiring more complex load reduction monitoring and verification techniques,
* currently, the only full scale DPP pricing program operating in the NEM (SP AusNet's C&I sector Critical Peak Demand Multi-Rate network tariff) is showing very promising results, with a significant number of customers achieving peak load reductions of 50% relative to BAU operations;
* TES has had only limited success as a DSP measure in recent times – most probably reflecting the difficulty in achieving a reasonable return on investment for many projects of this type;
  - however, under the right circumstances individual TES projects can provide significant peak load reduction and network capacity benefits, as demonstrated by the 5 MW plant implemented under a partnership between Ergon Energy and James Cook University,
* active marketing of proven PFC measures by the DSNPs in South Australia, New South Wales, and Queensland over the past five to ten years, has successfully provided DSP from within a wide range of medium to large C&I facilities;
* targeted energy efficiency measures, as demonstrated by the 30 MW of peak demand reduction obtained from Ergon Energy's and Energex's tailored energy efficiency solutions product for the C&I sector appears to be an effective DSP option;

16 Independent Market Operator. *2011 Statement of Opportunities.* 2010.

17 Faruqui, A. *Energy Efficiency and Demand-side Management Programs*. 2011.

18 In 2006, the UK National Grid Reserve Service had around 2,000 MW of small diesel standby generators under contract representing about 5% of average demand.

- fuel substitution based DSP is being driven by the Commonwealth and State Government's phase-out of greenhouse gas intensive electric water heaters which will significantly reduce residential sector greenhouse gas emissions over the next twenty years;
  - the peak demand impact of the phase-out has not been quantified for this study as it was outside of the scope of work; however, anecdotal evidence from the DNSPs suggests that the transition to electric boosted solar, and heat pump hot water will contribute load to the peak period if not properly controlled and managed,
- appropriately located small scale PV in the grid can generally dampen system-wide peak demand for electricity, and as a very preliminary estimate our analysis suggests a NEM system-wide load reduction capacity of around 190 MW; [19]and
  - a key challenge for the future will be to establish mechanisms to overcome barriers to take-up such as limited or no perceived financial benefit, consumer's need for topical information, and split incentives related to renting,[20]
  - operational issues related to voltage rise and harmonics imbalances are emerging as a concern for both the network and PV host if high concentrations of PV installations are clustered in localised areas;[21]
- there is a small amount of cogeneration/trigeneration installed in the NEM;[22] however, the peak demand impacts of this technology are not known at this time.

1.7 FUTURE OPPORTUNITIES FOR DSP IN THE NEM

Emerging DSP opportunities are likely to emanate from recent pilots and trials which have examined consumer take-up and acceptance of new DSP measures, evaluated peak demand and energy use reduction impacts, and collected operational and cost-benefit data to inform business cases for potential full scale deployment. As well, DSP potential in the future will be significantly enhanced as new appliances and technologies, control and communications systems, and other facilitating mechanisms like smart grids are integrated into the NEM.

An overview of these opportunities follows. It must be noted that although the cost-benefit analysis for the trials and pilots reviewed for this study will be a key factor in determining the viability of a roll-out of these DSP measures to full-scale programs, this information was considered to be commercially sensitive and hence it is not considered in the discussion in Section 1.7.

19 Note that this analysis cannot be extrapolated to the impacts of PVs on localised network elements such as feeders or zone substations.

20 Ergon Energy. *Townsville Queensland Solar City Annual Report.* 2010.

21 Ibid.

22 Clean Energy Council cogeneration project data, July 2011.

1.7.1 Overview of results of current pilots and trials and new initiatives[23]

Direct load control

DLC cycling of residential air conditioners and pool pumps has been trialled by several DNSPs, and from early results appears to be a promising future DSP option. The approach has the capacity to reach a large number of customers, and provides highly reliable peak load reduction. Participants in the trials generally indicated that they have been satisfied with their involvement, highlighting that they did not consider comfort levels to have been compromised. The trials have also offered consumers the opportunity to save money and satisfy a desire to help the environment.

The trade-off with DLC in these applications can be the relatively high transactions costs associated with expenditure for marketing the program to large numbers of consumers, and installing the necessary communications and control infrastructure. A particular issue in the past has been the cost associated with recruiting participants that have 'technically eligible' air conditioning units in their homes. As noted, standardisation of air conditioner DLC control mechanisms and functionality through the AS 4755.3.1 interface should alleviate this problem in future.

ETSA Utilities has a long history of activity in this area, having developed five DLC air conditioner projects. The ETSA Utilities trials found that there is a noticeable load response effect when DLC is activated, with peak demand reductions ranging from 19% to 30% achieved depending on the location of the trial, and the size of the air conditioner targeted.

Endeavour Energy (operating as Integral Energy) and Western Power have demonstrated the use of the Demand Response Enabling Device (DRED) – which receives the demand response signals and manages cycling routines – to access the AS 47553.1 air conditioner appliance control interface. Endeavour Energy's trial cut the power to the air conditioners to 50% of their normal operating load, reducing peak demand by 32%, on average. Western Power used the DRED to cycle trial participant's air conditioners to obtain a 20% overall reduction in summer demand.

Energex's Cool Change air conditioner trial provided a 17% demand reduction per participant, averaged over the three summers the trial operated.

Energex and Endeavour Energy (operating as Integral Energy), have also managed the operation of pool pumps using DLC, with indications of peak demand being reduced by up to about 30%.

23 Owing to the use of many different resources and information sources in the development of the case studies in Section 1.7.1, readers are referred to the detailed case study materials presented in appendix B for specific references.

Pricing and incentives

TOU tariffs

Ausgrid (operating as EnergyAustralia), commissioned an analysis of the interval meter data for a number of residential customers who were transferred from a standard domestic tariff that does not vary with time to a TOU tariff. Results showed an average shift of about 4% in the normalised coincident maximum demand (CMD)[24] for customers that switched to a TOU tariff compared with the customers that remained on the standard tariff. Thus the trial demonstrated that even simple pricing strategies have the capacity to induce some (if minor) change householder's energy use behaviors.[25]

Not surprisingly, the trial did not show any significant levels of demand reduction for the small business customers that were transferred to the TOU tariff. From experience, due to the diversity of business types and priorities in this segment, engaging these consumers in energy matters using non-targeted approaches has not been highly successful.

STOU and DPP tariffs

Results from trials conducted by Essential Energy (operating as Country Energy), Endeavour Energy (operating as Integral Energy), and Ausgrid (operating as EnergyAustralia) demonstrate that residential customers understand and respond well to DPP tariffs (despite their apparent complexity), and are willing to reduce their electricity usage on hot days. These results highlight that, based on the positive consumer response, there may be potential for DPP measures to be rolled out as full-scale programs to the residential sector, in future. Benefits noted by participants in the trials included increased energy awareness, conscious decision-making, and increased choice about when to use electricity in order to make bill savings.

In the Essential Energy trial, peak demand reduced by 30% in response to a CPP price of about 38¢ per kWh, while Endeavour Energy's Western Sydney Pricing Trial (WSPT), found that residential consumers responded to critical peak prices of $1.67 per kWh with a 30% to 40% per cent reduction in peak demand. The business' Blacktown Solar City (BSC) DPP pilot demonstrated similar results with peak demand reductions of about 24% per household.

Ausgrid's Strategic Pricing Study (SPS) found reductions in residential consumption during specific CPP dispatch events corresponding to extreme temperatures of 36% on hot summer days and 30% on cold winter days (in response to a critical peak price of $1.00 per kWh). The results for the average peak demand reduction across all CPP events in the trial was lower – in the range of 23% to 25%. The decrease is an outcome of the relatively mild temperature conditions that occurred during the trial. As such the

24 CMD was defined as a customer's electricity consumption during the half hour interval that either the system or the customer's local zone substation has its seasonal maximum demand period. The analysis then normalized the CMD using the customer's average seasonal half hour consumption to give a seasonal coincident peak to average value.

25 It should be noted that Ausgrid's trial also showed some degradation of load reduction over time for the customers that were transferred to the TOU tariff..

extreme day results are considered to be more representative of the peak demand impacts demonstrated by the SPS DPP trials.

Residential customers participating in the SPS STOU trial achieved overall reduction in peak demand of 13% and 5% in summer and winter, relative to days with very high network loadings. Importantly, the small business customers on the SPS trial did not show any statistically significant peak demand reductions on the DPP tariff. This result again suggests that the DPP value proposition may suit residential customers better than SMEs. Alternatively, small business may respond to these options in the longer term, but additional trials are needed to confirm this hypothesis.

The results of Ausgrid's 'information only' campaign component of the SPS did not show any consistently positive results with load reduction from participating households ranging from minus 1% to 24%.

In both the WSPT and SPS trials, IHDs were found to have a limited impact on consumer response compared to households without displays. With the Endeavour Energy trial, IHD usage dropped from 85% at the start of the trial to only 55% two years later. Ausgrid found that a significant number of customers who had received the technology in the SPS trial did not even bother to plug them in. At face value, the low customer acceptance of IHDs seen in these trials combined with the relatively high cost of the technology put its cost-effectiveness into question. Results from trials currently underway will provide additional findings in this regard.

Peak time rebates

To further expand the energy efficiency options available to its residential customers, Endeavour Energy rolled-out the *Peak*Saver PTR program prior to the 2010/11 summer. The rebate to customers for their load reduction is $1.50 per kWh up to a cap of $50 per dispatch event day.

Although in early stages of development, the program has successfully demonstrated significant peak demand reductions ranging from 29% to 51% on dispatch days. Customers have actively participated in the program by 'going out' to avoid using their air conditioning and electric cooking appliances, and shifting discretionary loads like pool pumps, dishwashers, clothes washers and dryers to out of peak periods.

As regards consumer's reactions to the trial, *Peak*Saver participants were interested in financial gains from bill savings and the incentives, as well as finding out about a new electricity use opportunity. Key needs were advice and information on ways to reduce their energy use during peak demand dispatch events.

Hybrid pricing approaches

Ergon Energy recently implemented an innovative Solar Cities trial on Magnetic Island to get consumers to reduce their energy consumption over the peak demand hours of 6 pm and 9 pm *each day*. Rebates of up to $25 per month are offered as an incentive, with additional rebates available to households that sustain the reduction for three months.

Preliminary results are promising with a total peak consumption reduction of 1,649 kWh, or 23%, over the 6 pm to 9 pm peak period achieved for June 2011 as compared to June 2010 for the 80 plus trial participants.

Energex and Ergon Energy's collaborative Rewards Based Tariff Consumption trials are also a new approach that is successfully using cost reflective pricing to manage peak demand in the residential sector. The trial (which at present is paper-based) consists of a DPP rate (that is 5 to 8 times higher than the general use T11 tariff), a TOU tariff, and a PTR incentive to reduce consumption.[26]

The DPP program has successfully reduced household peak demand for electricity. In the case of Brisbane, which is one of three trial areas, average peak load reductions of 21% were observed over summer and winter CPP dispatch events. The trial has also demonstrated that it is possible to reduce peak demand by reducing other than base load energy use. For those customers that were unwilling to stop using their air conditioners during peak demand periods, they did appear to be willing to reduce their peak demand by electing to shift chores such as dishwashing, clothes washing and drying, and vacuuming out of the peak period.

The preliminary results for the TOU tariff were much less promising with apparent shifts of only 1% to 3% of electricity use from the peak to the off-peak period.

Peak demand limiting

ETSA Utilities undertook to trial load limiting devices in approximately 80 new homes in an eco-village under development by the Land Management Corporation (LMC). A first for Australia, aims of the trial included testing customer acceptance of the technology, and the scope for its widespread deployment in South Australia. However, the trial did not proceed past the planning stage. Changes in the design guidelines for the development to meet consumers' expectations for having reverse cycle air conditioning would have meant that household loads exceeded the pre-determined peak demand limits too frequently, compromising the amenity of the occupants.

Community based social marketing energy efficiency

Perth Solar City Living Smart is an innovative CBSM behaviour change initiative working with households to reduce their electricity (and gas and water) bills. Energex and Ergon Energy, amongst others, are also using this approach to encourage consumers on their networks to implement energy efficiency opportunities.

Key features of the Living Smart program include; hand delivery of practical 'how to' energy efficiency information, follow up telephone coaching calls, electricity use benchmarking against the community average, home energy efficiency (and water) consultations, and community workshops on sustainable living.

Through this ongoing process of engagement, information provision, and capacity building, over 6,000 householders have realised energy use reductions of some 9% per day. Feedback from participants on the utility of the approach to reducing electricity bills has also been extremely encouraging.

Ergon Energy is in the process of implementing the Townsville Energy Sense Communities initiative. The project aims to apply knowledge, expertise and findings

26 Results for the PTR component of the trial are forthcoming.

derived from trials conducted by Ergon Energy to date to defer the construction of several network infrastructure projects.

Energy Sense Communities has a significant stakeholder, community, and consumer engagement element, and seeks to engage consumers within several focus areas including a greenfield residential corridor, existing residential areas – including areas targeted for rollout of the National Broadband Network (NBN) – commercial and industrial growth areas, and the greater Townsville area.

1.7.2 Smart grids and other emerging opportunities

Australian Standard AS 4755

As noted, DLC trials of air conditioners using AS 4755.3.1 interfaces have successfully demonstrated the technical viability of the approach. Further development in this area will be an important factor in managing the contribution of air conditioners to peak demand loads, in future.

Work is proceeding on extending AS 4755 interfaces to swimming pool pumps, and solar electric boost, and heat pump water heaters. The advancements will enable improved demand response from these appliances using a range of communications protocols and technologies, and consumers will be provided with options for using standardised DLC products to control their appliances energy use.

This work will also be particularly important for managing water heating loads where the recently implemented phase-out of greenhouse-intensive water heaters will lead to a reduction in the number of electric storage hot water services, reduce the total amount of controlled load available to the DNSPs, and potentially increase peak demand if the new water heating loads deriving from electric solar and heat pumps are not properly managed.

Home area networks

A Home area network (HAN) is a local area network that connects the smart meter to individual appliances and other devices in a home using wired or wireless technologies or a combination of both.

An important feature of the HAN is that it will allow consumers to receive real time energy usage and cost information on individual appliances through devices such as a web portal or IHD. This will assist consumers in pinpointing high energy consuming appliances and empower them to take action to modify their usage of these appliances. The HAN also allows DLC of individual appliances that are connected via control modules to the device.

Several HAN trials are currently underway or in planning. Ausgrid is trialing HANs in 100 'smart homes' in Newington as part of its Smart Grid Smart City initiative. The trial will evaluate the level of customer acceptance, and potential impact on energy usage behavior of HANs. Endeavour Energy is planning to trial HANs as part of an integrated Smart Grid trial. Participants in the trial will receive real time energy usage information, feedback on energy savings from behavior change and directly control air conditioners and pool pumps.

Smart appliances

International interest in smart appliances is growing rapidly. Notably, recently, the US Department of Energy (DOE) published an RFT seeking comment regarding how it should consider smart appliances in future energy conservation standards and test procedures for the Appliance Standards Program, as well as in the test procedures for the ENERGY STAR Program. Utilities are also becoming involved and there have been some limited trials of HAN connected 'smart' appliances.

Major appliance manufacturers such as LG and GE have recently introduced several appliances that allow consumers to adjust the operating cycles to take maximum advantage of utility pricing strategies such as TOU, or DPP tariffs through strategies that automatically delay or defer cycles during the more expensive peak demand times, and run in hours when demand and prices are low. Examples include; dishwashers, clothes washers, and dryers that delay their start until low cost periods, ovens that disable the self clean cycle during high cost periods along with cooktops that automatically reduce power use by 20% during high cost hours, and refrigerators that automatically delay defrosting until low cost times of the day.

Distributed storage

Distributed storage systems, are actively being tested by the industry to demonstrate the utility of battery technologies in managing peak loads and intermittent renewable generation in both 'traditional' network applications and smart grid trials.

At the large scale, RedFlow is participating with University of Queensland (UQ) in a trial aimed at demonstrating the efficiency gains from storage of electricity generated by 339 kW of PVs. At the smaller-scale 5 kW RedFlow batteries will be installed by Ausgrid as one component of the Commonwealth's Smart Grid Smart City *(SGSC)* project in residences in urban areas to test the broader integration of battery technology into a smart grid for optimising the output of intermittent generation from PVs and mini-wind turbines, in combination with fuel cells. A second *SGSC* trial will see RedFlow batteries power a micro-grid in a regional town, testing the opportunities for improved reliability, and providing consumers with greater control over their household energy use. In Victoria, SP AusNet is trialling integrated battery-PV technologies to assist in managing peak network loadings on long feeders in rural areas of the business' distribution network.

Cogeneration/trigeneration

Although, at present, cogeneration/ trigeneration projects have only a minor presence in the NEM, factors such as rising energy prices, building efficiency rating schemes, and the recent carbon price legislation are providing incentives to increase the uptake of these technologies. Some recent project announcements point to the increase in DSP that may develop from future activity in this area:

- the Sustainable Sydney trigeneration target of some 360 MW is projected to reduce summer peak summer demand for electricity by up to a third by 2030 – as well as supplying 70% of the City's electricity needs from local generation;
- in a first for commercial buildings in Australia, Origin Energy in partnership with a major property developer, has demonstrated how a single trigeneration plant can serve multiple buildings, paving the way for precinct-based trigeneration systems; and

- AGL Energy, in 2011, announced plans to construct a state of the art 21 MW cogeneration plant for a major plastics facility in Victoria – representing the largest investment in industrial or manufacturing cogeneration in the state, in over 10 years.

1.8 Market conditions to enable future DSP opportunities

Based on our review and analysis of the current levels of DSP, findings from the DSP pilots and trials and feedback from interviews with stakeholders this section outlines the key market conditions necessary to enable greater take up of DSP in the NEM. Some of the market conditions are in place to varying degrees in the NEM while there are reforms being implemented to address others.

1.8.1 Price signals and other financial incentives

Currently, an estimated 94%[27] of residential consumers in the NEM see either average-cost based flat or IBT tariffs that give them no indication that the cost of electricity changes over time, nor any incentive to vary their electric use in response to wholesale market conditions. These tariffs serve to insulate consumers from wholesale price volatility and prevent them from choosing to reduce demand when prices are rising dramatically or when network loadings are reaching capacity reliability limits.

Results of pilots and trials indicate that residential consumers are willing to take up TOU and DPP tariff offers and subsequently change their electricity consumption behaviour in response to these tariffs. Consumers also appear to be willing to participate in incentive based PTR options. Consumers can and do alter their energy usage behaviour when given the right information and incentives.

Market conditions that need to be in place to support and encourage consumer take-up of DSP:

- widespread availability and consumer awareness of pricing based DSP options, such as TOU and DPP tariffs, and/or incentive based programs such as DLC or PTR offers;
- incentives within the regulatory and licensing frameworks for retailers and NSPs to investigate, develop and implement these initiatives and actively market them to consumers;
- knowledgeable and well-informed consumers that have the capability and opportunity to take full advantage of available tariff and program choices supported by information and advice on the benefits of participating and the types of actions they can take once they have signed up;
- market mechanisms that ensure cost reflective network pricing signals are passed through and seen by consumers; and
- ensure that consumer protection and compensation frameworks for consumers who may have difficulty in modifying their consumption patterns and could be adversely affected by the implementation of cost-reflective pricing.

---

27 Based on a Futura Consulting review of DNSP annual tariff reports, network pricing proposals and regulatory submissions.

Based on our findings, there is also potential for additional DSP from consumers in the C&I sector. Market conditions that need to be in place for the C&I sector include:

- widespread availability and consumer awareness of cost reflective pricing based DSP options and incentive based programs that recognise the differing needs, characteristics and diversity of business types;
- well informed consumers with a detailed understanding of their electricity consumption patterns and their capabilities to curtail or shift discretionary usage and a high level of interest in, and understanding of, the benefits of DSP across *all* key decision makers in the organisation;
- consumers with technical skill, systems and training to take full or partial pool price exposure in their retail contracts to enable them to reduce load in response to high pool price events;
- consumers with basic knowledge of the fundamental aspects of the NEM, how the market functions, role of the main participants, and the relationship between demand and price and the role of DSP; and
- availability of product and service providers that can assist consumers to identify and assess operational strategies and/or technologies, assess the financial value of DSP to the business and provide information and advice on the available actions and options.

1.8.2 Metering, enabling technologies and communications infrastructure

Most residential and small business consumers in the NEM currently lack the necessary metering and enabling technologies to make informed choices about their energy usage and participate in pricing and incentive based DSP initiatives. Market conditions needed include:

- interval or smart metering in consumer's premises capable of measuring and recording electricity consumption in real time, supporting cost-reflective pricing and providing the functionality to support consumers in managing their energy use and costs; and
- subject to the outcomes of further trials and cost-benefit assessment, availability of enabling technologies that provide energy usage information, communication and control capability to assist consumers to modifying their energy consumption, and in responding to prices or incentive based programs.

1.8.3 Connection arrangements and standards

There are several market conditions related to connection arrangements and standards for existing and new technologies that offer potential for greater take up of DSP. The identified market conditions are:

- distributed generation;
    - availability of streamlined, consistent and standardised DG connection processes for DG owners seeking connection to the grid;

- DNSPs that are adequately incentivised, resourced, and motivated to engage with DG proponents to provide improved and more streamlined DG connection services;
- market and metering arrangements that encourage economies of scale by allowing and supporting the aggregation of multiple sites so that larger DG systems are able to serve multiple sites;
- DG owners and proponents that are aware of the opportunities and benefits available to them for utilising their generators in the NEM; and
- EPA air quality emission and noise regulations that recognise and allow for the use of generators for short duration demand response purposes.

- air conditioners and other appliances in the market with inbuilt DRED functionality and smart meters with the functionality to communicate and interface with DRED appliances; and
- common and mandated HAN standards and specifications across the NEM to support consumer acceptance and take-up of HAN technologies and devices.

1.8.4 Awareness, education and information

Education and raising consumer awareness of DSP is of paramount importance in engaging consumers to take-up DSP pricing, program offers and new technologies. Educated customers will be able to make better choices and will be more empowered to make decisions about their energy usage and costs.

Market conditions that are needed include:

- availability and access to useful and effective multi-lingual information, to assist consumers to better understand and manage their own energy usage and costs;
- regulatory arrangements and frameworks that cover the collection, sharing and retention of data, data accuracy, protection and privacy of shared data and limitations and restrictions on third party data;
- well timed and designed consumer engagement campaigns involving consumers, community leaders, business and consumer advocacy associations, and local government;
- standards for consumer and social engagement frameworks to ensure consistent and effective implementation of short and long term campaigns that draw on international best practice;
- NEM participants with competence and capabilities in DSP practices and methods, including the design, implementation, analysis and evaluation of DSP initiatives;
- availability of trained and accredited third party technology and service providers that are able to competently provide technical assistance and products that support consumers in responding to DSP opportunities;
- availability of up to date, transparent and accurate information on the levels, sources and characteristics of DSP in the market including pilots and trials of new initiatives; and

- standardised methods and frameworks for quantifying, analysing and reporting on the results of DSP initiatives and assessing the potential of new initiatives.

1.8.5 Market, regulatory and institutional support

Although not directly identified from the review of pilot and trials there are market conditions related to the strengthening of market, regulatory and institutional arrangements in the NEM that support DSP. These could enhance additional DSP from existing DSP opportunities as well as ensuring that the DSP potential identified from successful pilots and trials is developed further and implemented across the NEM as full scale initiatives where cost-effective. These include:

- availability of further commercial opportunities for DSP in the NEM such as direct participation in the wholesale energy and/or ancillary services markets;
- NSPs and retailers that are actively participating in developing DSP supported by internal business cultures, and regulation and incentive frameworks that encourage and reward DSP activities;
- participation in the market by demand aggregators and third party product and service providers in supporting consumers to identify and implement DSP opportunities; and
- incorporation of specific peak demand management objectives in existing and new Commonwealth and State government energy efficiency and greenhouse gas policy and program initiatives.

2. Introduction

2.1 Study context

The AEMC's Stage 3 DSP Review '*Power of choice – giving consumers options in the way they use electricity*' was launched in March 2011. The purpose of the Review is to identify market and regulatory arrangements that would enable the participation of both supply and demand side options in achieving an economically efficient demand/supply balance in the electricity market.[28]

Futura Consulting was contracted by the AEMC to provide advice in relation to the Review, with the specific aims of:

- identifying the existing and potential foreseeable DSP options that may be enabled in the Australian electricity market;
  - quantifying the current levels of DSP operating in the market by the type of actions being undertaken by customers,
  - compiling a stocktake of trials and pilots that have been recently completed, are underway or planned for future implementation with a focus on identifying 'what worked' and what did not,
- assessing the market conditions to enable take-up of DSP based on the outcomes of the trials/pilots;
- undertaking a 'gaps' analysis to identify broadly market conditions needed but not currently in place; and
- providing directional comments on needed market and regulatory arrangements.

2.2 Our approach to the study

Futura's project team undertook the following activities in delivering the service requirements of this engagement.

2.2.1 Quantification of existing levels of DSP in the NEM

In-person or telephone interviews were held with representatives from across the electricity supply chain (including retailers, DNSPs, third party DSP aggregators, the AER, and the AEMO) to canvass their views on the existing levels of DSP in the NEM as well as to obtain any specific data or reports of relevance to the topic not readily available in the public domain but which were not considered to be confidential in nature. These resources complemented in-house databases and information held by Futura's project team.

High level empirical and anecdotal evidence on the use of DSP in the NEM was sourced from available reports. More detailed analysis regarding the quantities of DM and DG currently operating in the market in terms of MW (and MWh where appropriate) were derived from bottom-up estimates of the aggregate impacts for DSP options and measures considered to be BAU programs, rather than trials and pilots.

---

28 http://www.aemc.gov.au/Market-Reviews/Open/Stage-3-Demand-Side-Participation-Review-Facilitating-consumer-choices-and-energy-efficiency.html.

2.2.2 *Analysis of future DSP opportunities*

Details of DSP pilots and trials were obtained from prior reports by Futura's project team, a desktop review of recently published reports and meetings and communications with NSPs, regulators, retailers, industry associations, third-party DSP aggregators and government representatives.

For a number of those studies with publicly available results on peak demand impacts, trial findings, and customer feedback, case studies were prepared. The case studies selected for presentation in our report aim to provide readers with insights into the types of DSP measures that NSPs, electricity retailers, or third party aggregators could implement in the near future. As such, a set of filter criteria was applied to each candidate to determine its suitability for inclusion in the review. These criteria, which were applied judgementally, based on our prior work and expertise in this area included:

- ability to facilitate the implementation of cost-efficient DSP in the NEM (relative to supply-side investment) by retailers, NSPs, and third party aggregators;
- ability to promote efficient outcomes for consumers;
- capacity to engage with consumers and raise awareness of electric supply- and demand-side issues;
- ability to educate consumers so that they have a desire and capability to participate in demand response;
- technical capability of improving quality and reliability of supply to consumers;
- potential for automating demand response for inclusion in future smart grid initiatives; and
- long term cost-effectiveness as certain classes of DSP have higher transaction costs than others but these may reduce in future with technological advances.

2.2.3 *Identification of market conditions to enable future DSP opportunities*

Through our examination of DSP pilots, and trials and emerging initiatives, we have firstly identified a range of DSP measures that could be provided as full-scale BAU programs in the NEM in future. Our interviews with industry experts then provided a forum for:

- consideration of the barriers that may exist to the implementation provision of these DSP measures; and
- identification of the market conditions to enable implementation of cost-effective DSP options.

This task was also informed by other work commissioned by the AEMC for the Power of Choice review,[29] and submissions to the AEMC's Issues Paper.[30]

---

29 KEMA. *Services Enabled by Smart grid Technology.* 2010.

30 Source: http://www.aemc.gov.au/Market-Reviews/Open/Stage-3-Demand-Side-Participation-Review-Facilitating-consumer-choices-and-energy-efficiency.html

2.2.4 Suggested changes to regulatory and market arrangements

Potential changes to regulatory arrangements were proposed in light of our review of the conditions needed to promote effective DSP in the market, our assessment of which of these conditions are not presently addressed in the regulatory framework, and the requirement for any such proposed changes to support the National Electricity Objective (NEO), which is:

> *to promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to –*
>
> *1. price, quality, safety, reliability, and security of supply of electricity; and*
>
> *2. the reliability, safety and security of the national electricity system.*

2.3 LIMITATIONS ASSOCIATED WITH OUR ANALYSIS

As requested in the AEMC's outline of required services for this study, we have prepared a brief synopsis of the factors impinging on the robustness and accuracy of our analysis undertaken for this engagement, the results of which are presented in this report. Briefly, these factors included:

- lack of easy access to comparative data demonstrating the results of pilots undertaken within Australia, which in turn limited the level of detail that could be reported on each within the timeframe available for the study;
- meagre public documentation on the outcomes of peak demand reduction pilots and trials carried out as part of the Commonwealth Government Solar Cities program;
- turnover of personnel with responsibility for managing the implementation of a number of the trials which impacted on the 'richness' of the information available on qualitative outcomes of the trials;
- commercial sensitivity and confidentiality which prevented disclosure of some information regarding current and planned DSP activities;
- confidentiality concerns that limited the level of detail provided by program proponents in relation to the cost-effectiveness of the DSP measures implemented in the trials; and
- comparatively few studies have been completed to date within Australia so it is difficult to demonstrate repeated and consistent results.

One approach recommended as a mechanism which would overcome many of these issues would be to extend the breadth of the review of DM and DG trials and pilots to the international arena. This would provide a larger number of trials to compare with the outcomes of the Australian pilots reviewed for this study and assist in demonstrating results in terms of demand and energy use reductions achieved. Greater insights into customer's response to and perceptions of DSP would also be gained, and additional insights into the key factors that would enable electricity market participants (customers, retailers, NSPs, third party aggregators, and others) to successfully participate in demand response in the NEM obtained.

2.4 REPORT ORGANISATION

The remainder of this report is structured as follows:

- section 3, which is outside of the scope of work for the RFT, introduces some key concepts related to DSP strategies, options, and measures for the convenience of readers who are not experts in the topic;
- empirical and anecdotal evidence of the operation of DSP in the NEM is presented in Section 4, along with an estimate of the existing quantities of DSP associated with the options and measures described in Section 3;
- section 5 summarises the outcomes of trials, pilots and new initiatives that have been completed or implemented recently in the NEM and the Western Australia electricity markets; [31] and
- section 6 discusses the market conditions, and high level arrangements, needed to enable active DSP in the NEM, in future.

Appendix A and Appendix B present the stocktake of trials and pilots and details of the individual case studies developed from these DSP initiatives, respectively.

31 The review was extended to the Western Australia electricity market in order to present the results of recent developments in the area of DLC utilising DRED technology, and the outcomes of the innovative Living Smart community engagement program implemented under Perth Solar City, and recently evaluated.

3. Demand Response Concepts

3.1 INTRODUCTION

Section 3 initially outlines some key concepts related to the use of DSP in the NEM. This is followed by a description of the main classifications or types of DSP currently employed by NSPs, electricity retailers, and third party aggregators to manage peak demands for the convenience of readers who do not have detailed knowledge of the topic.

3.2 OVERVIEW OF DSP IN THE NEM

3.2.1 Role of DSP

Most electricity consumers in the NEM see electricity prices that are based on average electricity costs, and which bear little relation to the true production and delivery costs of electricity as they vary over time. Demand side participation encompasses a range of measures that consumers can chose to engage in to manage their demand for electricity from the grid at times of high wholesale market prices, or when capacity constraints are jeopardising quality and/or reliability of supply. Flexibility in consumer's usage levels and patterns, in turn, effectively improves the overall efficiency of resource use for electricity generation and distribution by more closely aligning the value consumers place on electricity with the prices they pay for it. DSP, by increasing efficiency, has the potential to provide a variety of benefits:[32]

- *consumer* benefits – by providing consumers with options for managing their electricity costs;
- *consumer* benefits – through bill savings and incentive payments from changes to their electricity use behaviours in response to time-varying electricity prices or other energy efficiency measures;
- *market price* benefits – from potentially reducing the need to run costly peaking generation plant in high demand periods, and mitigating spikes in the wholesale pool prices;
    - over the longer term reduced demand from consumers may also lower aggregate capacity requirements allowing less expansion of generation, transmission, and distribution capacity – which, in turn, should limit future increases in retail prices,
- *reliability* benefits – by enhancing operational security, lowering the probability of outages, and reducing the associated financial costs and inconvenience to consumers; and
- *environmental benefits* – reductions in greenhouse gas emissions through conservation measures from consumers altering their behaviour and increased awareness of their electricity consumption patterns and costs.

32 CRA International and Gallaugher and Associates. *Electricity Demand Side Management Study Review of Issues and Options for Government.* 2001.

3.2.2 Enabling strategies, options, and measures

DSP strategies, options, and measures encompass a range of activities that can be implemented in the residential, small to medium enterprise (SME) and commercial and industrial (C&I) sectors. Various strategic classification schemes have been proposed as a means of broadly grouping these techniques and measures based on the type of load reduction response and how it is brought about.

For example, the US Department of Energy (DOE) used a behavioural classification reflecting whether the techniques are price-based or incentive-based, where:[33]

- *price based DSP* – refers to changes in usage by consumers in response to changes in the prices they pay; and
- *incentive-based* DSP – refers to programs where consumers receive load reduction incentives that are separate from, or additional to, their retail electricity tariff.

The International Energy Agency (IEA) proposed a DSP classification based on the operational characteristics of the load response. Two options were proposed – dispatchable DSP and non-dispatchable DSP. Event driven dispatchable DSP is seen as being a peak demand management resource where an external party who has contracted the resource has the ability to effectively manage the timing of the load reduction, and verify the response. An example of this technique would be where an electricity retailer has an agreement with a customer to temporarily reduce consumption on request, subject to a certain agreed price or other criteria. Demand response is considered to be non-dispatchable "…where it occurs in a way that is not verifiable or enforceable;"[34] for example, where a consumer voluntarily reduces consumption load through energy conservation activities, but the impact is not measured.

DSP as defined by the AEMC for the Stage 3 review encompasses a broader range of demand response initiatives than were included in either the US DOE or the IEA reports, stating that "…options that consumers (or other parties acting on their behalf) may deploy, include, but are not limited to, measures such as peak shifting, electricity conservation, fuel switching, utilisation of distributed generation and energy efficiency."[35] As such, an independent classification developed by Futura's project team has been used, based on the following:

- 'peak load' management strategies that focus specifically on reducing demand at the time of system peak loadings, where system peak broadly refers to the NEM-wide system peak, a regional distribution network-wide peak, or a localised constraint on a transmission or network element catchment area (a terminal or zone substation, for example);
    - peak load management options and measures are generally dispatchable,

---

33 IEA. *Empowering Customer Choice in Electricity Markets.* 2011.

34 Ibid.

35 AEMC. *Issues Paper Power of choice – giving consumers options in the way they use electricity*. 2011.

- 'whole of load' management strategies that reduce demand across the entire electrical load curve; and which if the end-uses contributing to the demand at times of system peaks can be identified, can be tailored to also manage peak loads on the electrical system;
    - these strategies are generally not dispatchable, and
- 'distributed resource' management strategies which include technologies that actively participate in power system generation and operation;
    - distributed resource strategies may be either dispatchable or non-dispatchable.

Table 2 summarises the major DSP strategies, options, and measures that are either currently deployed in the NEM as BAU programs, or are actively being trialed and piloted to differing degrees.

Table 2: DSP strategies options and measures

Strategy	Option	Measure
Peak Load Management		
	Curtailable arrangements	Contracts
	Direct load control	Direct load control
	Pricing and incentives	Time of use tariffs
		Seasonal time of use tariffs
		Dynamic peak pricing
		Peak time rebates
	Thermal energy storage	Thermal energy storage
	Peak demand limiting	Peak demand limiting
Whole of Load Management		
	Energy efficiency	Mandated requirements
		Market-driven voluntary
		Community based social marketing
	Fuel substitution	Mandated requirement
	Power factor correction	Power factor correction
Distributed Resources		
	Distributed generation	Standby generators
		Small scale PV
		Cogeneration/trigeneration
	Distributed storage	Battery technologies

In the next sections of our report, each of these options and measures are described in detail, with examples given where appropriate to assist readers' understanding of their characteristics and deployment.

3.2.3 Peak load management – options and measures

Curtailable arrangements (non-tariff)

Curtailable arrangements derive from loads in customers' facilities that have flexibility in their operation and can be shifted to operate in non-peak periods, or discretionary loads that can be switched off or have their energy use reduced during peak demand periods. Raising the set point of a refrigeration plant in an industrial process cooling duty so that the equipment does not operate during peak periods is one example of load shifting through operational flexibility. Shifting the operation of a batch reactor in a chemical plant is another. Turning off or dimming warehouse lighting is an example of utilising discretionary loads for curtailable load DSP. With either approach, the key is that customers elect to manage their load reduction in the way that is most appropriate to their operations, and minimises potential risk to their business.

Curtailable arrangements in the NEM currently take the form of either a DSP contract between a customer and an external party, or a wholesale pool pass-through approach.

Under curtailable contracts with external parties, customers who are able to reduce their electricity use by an agreed amount when dispatched during specified peak load periods are offered incentive payments. Such contracts are entered into by retailers (who use it as a physical hedge against high wholesale pool prices), NSPs (to defer network augmentations, reduce load at risk, or improve supply quality and reliability), and specialist third party DSP aggregators (who may be engaged by the retailers or NSPs to secure DSP on their behalf, and can also act as the agent of customers capable of offering DSP into the market). These contracts will generally limit the length of time the load will be requested to be off (usually 4 to 6 hours), how frequently it will be requested to be off (usually 10 days per year maximum), and the number of consecutive days they may be likely to be asked to be switched off (usually 3 in a row maximum). The payment schedule to the customer is also included. For most of the curtailable load contracts implemented in the NEM this has been based on two tiers of payment:

- *availability payments* – which participants received for nominating a DSP resource that they can commit to a dispatch request; and
- *dispatch payments* – which participants receive if they actually shed load in response to a request.

Under the pool pass-through approach a customer enters into a contract with their electricity retailer that leaves the business fully exposed to variations in the wholesale pool price. This enables the business to monitor pool prices, and exercise load curtailment based on internal operating and financial criteria to reduce consumption at times of very high prices.

To date, curtailable load arrangements have focused on medium to large C&I customers with interval meters to verify load reduction response to peak period dispatch events. Because of this focus, relative to many other DSP measures, curtailable arrangements have the advantage of obtaining relatively large amounts of load reduction capacity from individual customers – which can range from hundreds of kilowatts to megawatts. In consequence the transaction costs ($ expended per kWh of peak demand reduction obtained) are very low.

Direct load control

DLC technologies allow remote control of electrical appliances in a home (or a business) through automated switching. Traditionally, DLC has taken one of two forms. One approach totally interrupts an end-use for an extended period of time so that the entire load is moved out of the peak period. Alternatively, DLC entails remote cycling or 'on-off' switching of large numbers of appliances for short periods of time. This approach reduces the coincident peak[36] demand of the end-use. Communication of the control event to interrupt or cycle an appliance can be via radio, ripple control, or web based.

DLC of hot water loads has been used since the 1960s to shift the electricity consumption use for this service to pre-determined off-peak times. Time switches are predominantly utilised throughout Victoria, South Australia, and the Australian Capital Territory to interrupt supply to off-peak controlled load hot water heaters overnight for about 8 to 9 hours (the exact schedule depends upon the geographical location).[37] Audio-frequency load control (AFLC) or ripple control is the main technology used to manage off-peak hot water loads in large areas of New South Wales and Queensland. The AFLC system allows hot water loads to be remotely controlled in 'banks' or groups of appliances to optimise the switching times. Consumers who have taken up hot water DLC have received incentives in the form of off-peak controlled load tariff rate discounts, which are more economical than the default general use tariffs that do not vary with time. To illustrate, Origin Energy's Super Economy Plan - T31 tariff is about 59% cheaper than the normal domestic general use rate.[38]

Peak loads due to the operation of pool pumps can also be managed through the application of DLC strategies. This approach has been employed for several years by the Queensland DNSPs as part of their broader control of hot water heaters via ripple control.

36 Coincident peak demand is the demand of individual consumers that coincides in time with the peak demand of the electricity system, where system can be defined as a network element, an entire network, or the NEM.

37 In Victoria DLC based on time switches is gradually being phased out with the introduction of interval metering as part of the Advanced Meter Infrastructure (AMI) roll-out, and control of the off-peak load will be progressively transferred to the interval meters.

38 Source: http://www.originenergy.com.au/2087/Electricity-tariffs-QLD.

More recently, technological advances have expanded the functionality of DLC to include the operation of equipment at part load as well as cycling. This entails the use of the Australian Standard air conditioner interface (AS A47553.1) accessed by means of a DRED. Benefits of the 'newly' developed approach includes standards for demand response DLC functionality, and the option of continuing to run an air conditioner at 50% or 75% of the power required for full load operation in addition to 'on-off' cycling – providing more cost-effective DLC cycling options for DNSPs and consumers.

Thermal energy storage

A TES system shifts all or part of the cooling load for air conditioning in a commercial building, or process cooling in an industrial facility out of daytime peak load periods. Effectively, cooling energy in the form of chilled water, or ice, is produced overnight in a conventional air conditioning chiller plant, or a process cooling refrigeration plant, and then stored. The stored energy is used the following day to provide space or process cooling – avoiding electricity use for these end-use services during peak load periods.

Challenges to the use of TES technologies include high capital costs relative to conventional chiller, or refrigeration systems, owing to the need to install storage tanks and associated equipment. In addition, the storage system often requires space that could be put to other uses that receive a commercial return. These barriers have been addressed in many of the programs that have sought to facilitate installation of TES equipment through a combination of financial incentives and technical assistance to get the technology put in place, along with off-peak rates or demand-based tariffs that provide significant financial reward for customers.

Peak demand limiting

Peak demand limiting refers to automatically shedding loads when pre-determined peak demand limits are about to be exceeded. Loads are automatically restored when the demand is reduced sufficiently. Current technologies allow customisation of the loads to be shed and the control strategy to be used. With a 'priority' demand limiting schedule' the least important loads to the consumer are shed first. Higher priority loads are then shed sequentially, as required, to maintain the total demand of the household or business facility under the pre-determined limit. Capacity or demand based tariffs with rate reductions are usually offered as an economic incentive to consumers who participate in the load limiting DSP programs. Peak demand limiting is at the trial stage in the NEM.

Pricing and incentives

There are a number of options that have been used to manage peak electricity demand by encouraging consumers to shift load from high priced peak periods to lower cost non-peak periods. To date, these strategies have been predominantly tariff-based, and include TOU, STOU, and DPP tariffs.

A TOU tariff divides a day into time periods, or bands, and different unit prices are charged during each time period. In a basic TOU tariff, which is the format used in Victoria, the day is divided into peak and off-peak periods, with a higher price charged during peak periods. More complicated forms of TOU tariff may identify shoulder periods between the peak and off-peak periods, with prices intermediate between the peak and off-peak prices, as is the case in New South Wales.

 Figure 3 provides a comparison of the rate schedule for Ausgrid's PowerSmart TOU tariff with the network business' general use non-time varying tariff.

Figure 3: Illustrative example of Ausgrid's residential TOU tariff

Tariff	Usage Rate
Domestic all time	20.6 ¢/kWh for consumption up to 1,750 per quarter, 29.1 ¢/kWh for remainder
PowerSmart Home	Peak period (2 pm to 8 pm weekdays) 40.6 ¢/kWh Off-peak period (10 pm to 7 am) 9.6 ¢/kWh Shoulder period (all other times) 16.4 ¢/kWh

Source: http://www.energyaustralia.com.au/nsw/residential/products_and_services/electricity/powersmart.

The TOU price and length of the peak period varies based on the timing over the day and week of the peak system demand in the service territory of the NSP. To illustrate, for consumers on Endeavour Energy's network the rate and peak period for Origin Energy's retail Standard Contract Domestic TOU rate is 31.820¢ per kWh (ex. GST) and extends from 1 pm to 8 pm on business days. This reflects a peak driven by summer afternoon air conditioning loads.[39] In contrast, for Origin Energy consumers on Essential Energy's network, the analogous retail TOU tariff is 28.2460¢ per kWh (ex. GST) with two peak periods occurring on weekdays – the morning period being 7 am to 9 am and the evening period extending from 5 pm to 8 pm.[40] This pricing structure is aimed at managing a winter peaking network.

TOU tariffs aim to achieve an improvement in the overall or *average* load factor of supply-side infrastructure. TOU tariffs, however, do not accurately reflect the short-term demand spikes associated with peak summer or winter loads – and the capacity constraints these impose on electricity networks (and generation assets).

STOU tariffs

As the timing, duration and magnitude of peak periods can differ from summer (3 pm to 6 pm for example) to winter (7 am to 9 am and 5 pm to 7 pm, for example), STOU tariffs aim to better reflect the differing seasonal costs of electricity supply, and therefore apply a different TOU price schedule at different times of year. The seasons may be defined in various ways, depending on the network objectives, but typically, there are higher prices for summer and winter peak periods (reflecting higher demands for electricity for space cooling and heating) and lower prices for spring and autumn.

Figure 4, on the next page, provides an example of the STOU pricing schedule for Endeavours Energy's Western Sydney Pricing Trial (WSPT).

39 Origin Energy. *Energy Price Guide Standard form customer supply contract.* 2011.

40 Origin Energy. *Energy Price Guide Standard form customer supply contract.* 2011.

Figure 4: Illustrative example of Endeavour Energy's residential STOU tariff

Tariff	Usage Rate
Summer 1 pm to 8 pm working days between 1 November and 31 March	30.4 ¢/kWh
Winter 5 pm to 7 pm working days between 1 June and 31 August	30.4 ¢/kWh
Off-peak	all other times 9.7 ¢/kWh

Source: National Smart Metering Program. *Pilots and Trials 2008 Status Report to the Ministerial Council on Energy*. 2009.

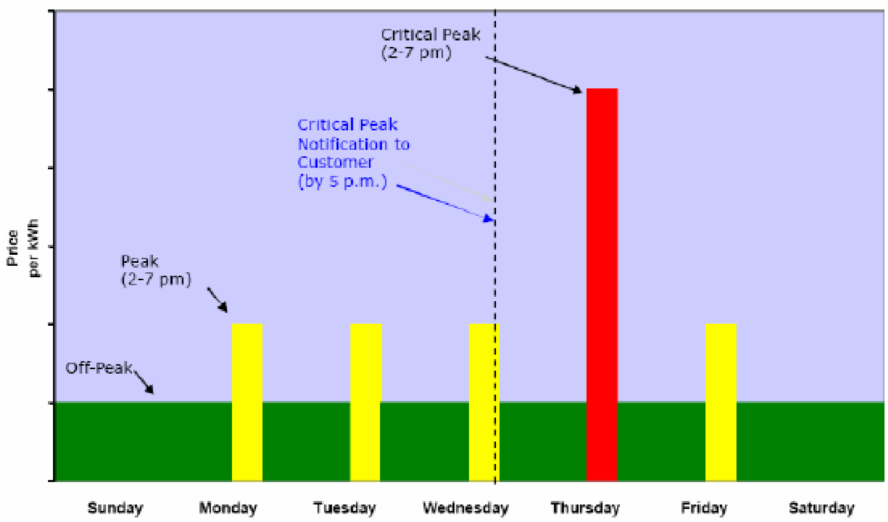
STOU tariffs are a refinement in the level of granularity of the information received by consumers about their usage patterns and related supply-side costs but the pricing signal is still highly averaged.

DPP tariff measures seek to more closely mirror supply and demand conditions where for the top few hours of peak demand each year, the cost of electricity supply is highly skewed above the average. Typically DPP tariffs consist of a CPP tariff, overlaid on a two-part TOU tariff. During the critical peak period, prices increase significantly, and can be over 20 times higher than the off-peak component of the underlying TOU tariff.

The days in which critical peak periods occur are not designated in the tariff, but dispatched as needed on relatively short notice for a limited number of days during the year (typically when network capacity is constrained or high wholesale pool prices are expected). Customers are informed about an impending CPP dispatch using various communications media, including automated telephone calls, email, SMS, and messages on in-house displays. The warning may be received as much as 24 hours before the event or as little as two hours prior. The customer then has the opportunity to avoid the high prices (and potential bill increases) by curtailing consumption during the critical peak.

A schematic overview of the DPP approach is presented in Figure 5.

Figure 5: Illustrative example of the workings of a DPP tariff



Source: CRA International. *Dynamic Peak Pricing in California: Do Customers Respond?* 2007.

Peak time rebates

PTR rewards based measures are an alternative form of dynamic peak pricing where customers receive an incentive in the form of a positive $ per kWh rebate for reducing energy use during peak period dispatch events. Since customers are assured that their bill will not increase, and that there is no risk of incurring higher prices if they fail to reduce their use in response to a peak period dispatch event, a PTR measure can have a higher appeal to customers (and policy makers) compared with a DPP tariff. Other benefits include:

- ease of marketing the product to customers owing to the simplicity of the approach which facilitates their understanding of the product and its 'up-front' benefits; and
- reduced revenue at risk for the proponent;
    - peak day events can be called only when needed, as opposed to a DPP tariff that must be called for the designed number of events each year to be revenue neutral for participating customers,[41]and
    - the total amount of the PTR rebate can be capped seasonally or annually for each participant.

Countering these benefits there is a need to verify each customer's load reduction by comparing their half hourly usage during a peak demand dispatch event to a 'baseline' usage profile. The baseline for each customer is derived from a representative 'similar' previous time period where there was no dispatch event. Although, simple in concept, the development of the individual reference baseline can present challenges, including; ease of implementation (particularly if the program has large numbers of participants), accuracy of the non-event day baseline, transparency regarding how it was developed, and minimisation of gaming by participants (manipulating loads deliberately to inflate the baseline artificially and obtain excess incentive payments).

3.2.4 Whole of load management – options and measures

Energy efficiency and conservation

Energy efficiency initiatives differ from conservation measures in that they seek to get customers to invest in more efficient designs or equipment rather than reducing their demand for a service. Improvement in energy efficiency is defined as using less energy to achieve the same level of output, or improving the level of output from the same amount of energy.[42] Energy conservation programs are defined as programs designed to change how customers use their appliances, lighting, water heating and space conditioning systems to minimise either annual energy use or shift their energy use to off-peak periods.

41 Revenue will remain the same as it would have been under a default single rate tariff.

42 Prime Minister's Task Group on Energy Efficiency. *Final Report*. 2010.

At present, energy efficiency is being implemented in the NEM through a combination of Commonwealth and State government mandated approaches targeting large C&I consumers and retailers. These initiatives are being complemented by voluntary energy efficiency initiatives delivered to consumers by retailers and DNSPs.

A relatively new technique in Australia, community-based social marketing is emerging, as an alternative to broad-based, generalised information campaigns that promote energy efficiency and conservation. This arises from the recognition that while information campaigns can be effective in creating public awareness, they are limited in their ability to actually engender behaviour change.[43]

CBSM focuses on group (social) processes and works to bring consumers in a community together to foster learning and encourage behaviour change. In practice there are three key steps that are used in the application of CBSM to encouraging consumers to become engaged in DSP activities. The first relates to uncovering barriers to desired behaviours (these can be either internal, such as knowledge, skill or attitude, or external, such as a technology or institutional barriers). Then, based on this information, behaviour(s) are selected to be promoted in the community. Finally, a community specific program is designed to overcome as many of the identified barriers to the chosen behaviours as possible and practicable. These programs are frequently based on commitment strategies or incentives that can reinforce people's intentions to engage in energy efficiency and conservation behaviours, and prompts that act to remind people to carry out these activities once they are receptive to the behaviour.

CBSM based DSP programs are currently being trialled in the NEM – some under the umbrella of Solar City initiatives, and others independently.

Fuel substitution

Fuel substitution DSP totally replaces electricity as an end-use energy source with another fuel. Natural gas, if available, is one of the most commonly used substitutes for electricity, particularly for space and process heating duties in the C&I sector. In the residential sector, the substitution of gas for cooling or space heating or the substitution of solar hot water for electric resistance heating are commonly encountered examples of this DSP option.

Power factor correction

Electricity supply to households and businesses from the distribution network consists of 'real power' which is measured in kW and is the power that translates into energy and 'does work' in the sense of providing the electrical end-use services desired by consumers. The electricity system must also provide 'reactive power' which is measured in kilovolt-Amps reactive (kVAr), and is the result of magnetising loads in inductive equipment such as motors and fluorescent lighting. Reactive power 'does no work' but must be supplied to each consumer.

Power factor measures the proportion of power delivered by the network to customer's loads in the form of reactive power relative to the real power consumed. Low power factor means poor electrical efficiency, in that generation, transmission, and distribution

43 McKenzie-Mohr, D. *Fostering Sustainable Behaviour*. 2000.

infrastructure is not optimally sized, and is larger than necessary. This, in turn, translates into higher capital expenditure and ultimately higher costs to consumers.

Poor power factor is alleviated by installing capacitor banks at low voltage so that the reduced total power supplied to a customer's premises has a beneficial effect on every upstream portion of the network. PFC is not economical in residential and small business premises but can be very cost effective in medium and large C&I facilities.

3.2.5 Distributed resources – options and measures

Distributed generation

DGs have been defined as small, modular units connected on the 'customer's side of the meter'.[44] DGs are situated close to the load served, and reduce demand on the grid infrastructure that would otherwise supply the load. Other potential benefits (which are not included as part of this study) include enhanced reliability and security of supply. Notably, the dispersed nature of DG systems means that a reduction in output in any one generating system will not have a marked impact on overall reliability of supply. Reliability of supply is also improved because consumers are less subject to outages caused by transmission and distribution failures. This is particularly true for rural and regional consumers who can be subject to outages and voltage variations arising from their position at the end of a long distribution feeder. Reduction in network line losses (primarily energy that is paid for by consumers but 'lost' in the form of heat as electricity flows through the distribution network) is a third benefit of DG.

DG, as defined for this study, comprises three general categories:

- standby generators that are installed in customer's premises to provide backup supply in the event of a loss of mains power;
- small scale renewables, notably rooftop PV installations; and
- cogeneration and trigeneration units in C&I facilities.

Standby generators

C&I customers with operations needing high levels of supply reliability frequently install standby generation equipment to act as backup load carrying capacity in the event of a distribution system outage. Many telecommunications, IT facilities, banks, hospitals, television stations, large office complexes, sporting clubs and water authorities have this need. Similar to curtailable load arrangements, standby generators are utilised by retailers, NSPs, third party DSP aggregators, and customers on pool pass-through arrangements to reduce exposure to high pool prices. NSPs also use this resource to defer network augmentation or to increase reliability of supply.

44 More broadly, DGs encompass small modular generators connected directly to the local distribution network, rather than to the transmission network. DGs registered with the AEMO as generators have been excluded as they are considered to be on the supply-side. Generators temporarily installed on the low voltage 11 kV network to manage peak demands on specific network elements have also been excluded owing to the lack of information regarding the location and number of such installations.

Standby generators offer a ‘firm’ quantum of peak load reduction, which is easily monitored and verified using the site’s NEM compliant meter or via instrumentation on the generator itself. Further, building managers test backup generation equipment regularly, and hence are often positively disposed to being paid to run the generators when they would have had to do so anyway.

Standby generators can be operated for DSP in one of two ways:

- electrical load is transferred to the generator while the generator operates in isolation or ‘islanded’ from the grid; or
- the generator operates in parallel with the grid, allowing the generator to meet part of the site’s electrical load while drawing the rest from the grid, or potentially exporting any access energy to the distribution network.

Islanded operation means that a premise must disconnect from mains supply prior to transferring load onto the generator. This temporary supply interruption can put essential energy services at risk, and additionally inconvenience tenants if the generator is located in a commercial building. These issues can prevent customers with generators from considering their application as a DSP resource.

A parallel configuration on the other hand makes the use of a standby generator for peak load reduction easier and more convenient. However, this extra capability is not usually built in to most generator sets and the cost of synchronising and fault protection equipment required by the local NSP to ensure the generator operates safely in parallel with the grid requires facility owners to invest additional capital cost. Recouping the investment will depend upon the number of hours the unit is run in future years, and the DSP incentives and/or bill savings obtained during the periods it is run.

Further, environmental regulations regarding the operation of diesel standby generators in densely populated areas, particularly with respect to air and noise pollution, may be a significant factor in determining the usability of standby generation as a DSP resource. Local council or EPA approval may need to be sought or license conditions may have to be reviewed to determine the nature and frequency of diesel generation operation that can be permitted.

Small scale solar PV

Solar PV cells convert sunlight directly into low voltage direct current (DC) electricity. Grid-connected applications use an inverter to convert the DC output from the panels to a higher alternating voltage suitable for use on-site or for export to the distribution network. Batteries are not needed to maintain supply as electricity is drawn from the grid when the solar cells are not providing power (at night) or have reduced output due to cloudy weather.

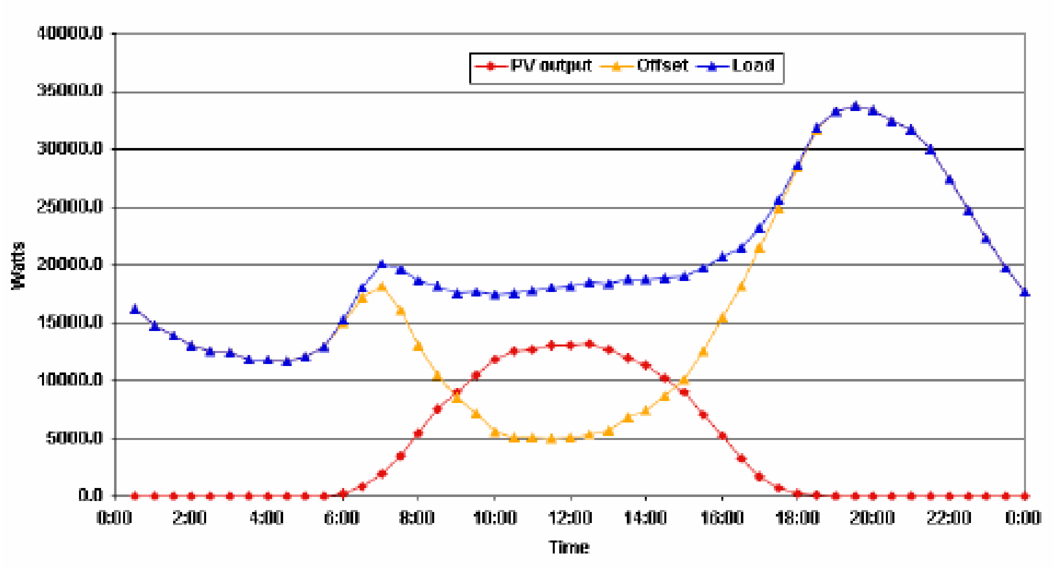
The benefits of utilising solar PV as a DSP strategy for managing peak demand at the system wide or local network level depends on the degree of overlap between the output of the generation and timing of the peak:

- for local network elements (feeders) with high residential loads, which peak in the late afternoon, PV can reduce load prior to the peak event; however, contribution to the peak load itself is low; and

- for feeders with a mixed load (including commercial and industrial customers), and for the overall system load, the PV contribution can be more significant.

Figure 6 presents one example of the potential relationship between household load and PV output, as measured at Ausgrid's Newington trial site.

Figure 6: Annual average load, PV output, and resultant load for 30 Newington homes



Source: http://www.ceem.unsw.edu.au/content/userDocs/WattMorganPasseySolar06_000.pdf.

Monitored data from 28 household installations in Newington showed that the maximum output per 1 kW of PV panels array on a high load summer day was 0.68 kW. On cloudy days, production levels were much lower.[45]

Cogeneration/trigeneration

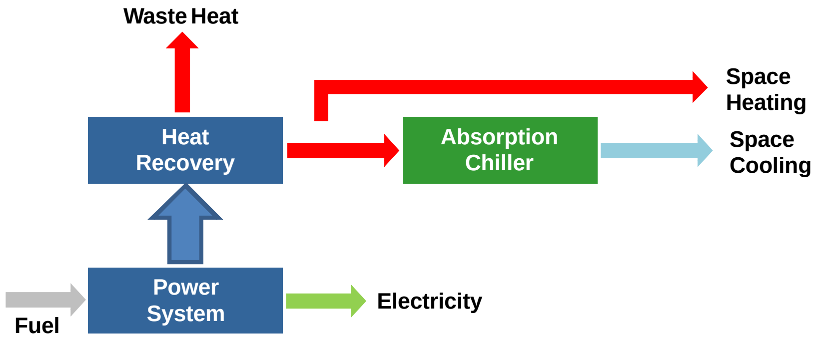
Cogeneration projects (also known as combined heat and power) produce electricity on-site, as well as simultaneously providing heating services. Trigeneration technologies can provide simultaneously electrical power, heating, and cooling.

In both cogeneration and trigeneration systems, fuel (typically gas, although renewable or other fossil fuels can be used) drives a generator to produce electricity. In cogeneration systems the waste heat from the generator is used for space, water or process heating. In trigeneration systems waste heat is also converted to chilled water for space cooling through an absorption chiller. These technologies provide up to 80% efficiency, a significant increase compared to conventional coal-fired power stations which convert about 30% to 40% of their fuel energy into electricity.

45 http://www.ceem.unsw.edu.au/content/userDocs/Oliva_Estimating_Economic.pdf.

Figure 7 provides a schematic overview of a cogeneration/trigeneration system.

Figure 7: Schematic of a cogeneration/trigeneration system



Cogeneration and trigeneration are most attractive at sites with a large heating and/or cooling load such as hospitals, hotels, cinemas, hospitality venues, manufacturing and industrial plants, multi-dwelling residential, commercial buildings, and public infrastructure facilities.

Distributed energy storage

Distributed energy storage technologies do not generate electricity but rather interact with power generation systems to deliver stored electricity to the electricity grid or to an end-user. Like distributed generation, distributed electricity storage technologies are generally located at or near the point of use. These technologies can be used for load shifting and peak shaving, and can also increase power quality and reliability for residential, commercial, and industrial customers by providing backup during power outages. Distributed storage technologies also hold significant potential to increase the value of intermittent generators like small scale solar PV and wind by overcoming the misalignment between solar PV generation and the timing of consumer's peak demand for electricity.

Within Australia, battery storage is an emerging area that holds potential for both large and small consumers; however, it is still very expensive. (in the order of $3,000 to $5,000 per kW installed) and generally only has application in very remote areas where the alternatives are diesel fuel generation or intermittent renewable such as solar PV and wind.

4. Existing Level of DSP and Options in the NEM

4.1 Introduction

Section 4 initially provides a high level review of the quantum of DSP currently available in the NEM. This is followed by a more detailed analysis of the main DSP options and measures that have been implemented (and are currently operating) in the NEM, and an order of magnitude estimates of the peak demand reduction capacity associated with each.

4.2 Evidence of DSP in the NEM

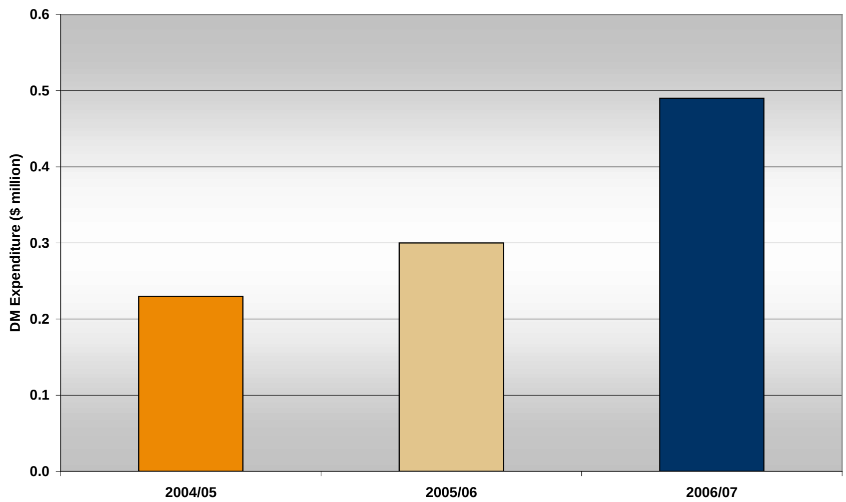
4.2.1 Illustrative examples

Market participants

IPART has conducted three reviews of the DM and DG projects undertaken by the New South Wales DNSPs under the d-factor[46] scheme. Based on information contained in IPART's third review of the d-factor,[47] between FY2004/05 and FY2006/07 Integral Energy's total expenditure on non-network activities (excluding foregone revenue) was some $1 million on nine demand management programs. This expenditure resulted in deferral of approximately $13 million of planned capex and opex for capacity augmentations, with annual peak demand reduction totaling 31 MVA.

Figure 8 presents Integral Energy's annual expenditure on d-factor DM and DG projects from FY2004/05 to FY2006/07.

Figure 8: DM costs and d-factor claims approved by IPART for Integral Energy



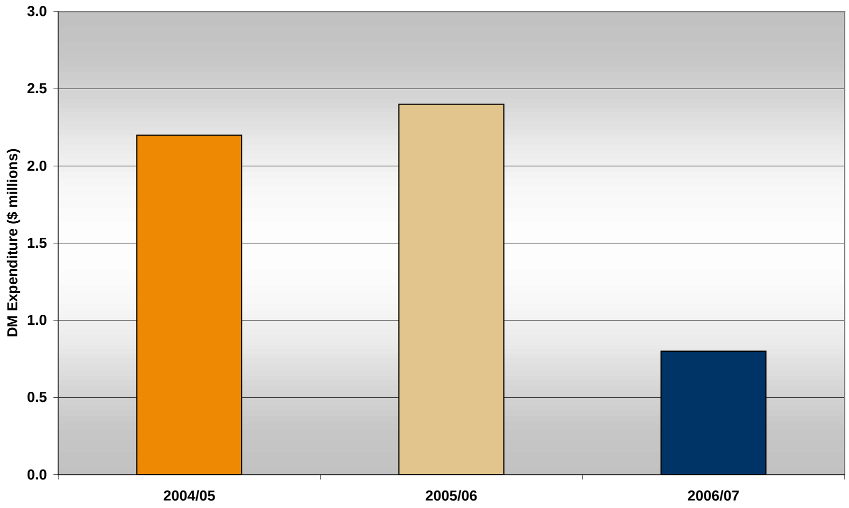
Ausgrid (operating as Energy Australia) has been the most active proponent of DM in New South Wales. According to IPART's third review of the d-factor scheme, EnergyAustralia implemented a total of 17 DSM programs over the period FY2004/05 and

46 The d-factor is an incentive scheme introduced by IPART in 2004 that allows DNSP to recover the costs of implementing DM and DG measures, including lost revenue.

47 IPART. *NSW Electricity Information Paper No 3/2008 - Demand Management in the 2004 distribution review: progress to date.*

FY2006/07. As illustrated in Figure 9, the total DSM expenditure associated with these programs, exclusive of foregone revenue costs, was some $5 million. Ausgrid estimated that the DSM measures implemented by the business delivered a reduction in peak demand of 64MVA in the three years to FY2006/07, resulting in avoided distribution costs of some $17 million.

Figure 9: DM costs and d-factor claims approved by IPART for EnergyAustralia



Transmission businesses have also contracted DSP. In the summer of 2008/09, Transgrid implemented the largest ever network support arrangement to support a deferral of the proposed Western 500 kV upgrade project by one year. In total some 350 MW of network support was obtained of which about 100 MW was derived from a combination of dispatchable or interruptible load in the industrial sector.[48]

From a retailer's perspective, the key benefit of DSP is the avoidance of purchasing energy from the wholesale pool during very high price periods. Our interviews with the retailers indicated that if the transaction costs associated with using DSP to manage wholesale price risk are lower than financial or physical hedges through contracts with generators (or building their own generation), dispatchable DSP is seen as a viable option. However, the retailers view their hedge positions as commercially sensitive and did not provide specific information for release to the public domain. A number of the retailers did provide data that was sanctioned for use in aggregate in our analysis.

DSP aggregators

EnerNOC (formerly Energy Response) has been active as a third party aggregator providing access to DSP response to market participants in the NEM since the mid 2000s. At the time of this report, EnerNOC had almost of 20 MW of peak load DSP in the form of market non-scheduled generation registered with the Australian Energy Market Operator (AEMO).[49]

48 http://www.transgrid.com.au/mediaweb/articles/Pages/TransGridholdslargesteverAnnualPlanningForum.aspx.

49 AEMO. *Registration and Exemption Lists.* 2011.

In 2006, when operating as Energy Response, the National Electricity Market Management Company (NEMMCO) (now AEMO) awarded the firm a contract to provide 125 MW of firm Reserve Capacity through demand side response.

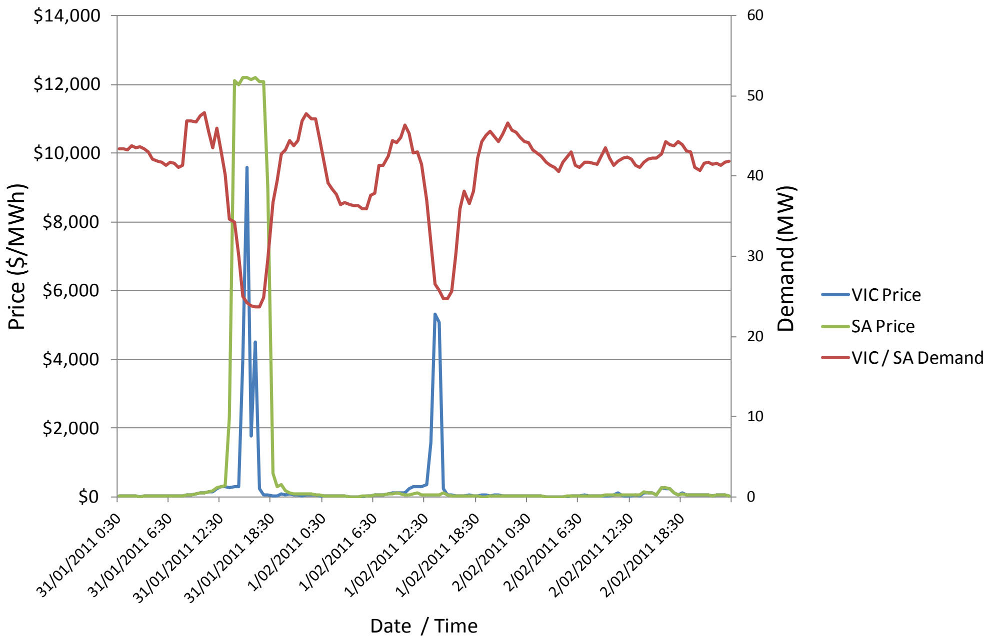
AEMO and the AER

AEMO conducts an annual survey of DSP quantities contracted by retailers, NSPs, demand response aggregators, and other market customers. An estimate of the quantity of curtailable load available in the market is derived by the AEMO from the survey and reported in the ESOO[50] as part of the supply-demand forecast for the NEM. The maximum available resource reported by the AEMO in the 2011 ESOO totalled 263 MW.

Figure 10 shows the results of an analysis conducted by Futura's project team using raw data provided by AEMO for the combined Victorian and South Australian region.

The analysis indicates that a demand response of approximately 20 MW to 25 MW occurred on two occasions over two consecutive days where prices exceeded $100 per MWh and reached the Market Price Cap of $12,500 per MWh.

Figure 10: Vic/SA demand response of reported curtailable loads from ESOO data

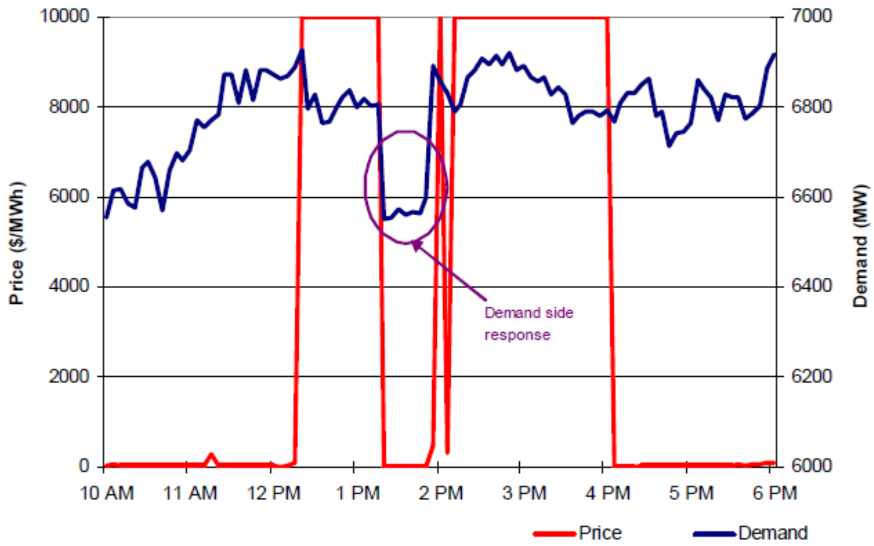


Additional discussion of the ESOO DSP estimate is provided in Section 4.3.1.

The National Electricity Rules (NER) requires that the AER publish a report whenever spot prices in the market exceed $5,000 per MWh. The report is intended to identify and analyse the factors that contributed to high spot prices such as generation capacity, generator bidding strategies, supply-demand imbalances, network constraints and any demand response that may have occurred. The type of load profile that is observed as evidence of probable demand response at times of a high price reporting incident is presented in Figure 11, on the next page.

50 AEMO. *Electricity Statement of Opportunities*. 2011.

Figure 11: Indicative profiles for observed DSP related to over $5,000/MWh spot prices



Source: AER. *Prices Above $5000 MWh 22 April 2010.* 2010.

Over the 2 year period commencing November 2009 the AER issued 23 high spot price reports. Five of these noted that one or more demand response events had occurred during the high spot price periods. All five were issued between November 2009 and 2010. Table 3 provides a summary of the reports, including a description of the cause of the high spot price events, the magnitudes of the apparent demand response events that were observed, and the resulting change in the spot price due to the impacts of the demand response on market prices. Three reports noted apparent demand response of between 265 and 540 MW in NSW, one report noted between 50 to 100 MW in Tasmania and one noted 300 MW in Victoria. In all cases the apparent demand response led to a significant drop in spot prices.

Table 3: Summary of AER high spot price reporting and observed demand response

Report date	NEM region	Cause	Observed demand response (MW)	Resulting change in the spot price ($/MWh)	
				From	To
20-Nov-09	NSW	High temperatures	500	$6,204	N/A[1]
4-Feb-10	NSW	Supply constraints	540& 360	$5,541	$282
22-Apr-10	VIC	Supply constraints	300	$9,999	$9
7-8 Aug-10	TAS	Day ahead bidding	53 to 108	$12,400	$22
10-Aug-10	NSW	Supply constraints	265	$12,500	$19

Note 1.Specific price data was not provided for this excursion; however, the AER reported that the demand side response led to lower prices over the trading interval associated with the observed demand response.

Since most large loads are not registered in the market, and therefore are not transparent to the AEMO, the reported demand responses could have come from any sources that have very rapid response rates. These could include large individual customers such as smelter loads or steel mills, aggregated curtailable loads from the C&I sector, or customers on retail pool pass-through contracts. Non-scheduled generators with under rapid ramp rates are also likely to respond to these short term price spikes, noting that an increase in output from these generators is seen as a decrease in demand. Specific investigations as to the cause of the rapid change in demand and price are not undertaken by the AER; however, comments of a general nature are provided. For example, the AER attributed the Tasmanian demand response to possibly coming from large industrial users.[51] In the case of the single Victorian incident, the source of the demand response was believed to have been an industrial load being taken out of service.[52] Commentary was not provided on the three New South Wales events.

4.3 Estimates of DSP quantities in the NEM by measure

4.3.1 *Peak load management – options and measures*

Curtailable arrangements (non-tariff)

As noted, an estimate of the quantity of curtailable load available in the market is derived by AEMO and reported in the ESOO.[53] The estimate is based on a survey that collects National Meter Identifier (NMI) data for 140 large C&I customer sites, of which actual load data is extracted and analysed for 100 of these sites.[54]

There is also an additional quantity of DSP that is reported in the surveys in MWs, rather than by NMI and known smelter loads in NSW and Victoria that are included in the ESOO reported estimates. Table 4 provides a summary of the ESOO estimates by NEM region which in aggregate total 263 MW of DSP from C&I sector curtailable loads.

Table 4: Estimated MW of DSP from AEMO survey 2010 to 2011

	NSW	VIC / SA	QLD[55]	TAS	Total
DSP identified by NMI - price analysis	14	45	50	-	109
Additional DSP reported but not identified by NMI	56	15	8	-	79
Known smelter loads	25	50	-	-	75
Total	**95**	**110**	**58**	**0**	**263**

51 AER. *Prices Above $5000 MWh 7 and 8 August 2010.* 2010.

52 AER. *Prices Above $5000 MWh 22 April 2010.* 2010.

53 AEMO. *Electricity Statement of Opportunities*. 2011.

54 For various reasons no load data was able to be extracted and analysed for around 40 NMIs.

55 The Queensland DSP value of 50 MW is an estimate only due to limited data available from that region.

Several retailers have full or partial pool pass-through contract arrangements with their large C&I customers. Progressive Green, a relatively new retailer in the market, offers pool pass-through contracts in combination with a market monitoring and alert service. This product is attracting smaller business customers with flexible loads to take up pool pass-through arrangements. Many of these customers would not do in the absence of the service provided by Progressive Green due to lack of internal skills and resources to monitor market prices. From feedback and discussions with retailers it is estimated there is an additional 40 MW of DSP from customers on pool pass-through arrangements that are curtailing load in response to full or partial exposure to pool prices.

The total quantity of DSP from curtailable load arrangements in the NEM is therefore currently estimated at around 280 MW.

Direct load control

Analysis of the current status of the residential hot water load in the NEM indicates that DLC shifts some 2,500 MW of load away from the winter peak and 1,750 MW from the summer peak.[56] This represents 4% and 6% of the NEM summer and winter peaks, respectively. Table 5 provides an approximate disaggregation by NEM region.

Table 5: Estimated hot water load shifted to off-peak by existing residential DLC

NEM Region	Controlled load tariffs	Approx # of customers	Winter MW shifted to off-peak	Summer MW shifted to off-peak
NSW / ACT	OP1, OP2	1,150,000	1,040	690
Vic	Various	690,000	620	400
Qld	T31, T33	1,100,000	700	500
SA	OPCL	310,000	220	160
Total		**3,250,000**	**2,580**	**1,750**

In Queensland, Energex and Ergon Energy have been encouraging pool owners to connect their pool pumps to retail tariffs T31 and T33 for many years and installing energy efficient pool pump technologies.[57] Retail T33, which is aimed primarily at controlling medium sized water heaters but also allows connection of other household appliances such as pool pumps, offers 18 hours of supply at a rate 40% lower than the general domestic Tariff 11 in return for control of loads over the 6 hour peak afternoon period.

56 Hot water takes more energy to heat up in winter than it does in summer because the temperature of the water entering the tank is much colder. Standing losses to the environment are also higher owing to the lower ambient temperatures in winter. Consequently, DLC of hot water has greater peak demand reduction impacts in winter than in summer.

57 Ergon Energy and Energex, in third quarter 2011, introduced an incentive based DSP program to actively encourage consumers to manage pool pump loads. Participants can receive a $350 rebate for transferring their pool pump to Tariff 33 and a $250 rebate for installing a 5-star variable speed drive pool pump. The 5-star pool pumps are estimated to deliver a 0.33 kW reduction in energy use at peak times.

Energex estimate that there are 277,000 pools in South East Queensland and currently 34% of pool pumps are connected to Tariff 33.[58] The remaining 182,000 uncontrolled pool pumps contribute an estimated 147 MW to the peak which is equivalent to an average of 0.8 kW per pool pump converted to a controlled load circuit. It is therefore considered that about 75 MW[59] of pool pump load is shifted away from the peak period in Energex's service territory. Prorating this estimated on the basis of the total number of pools in Queensland gives an estimate of 110 MW of pool pump load shifted away from the peak period Queensland wide.

Thermal energy storage

Ergon Energy has implemented a major TES project with James Cook University as part of the business' Network Demand Management (NDM) pilot. The partnership has built the largest central district cooling system in the Southern Hemisphere incorporating high-efficiency chillers, sophisticated controls and large-scale TES for cooling 30 buildings on campus. Figure 12 summarises the benefits associated with the project which include a reduction in the projected peak demand for electricity of some 5MVA along with projected electricity cost savings of about $3m per annum.

Figure 12: Projected benefits of the Ergon Energy James Cook University TES

Forecast outcomes			
	BAU 2015	**2015**	**Savings**
Estimated Energy Consumption (kWh)	48,125,000	35,942,670	12,182,330
Greenhouse Gas Emission Reduction (Tonnes CO2 / pa)	49,088	36,662	12,426 (2700 medium cars)
Estimated Electricity Cost ($/pa) 2010 Rates	$8 million	$5.17 million	$2.915 million
Estimated Demand (kW)	13,035	7150	5885
Estimated Demand (kVA)	14,485	7525	6960
Capital Cost	$34 million	$21 million	$13 million

- includes all electrical and maintenance costs, together with sinking funds and escalation rates for each of them.

Source: Ergon Energy. *Network Demand Management Case Study – James Cook University Douglas Campus, Townsville.* 2011.

Price-based approaches

DPP

In 2010, just prior to summer, SP AusNet launched the business' Critical Peak Demand Multi-Rate tariff aimed at reducing peak demand from consumer's sites in the C& I sector. This program represents the first BAU full-scale roll-out of a network DPP tariff program in Australia.

---

58 Energex. *Energy Conservation and Demand Management* powerpoint presentation. 2011.

59 Calculated by Futura Consulting as 277,000 pool pumps x 0.34 x 0.8 kW per pool pump.

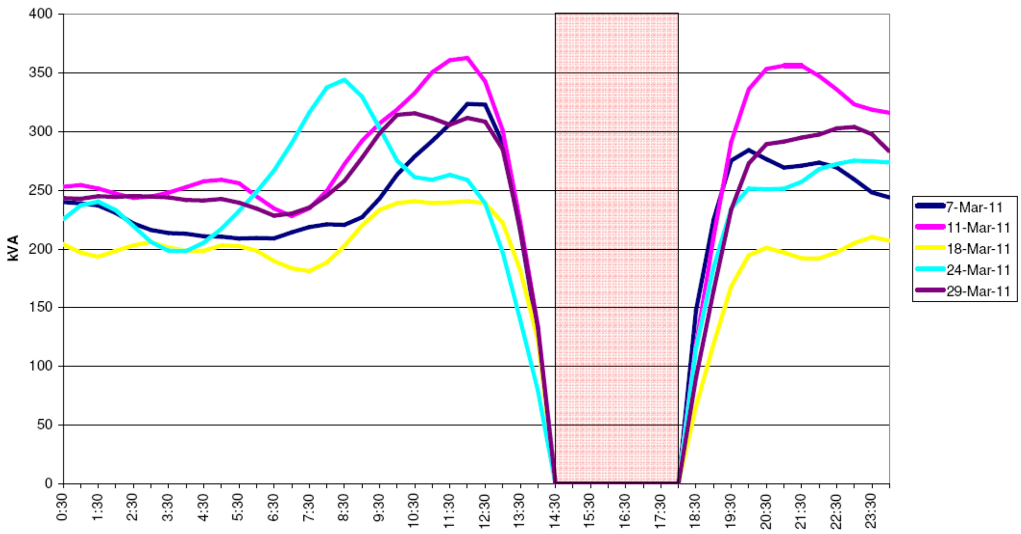
The tariff which was mandated to all C&I customers consuming more than 160 MWh per year (approximately 1,800 customers), comprises a 3 part TOU energy component (peak, shoulder and off-peak) and a kVA demand charge calculated based on the average demand over five defined critical peak demand periods. The critical peak periods, which can occur anytime between 2 pm and 6 pm from December to March, are nominated in advance by SP AusNet based on short term forecast of system load and weather conditions.

These events are communicated to customers at least a day in advance by SMS and email to enable customers with an opportunity to reduce their demand over the critical peak period of the forthcoming event, to take any necessary operational steps required to enable implementation of their load reduction capacity.

SP AusNet's analysis indicates that two-thirds of all customers responded by reducing demand, of which 300 reduced peak demand by more than 50%, and 75 of those reduced peak demand by more than 90%. SP AusNet has estimated of 88 MW of system wide peak load reduction was achieved on their distribution network[60].

They also noted that the tariff has created considerable activity in the market from retailers and trade allies who recognize the potential for a commercial opportunity in offering products and services to assist customers in maximizing cost savings under the tariff. Figure 13 and Figure 14 provide examples of how two customers responded to the tariff over the five nominated critical demand days.

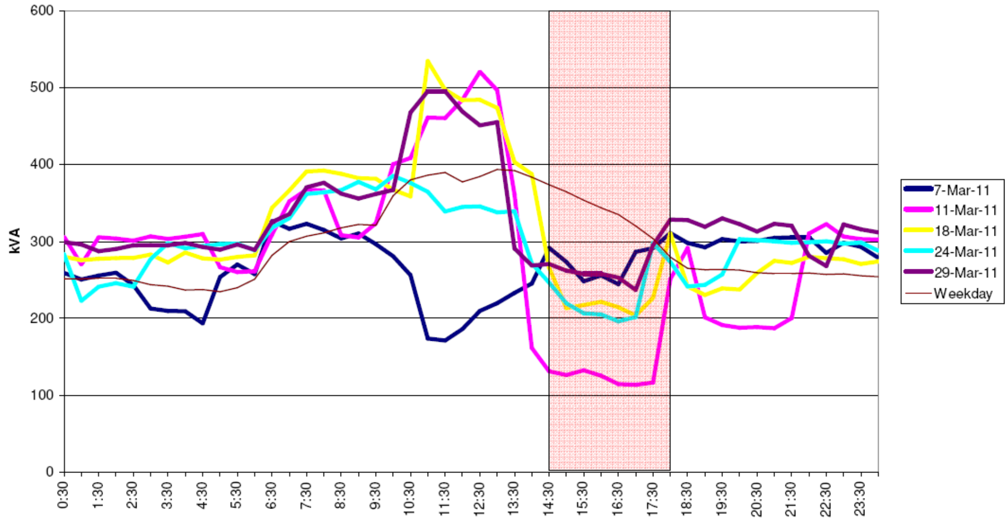
Figure 13: C&I customer response to critical peak pricing (with on-site generation)



Source: SP AusNet. *Via email from Tom Hallam*. 2011.

60 SP AusNet. *Review into Demand Side Participation in the National Electricity Market*. 2011.

Figure 14: C&I customer response to critical peak pricing (load curtailment)



Source: SP AusNet. *Via email from Tom Hallam*. 2011.

4.3.2 Whole of load management – options and measures

Energy efficiency and conservation

Facilities in the C&I sector have a diverse range of options and opportunities for enhancing the energy efficiency of their operations. Although to some extent these activities are industry specific in that they relate to specialised processes, there are a number of over-arching technologies and techniques that are frequently employed across numerous sectors. Examples of these measures include:

- replacement of inefficient lighting fixtures, fittings, and controls with high efficiency equipment;
- installation of high efficiency motors and variable speed drives that continuously match motor output to changes in the demand or load requirements of end-use services such as ventilation fans, pumps, or conveyors;
- refinements to the control systems of refrigeration compressors on industrial sites and space conditioning chillers in the commercial sector, and installation of high efficiency equipment; and
- optimisation of compressed air control systems to match output to load requirements, reduce leakage, and improve maintenance.

The Commonwealth Government's Energy Efficiency Opportunities (EEO) program is one of the key initiatives that requires businesses that use large[61] amounts of energy to improve their energy efficiency. Reported electricity savings from cost effective energy efficiency projects identified by just over 200 participating organisations in the EEO in FY2007/08 amounted to 3,303 GWh.[62] Of this total about two thirds or 2,000 GWh in

61 The program is being expanded as a voluntary measure to medium size energy users.

62 DRET. *First Opportunities A Look at Results from 2006-2008 For the Energy Efficiency Opportunities Program.* 2010.

savings is actually committed and likely to be realised. More recent reporting in FY2009/10 indicates that the total energy savings of committed projects has doubled, and electricity savings are therefore potentially in the order of 4,000 GWh.[63] Reporting for the EEO program does not include the peak demand benefits associated with these energy efficiency projects.

Residential consumers also have various options for improving the efficiency of their electricity consumption. Some of the more commonly employed measures target the largest energy household end-use services (space conditioning, hot water, refrigeration), and include:

- replacement of low efficiency water heaters with high efficiency models;
- replacement of low efficiency ducted space heating with high efficiency products;
- installation of wall and ceiling insulation, window seals, and energy-saving windows;
- replacement of low efficiency lighting with high efficiency products;
- upgrades to low-flow shower roses; and
- purchase of high efficiency refrigerators.

The Queensland Government has implemented a residential energy efficiency program called the ClimateSmart Home Service. The initiative is offered on a fee-for-service basis and aims to assist households in reducing their energy consumption, electricity bills and greenhouse gas emissions. For a once of fee of $50 participants receive an in home energy assessment, hot water temperature water adjustment, a customised power and water saving plan, access to a customised online energy efficiency resource and a pack of energy saving products including standby power eliminators, CFLs, and an energy and water saving showerhead. To date, an estimated 300,000 households have taken part in the service.

The Victorian, South Australian, and New South Wales Governments have recently (2009) implemented programs to promote and encourage the uptake of energy efficiency measures in the residential sector. Under these initiatives large energy retailers (broadly those with over 5,000 customers) are required to provide incentives for consumers to achieve greenhouse gas reductions and potentially lower their energy bills through improved home energy use. Review of the monitoring and verification reports for the programs suggest that over the 2009 and 2010 calendar years:

- the Victorian Energy Efficiency Target (VEET) has achieved greenhouse gas reductions of some 5.1 million tonnes of carbon dioxide equivalent ($tCO_{2\text{-}e}$) corresponding to a reduction of some 3,800 GWh of electricity; [64]
- South Australian greenhouse gas emissions have been reduced by 0.4 million $tCO_{2\text{-}e}$ as a result of the Residential Energy Efficiency Scheme (REES), which equates to about 425 GWh of electricity use savings in total for the calendar years;[65] and

---

63 Pro-rata estimate by Futura Consulting based on energy savings identified in (DRET). *Continuing Opportunities, Energy Efficiency Opportunities Program – 2010 Report*. 2011.

64 Essential Services Commission. *VEET Performance Report 2010.* 2011.

- the NSW Energy Savers scheme (ESS) has resulted in greenhouse gas emission reductions of some 0.80 million $tCO_{2\text{-}e}$ or about 740 GWh of energy savings through efficiency improvements in household (and business) electricity use.[66]

As noted for the EEO program in the C&I sector, explicit monitoring and verification of any associated peak demand reductions achieved through the implementation of energy efficiency measures is not reported for the VEET, REES, or ESS.

Market participants are also responding to the needs of their customers through energy efficiency initiatives. For example:

- various electricity retailers offer energy services to large consumers in the C&I sector that cover a range of measures including energy audits, fuel substitution studies, and PFC correction assistance;
- Ergon Energy and Energex are working with large C&I customers conducting tailored assessments and identifying opportunities to implement energy efficiency measures that also reduce peak demand – load reductions of some 30 MW have been achieved since the programs have commenced implementation in 2010; and
- Ergon Energy and Energex are implementing a web-based one stop shop for information that will assist consumers in reducing their bills, increase their energy efficiency, and reduce their consumption at peak times.

Fuel substitution

Water heating is the largest single source of greenhouse gas emissions from most Australian homes. To mitigate these impacts, the Commonwealth Government in partnership with state and territory governments is working to phase out electric hot water systems in all regions except Tasmania. Commencing in 2010, electric water heaters cannot be installed in any new detached, terrace or town house, or as replacements in existing homes that fall within these categories, and have access to natural gas. During 2012 the program will be extended such that electric water heaters will no longer be able to be installed in any existing detached, terrace or town house.[67] The phase-out which will convert electric water heaters to gas or LPG units, heat pumps, and solar water heaters is expected to result in greenhouse gas reductions of some 78.7 million tCO_{2e} over the period 2010 to 2030.

The Regulatory Impact Statement (RIS) for the phase-out[68] did not attempt to quantify the likely magnitude of the fuel substitution impacts on periods of peak demand for electricity but did note that the effects on electricity networks could be significant.

65 Essential Services Commission of South Australia. *Residential Energy Efficiency Scheme Administration of the Scheme in 2010.* 2011.

66 IPART. *NSW Energy Savers Scheme Presentation.* 2011.

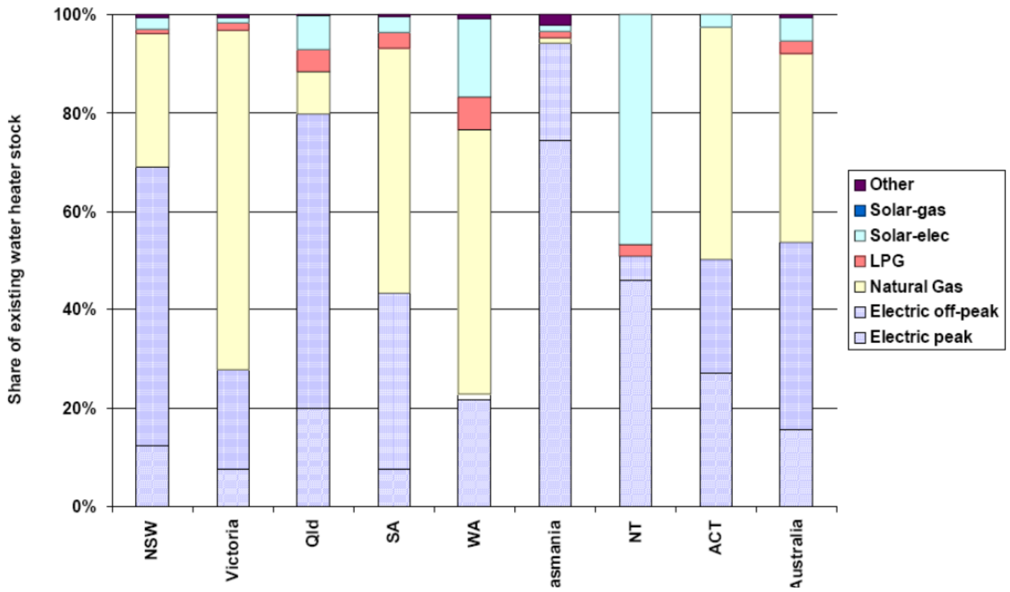
67 Source: http://www.climatechange.gov.au/what-you-need-to-know/appliances-and-equipment/hot-water-systems/phase-out.aspx.

68 George Wilkenfeld and Associates with the National Institute of Economic and Industry Research. *Regulation Impact Statement: for Decision Phasing Out Greenhouse-Intensive Water Heaters in Australian Homes.* 2010.

Firstly, off-peak electric resistance water heaters have enabled DNSPs to reduce the domestic water heating load at peak periods, when cooking, lighting, space heating and cooling loads are heaviest. The phase-out will mean that this DM capability would be reduced, and solar hot water heaters with electric boost and electric heat pumps will have the potential to introduce new water heating load to the peak period if consumers are not encouraged to connect these loads to controlled load tariffs.

On the other hand, increases in demand could be mitigated somewhat by the phase-out of electric water heaters that operate continuously during peak periods, leading to some reduction in their contribution to peak load. The degree to which this eventuates will vary from region to region, depending on the penetration of continuous electric hot water heaters. As can be seen from Figure 15, electric peak water heaters comprise a low of about 10% of total in Victoria and South Australia, to a high of about 30% in the Australian Capital Territory. Again, if these water heaters are simply replaced with uncontrolled electric boosted solar hot water heaters and electric heat pumps there is unlikely to be any significant load reduction benefit of the phase-out at time of peak.

Figure 15: Share of 2008 hot water stock by state and territory



Source: George Wilkenfeld and Associates. *Regulation Impact Statement for Consultation: Phasing Out Greenhouse-Intensive Water Heaters in Australian Homes.* 2009.

Importantly, the RIS also noted that the best way to manage demand for hot water (and other services provided by electricity) is not through time restricted controlled load tariffs but through a combination of dynamic electricity pricing and the ability of appliances to respond automatically to price signals.

PFC programs

ETSA Utilities, Ausgrid, Endeavour Energy, and Ergon Energy have all implemented PFC programs to actively manage peak demands for network services.[69] These programs have used kVA reduction rebates or kVAr penalties to provide an appropriate incentive to customers with poor power factors to install capacitor banks.

Over the period 2007 to 2009 ETSA Utilities PFC program was implemented at 139 sites with the average power factor improving from around 80% to over 90% resulting in a total peak demand reduction of about 33 MVA.[70] Based on advice from Ausgrid and Endeavour Energy,[71] over the last 3 years the businesses have installed approximately 7 MVA of PFC to assist in deferring zone substations augmentations (7projects) or reducing load at risk on zone substations (2 projects). Ergon Energy is in the process of identifying and implementing a potential 6 MVA of PFC in the Toowoomba area as part of the Toowoomba Power Factor Correction Pilot.[72]

4.3.3 Distributed resources – options and measures

Standby generators

Standby generators are not centrally registered and therefore it is difficult to determine an accurate value for the total quantum of standby generator DSP resource in the NEM. However, Futura's project team have derived an order of magnitude estimate of the quantity of standby generators currently deployed in the NEM from discussions with the NSPs, retailers, DSP aggregators and the ESOO. The total quantity of DSP from standby generators assessed from these sources is estimated at around 50 MW. Of this total, some 16 MW is export capable.

A survey conducted by DEUS in 2003 provides some interesting insights into how the current quantity of DSP from standby generators compares with the amount that might be potentially available for dispatch to assist in managing peak demand on the distribution network. This survey estimated that some 400 MVA to 500 MVA of standby generators were installed across NSW, and that this total represented 4.5% of regional average demand in the state. Extrapolating the survey results to the NEM based on the same relative percentage of generator installed capacity to demand, and an average demand of 22,424 MW in the NEM (for FY2010/11) indicates that there may be in the order 1,000 MW of standby generator capacity NEM-wide. Comparing this theoretical potential capacity to the level of DSP currently obtained from standby generators in the NEM suggests that there may be scope to increase the level of DSP from this resource.

---

69 Many of the DNSPs have tariffs in place to motivate customers to maintain the power factor of their facilities above a regulated requirement. However, these tariffs are not actively marketed. The figures presented in this study reflect active engagement by DNSPs with customers to promote the installation of PFC equipment.

70 ETSA Utilities. *Demand Management Program Interim Report No.3.* 2010.

71 Institute for Sustainable Futures at the University of Technology Sydney. *Survey of Electricity Network Demand Management in Australia (SENDMA).* 2010.

72 Ergon Energy. *Energy Conservation and Demand Management Funding Package Quarterly Report*, *April to June 2011*. 2011.

Small scale renewables

The take-up of small scale roof-top PV systems has accelerated rapidly in recent years, due in large part due to state feed-in tariffs, and certification schemes. Data sourced from the Office of the Renewable Energy Regulator (ORER) shows that 386,579 rooftop PV systems have been installed in Australia since 2001.[73] Adjusting this number to account for the 14% of systems that are installed outside the NEM, and based on an average nominal rated capacity of 1.9 kW per installation, this data suggests that the total installed capacity of rooftop PVs in the NEM is in the order of 630 MW.

The impact of PVs in generally dampening peak demand growth will be different across NEM region due to variations in solar output as well as variations in the timing of the peak. Ausgrid has reported from the results of the Newington Village trial that PVs have the potential to reduce peak demands in inner metro areas by between 10% and 60% of the rated capacity.[74] A more recent analysis by Ausgrid estimated the peak demand impact of solar PV on the top five 2011 system summer peak days as being between 30% and 43%.[75]

It should also be noted that the impacts of PVs on localised network elements such as feeders and zone substations may differ significantly from system-wide effects. For example, the Magnetic Island PV trial of the Townsville Solar City project, PV output data from Ergon Energy shows that the peak demand reduction of north facing solar panels at the 6 pm peak period is negligible.[76]

In summer, distribution network load peaks tend to occur at around 4 pm to 7 pm, depending on the region, and the customer mix. Assuming PV output at time of system peak on a distribution network is 30% of nominal rated capacity, the peak load reduction of the currently installed stock of PV systems would be in the order of 190 MW. Impacts of PVs on system peaks in winter are considered to be negligible. In most NEM regions sunset will be prior to the winter peak demand period which occurs between 6 pm and 7 pm so the contribution of solar to reducing winter peaks is highly unlikely.

There are some challenges related to the use of DSP based on solar PV resources that will need to be addressed, in future, in order to promote greater penetration of this technology. For example, mechanisms are needed to overcome barriers to take-up such as limited or no perceived financial benefit, consumer's need for topical information, and split incentives related to renting.[77] Operational issues related to voltage rise and harmonics imbalances are also emerging as a concern for both the network and PV host if high concentrations of PV installations are clustered in localised areas.[78]

---

73 ACIL Tasman. *Small Scale Technology Certificates Data Modelling*. 2011.

74 Watt, M. *Newington Village An analysis of photovoltaic output, residential load, and PV's ability to reduce peak demand.* 2006.

75 Ausgrid. *Research Paper Effect of Small Photovoltaic (PV) systems on Network Peak Demand.* 2011.

76 Ergon Energy. *Townsville Queensland Solar City Annual Report.* 2010.

77 Ergon Energy. *Townsville Queensland Solar City Annual Report.* 2010.

78 Ibid.

Cogeneration

Australia currently has approximately 3,338 MW of cogeneration installed, 592 MW of which is fuelled by renewable sources[79]. The impact of cogeneration on peak demand in the NEM has not been quantified for this review.

4.3.4 Summary of existing DSP measures and quantities in the NEM

In summary, our analysis suggests that at present, there is approximately 2,900 MW of dispatchable and non-dispatchable DSP in the NEM. As illustrated in Table 6, the size and nature of the available demand response varies significantly between sectors, and DSP measures implemented.

Table 6: Estimated MW and MWh of DSP in the NEM by option, measure, and sector

	Summer MW	Winter MW	Annual GWh
Peak load management			
Curtailable arrangements (C&I)	280	0	Not applicable
Direct load control			
• hot water DLC (residential)	1750	2500	Not applicable
• pool pump DLC (residential)	110		Not applicable
Pricing strategies			
• Dynamic peak pricing (C&I)	88		Not applicable
Thermal energy storage (C&I)	5		
Whole of load management			
Energy conservation and efficiency (mixed)	30[80]	30	8,965[81]
Fuel substitution(residential)	Impacts of electric storage hot water not quantified for this study		
Power factor correction (C&I)	46	46	0
Distributed resources			
Standby generation	60	0	
Small scale PV (predominantly residential)	190	0	
Cogeneration/trigeneration (C&I)	Impacts on peak demand not quantified for this study		

79 Clean Energy Council cogeneration project data, July 2011. Cited in Climate Works Australia. *Unlocking Barriers to cogeneration: Project Outcomes Report*. 2011.

80 Represents the peak demand reduction reported from Energex and Ergon Energy's C&I energy efficiency initiative.

81 Represents the energy use reductions from mandated Commonwealth and State government measures.

4.3.5 Comparison with other regions

Table 7 contrasts the estimated DSP resource currently available in the NEM (absent of legacy hot water and pool pump DLC) to that in Western Australia, and selected markets from around the world.

Whilst recognising that differences in market designs, regulatory regimes, customer compositions, and other factors will have a large impact on DSP opportunities, the presentation demonstrates that the current level of DSP in the NEM, described in terms of the ratio of MW of DSP to MW of system peak demand, is not as high a percentage as is exhibited in other markets. This result could be taken as empirical evidence that DSP may be potentially under-utilised in the NEM at present.

Table 7: Comparative analysis of DSP in the NEM to that in other markets

Region	Pre-dominant Source of DSP	DSP Resource[1]
NEM	Wholesale price hedging and network peak DM (curtailable loads, and DGs)	280 to 340 MW(1% of peak demand)[2]
WA	Reserve Capacity (curtailable loads and DG)	153 MW[3] (4% of peak)[3]
UK	Short Term Operating Reserve (load reduction and back-up DG)	835 MW (35% of requirement)[4]
S Korea	Reliability-triggered DSP (interruptible tariffs, DLC)	2,700 MW (4.5% of peak)[5]
Italy	TOU pricing (mandated TOU roll-out)	10% of peak (expected) [5]
California	Reliability-triggered DSP (eg DLC, interruptible tariffs)	3,300 MW (6% of peak)[5]

Note 1.Based on published information.

Note 2. 2011 ESOO, and Futura standby generator estimate.

Note 3. Independent Market Operator. *2011 Statement of Opportunities*. 2010.

Note 4. http://www.ct.gov/dep/lib/dep/air/energy/isomay2908.pdf.

Note 5. Faruqui, A. *Energy Efficiency and Demand-side Management Programs*. 2011.

5. DSP Trials and Pilots and Emerging Initiatives

5.1 Introduction

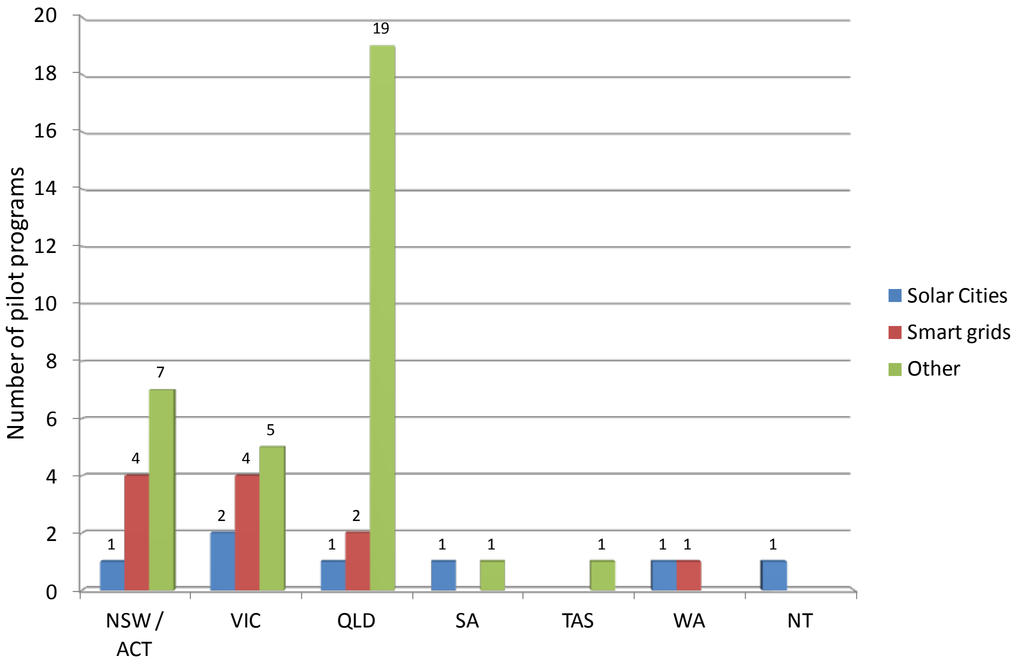
Section 5 provides a 'snapshot' of DSP opportunities that may be enabled in the near- to mid-term based on trials and pilots that have been completed and therefore provide impact and consumer load reduction response results. Recently implemented trials that demonstrate alternative DSP approaches, and emerging smart grid (and other) technology developments are also presented. The discussion highlights important lessons and findings to date from analysis and research conducted by the proponents of the pilots and trials.

5.2 Stocktake of Trials and Pilots

Currently, there are an estimated 50 DSP pilots and trials either completed, underway, or in the planning stage across Australia.

Figure 16 shows the distribution of trial activity by state and territory. Of particular note in this presentation is the high level of activity in Queensland, where funding from the state government's Energy Conservation and Demand Management initiative assists in underpinning the design and implementation of trials and pilots of DSP options.

Figure 16: DSP trials and pilots currently underway or in planning by location



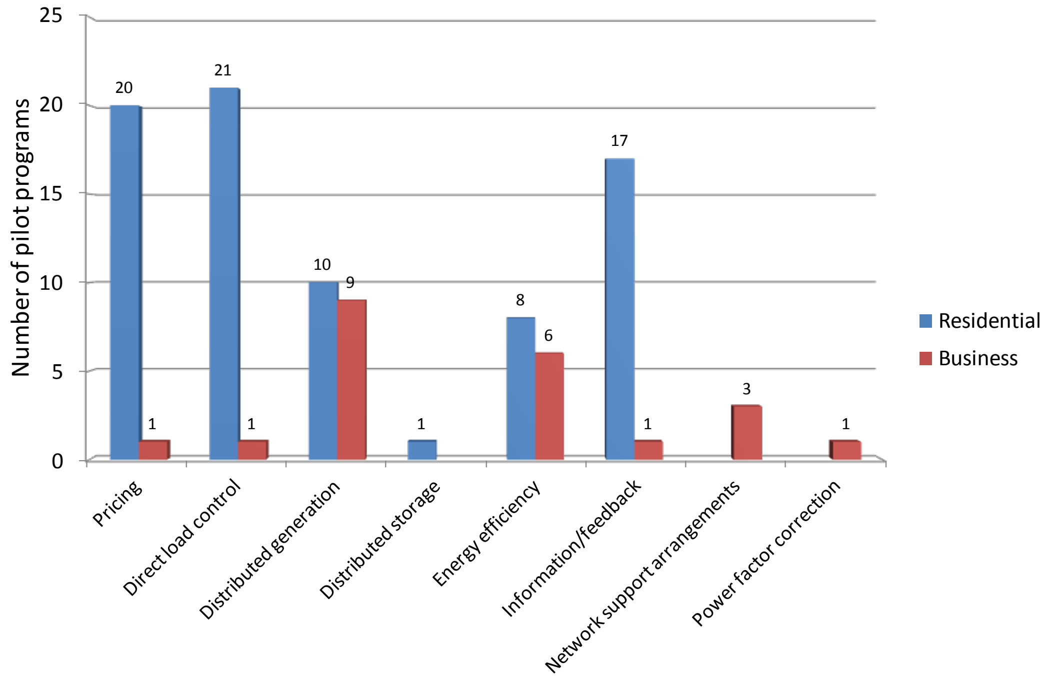
Overview level data used in this analysis, including the name of the pilot, the proponent, the sectors and end-uses targeted, and status are presented in Appendix A.

The presentation in Figure 16 includes the Solar Cities initiatives, smart grid projects, and a wide range of other DSP initiatives being implemented by NSPs or retailers. Most of these trials share common overarching objectives, which can be summarised as follows:

- evaluate consumer take-up of new DSP initiatives, and the reasons that consumers choose to participate in DSP pilots and trials;
- evaluate the peak demand reduction impacts (kW or kVA) and energy conservation impacts (kWh) of new DSP products and initiatives; and
- collect operational and cost data for accurate benefit cost analysis to inform business cases for potential full scale deployment.

Figure 17 provides an overview of the number of trials and pilots implemented to date, disaggregated by sector, and by DSP option or measure.

Figure 17: DSP trials and pilots currently underway or in planning by DSP type



In total, trials incorporating about 77 DSP measures targeting the residential sector and 23 targeting business consumers have been implemented, including:

- pricing trials involving TOU, STOU and DPP tariffs, and PTR incentives;
- DLC including trials mainly involving air conditioner, pool pump and water heating;
- information and feedback includes trials and initiatives involving IHDs, web portals and energy efficiency education delivered over the internet;
- home and business energy efficiency audits, and distribution of energy efficiency retrofit packs (CFLs, and low flow showerheads, for example); and
- network support arrangements including curtailable load, and embedded generation and pilots and initiatives being undertaken with business customers.

5.3 CASE STUDY RESULTS

Selected case studies are provided in the next section, for a number of trials and pilots with a substantial amount of documented information on energy and peak demand outcomes, and/or feedback on 'what worked' and 'what did not' from the perspectives of participating customers. The cost-benefit analysis for the trials and pilots reviewed for this study were considered to be confidential information by the program proponents; hence, no commentary is provided on this aspect in the discussion that follows. Appendix B provides additional detail on each of these case studies, and also provides the reference sources for the information and materials presented in Section 5.3.

5.3.1 Air conditioner DLC trials and pilots

Overview

Pilots and trials of DLC of air conditioners in the residential sector have been conducted by many of the DNSPs beginning in about 2006. Reported results from pilots and trials of DLC of air conditioners conducted by ETSA Utilities, Endeavour Energy (operating as Integral Energy), Western Power, and Energex are discussed below.[82]

ETSA Utilities implemented the business' first residential air conditioner DLC trial in 2006. The trial initially involved a modest sample of 20 participants from the Adelaide metropolitan area. Initial results were sufficiently favourable for the trial to be expanded in subsequent phases to about 2,000 residential and commercial participants in the suburbs of Glenelg, Mawson Lakes, Northgate, and the regional town of Murray Bridge. Customers were offered a once-off incentive payment of $100 to participate. The trials involved installing a 'Peakbreaker' external radio activated load controller to the external compressor of larger split and centrally ducted air conditioners.

Endeavour Energy implemented a residential air conditioner DLC trial in 2009 as part of the Blacktown Solar City project. The trial involved 529 participants selected from a sample of 1,500 customers who expressed interest in taking part. Participants received a $25 bill discount for allowing their air conditioner to be cycled on extreme temperature days over the summer period.

In 2010 Endeavour Energy implemented a 'commercial-scale' DLC air conditioner initiative, *Cool*Saver*,* as part of an integrated DM project to defer augmentation of the Rooty Hill 132/11 kV zone substation. The *Cool*Saver program targets customers who have a ducted air conditioning system with the AS 4755.3.1 DRED. Participants are paid $60 for taking part in the program each year for up to three years, and a free air conditioner service is also included as a 'sign up bonus' to entice customers to participate. A total of 11 customers participated in the first year. The three year target for the *Cool*Saver initiative is 200 participants in total.

82 Ergon Energy has also conducted a hybrid air conditioner-hot water DLC trial as part of their involvement in Townsville Solar City. The trial, which was conducted in an apartment complex at Bright Point in 2010 incorporated DREDs installed on 40 air conditioners and 60 hot water systems. Ergon Energy has reported average load reductions of 0.8 kW per participant from *combined* hot water and air conditioner load control. (Source: Townsville Solar City. *Annual Report 2010*, 2010).

Western Power launched an air conditioner DLC trial in 2010 as one of the initiatives in the Perth Solar City project. Participants in the first year were recruited by Synergy, through a mail-out campaign with an offer of $100 per participant for taking part over the first summer. The trial utilises an external DRED controller communicating via wireless through the Zigbee HAN and smart meter. The trial involved 203 residential participants over the first summer and is targeting a total of 375 participants over the two year trial period.

In 2007 Energex implemented the Cool Change air conditioner DLC trial in the northern Brisbane suburbs. The trial has run for the three past summers and as at early 2011 there were 1,480 residential customers and a total of 1,795 air conditioners with load control devices installed. The program utilised the existing AFLC ripple control system to issue the control signals on event days.

Table 8 summarises the key design features of the DLC trials and pilots.

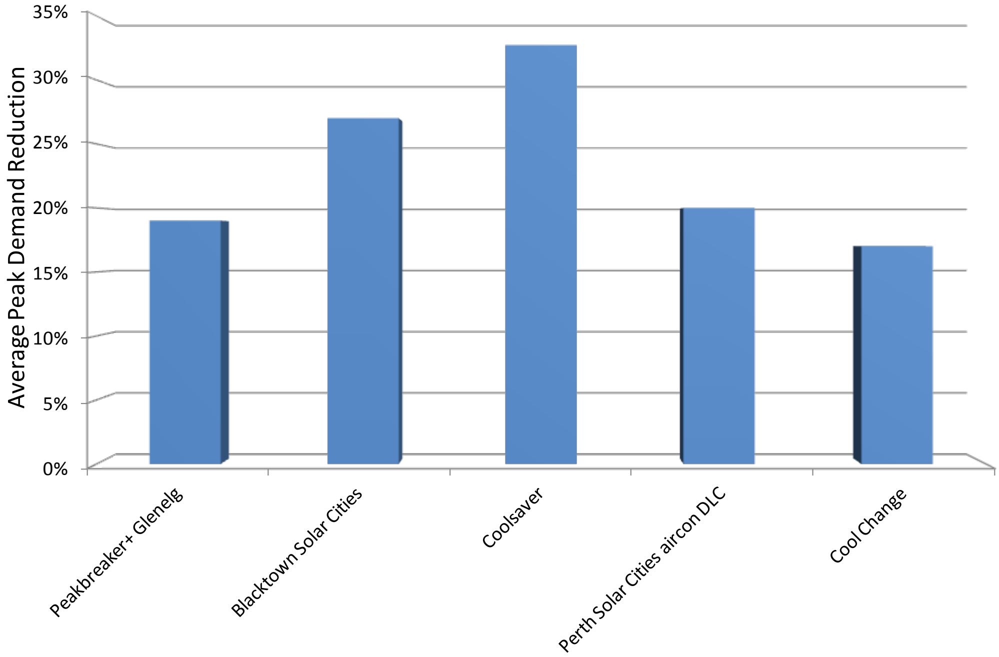
Table 8: Summary of air conditioner DLC pilots and trials

Pilot	Number of participants	Enabling Technology	Bonus Incentive	Dispatch Events	Dispatch criteria
Peakbreaker +	Approx 2,000	Peakbreaker unit, Interval meter	$100	n/a	n/a
BSC air con DLC	529	External load control switch, Ripple control, Interval meter	$25 bill credit upfront and $75 at end of the trial	12 max	Extreme temp days (hot)
*Cool*Saver	11	DRED enabled, retrofit kit, Enermet relay, Ripple control, Interval meter	$60 (plus $100 a/c service)	4	forecast high temps and load monitoring of network assets
Perth Solar Cities air con DLC	203 (year 1) 375 (year 2 target)	zigbee wireless HAN, external DRED, Smart meter	$100 (Year 1) raised $200 (Year 2) to increase take-up	10 max	> 35 deg C
Cool Change	1,480	External DRED, Ripple control, Interval meter	$60 gift card	11 (2009/10)	Extreme temp days (hot)

Outcomes and impacts

Results of the air conditioner DLC trials completed to date have provided estimates of the average unit load reduction (kW or kVA per participant), and the percentage reduction in household peak demand that has been achieved. Figure 18, on the next page, presents a summary of the outcomes for each of the trials as a percentage reduction in household peak demand.

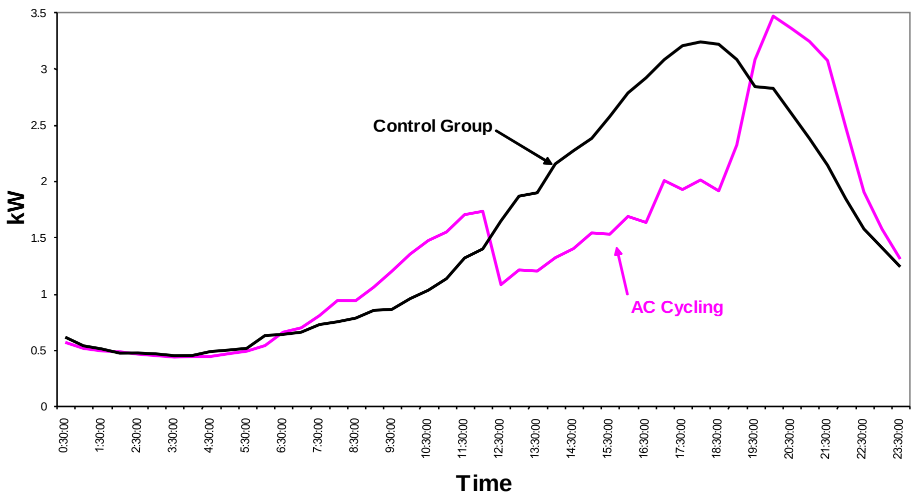
Figure 18: Average peak demand reduction of air conditioner DLC



In South Australia, ETSA Utilities found an average 19% reduction in peak demand (0.45 kW) from 68 households in the Glenelg area. To achieve this reduction the air conditioners were cycled 15 minutes off every 30 minutes over a 3.5 to 4 hour period commencing at 3:45 pm. Higher peak demand reductions of 1.34 kW per participant were achieved in Mawson Lakes due to targeting larger centrally ducted air conditioners.

The BSC trial achieved a 27% reduction in peak demand equating to an average demand reduction of 1.2 kW per participant. Air conditioners were cycled over a seven hour control period between 1pm and 8 pm on event days. Figure 19 provides illustrative load profiles for the air conditioner cycling and control groups during the dispatch event called on 14 January 2009.

Figure 19: Blacktown Solar Cities – impacts of air conditioner cycling 14 Jan 2009 (38.4°C)



Source: Endeavour Energy. *Customer Engagement in Smart Grid.* 2011.

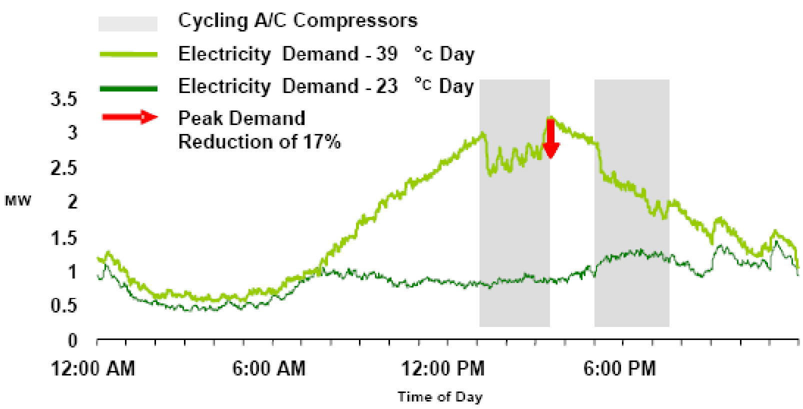
In Endeavour Energy's *Cool*Saver pilot all air conditioners were set to a 50% energy use reduction during the event period. First year results for the trial showed average demand reduction per participant of 1.3 kW or 32% compared to non-event expected hot day profiles between 2 pm and 7pm. Actual impacts were less than anticipated (2.5 kW per participant) because the capacities of the air conditioning equipment installed in participants' homes were smaller than expected.

The Perth Solar City air conditioner DLC trial conducted by Western Power has found average demand reductions of 0.6 kW per participant, equivalent to a 20% overall reduction in demand, over the first summer. Reductions were achieved by adjusting the air conditioner controls via the external DRED unit on a 15 minute 'on-off' cycle during the 3 to 4 hour event period from mid afternoon to the early evening.

Energex's Cool Change air conditioner trial found annual average demand reductions of 17% in 2007/08, 20% in 2008/09 and 13% in 2009/10. This equates to 17% demand reduction and 0.9 kW per participant averaged over the three summers of the trial.

Figure 20 illustrates the peak demand impacts achieved by the Cool Change trial on an extreme summer day.

Figure 20: Energex Cool Change trial impacts



Source: Energex. *Time for a Cool Change*. 2008.

In summary, and not withstanding differences in trial designs, climatic conditions and demographics, results to date of air conditioner trials conducted across Australia indicate an average of 23% peak load reduction, equivalent to about 1 kW of average load reduction per participant. Estimated total demand impacts based on participant numbers and unit peak demand impacts are presented in Table 9.

Table 9: Air conditioner DLC trial demand reduction results summary

Pilot	% reduction	Estimated per participant impact (kW or kVA)	Estimated trial impacts (kW or kVA)
Peakbreaker + (Glenelg)	19 %	0.45	30
BSC air con DLC	27 %	1.20	600
*Cool*Saver	32 %	1.30	15

Pilot	% reduction	Estimated per participant impact (kW or kVA)	Estimated trial impacts (kW or kVA)
Perth Solar City air con DLC	20 %	0.60	122
Cool Change	17%	0.90	1,300
Average	23%	0.97	n/a

Customer response

ETSA Utilities found that the level of customer interest and willingness to participate in the air conditioner DLC trials varied greatly across the trial locations, and that in some areas recruitment was somewhat problematic. For example, in Glenelg interest and take-up was significantly higher than in Mawson Lakes and Northgate. In addition, in some areas (Mawson Lakes and Northgate) only 20%of air conditioners were suitable to participate in the trials for technical reasons. Overall take-up for the trials was estimated at 10%, on average. Further, ETSA Utilities trials found that:

- importantly, the switching (cycling levels) trialled did not negatively impact on occupant's comfort levels;
  - for the Glenelg trial switching cycles of 15 minutes off every 30 minutes were able to be sustained without experiencing any change in their comfort levels within participant's homes, whereas at Mawson Lakes a less 'severe' switching cycle of 7.5 minute off every 30 minutes over 4 hours appeared to be the most acceptable to participants, and
- consumers in older houses with smaller rooms that heated up more slowly during a DLC event experienced fewer impacts on household amenity compared with more modern open plan homes with large rooms and expanses of glass.

In the BSC DLC trial Endeavour Energy had a 15% take-up rate for the program. Feedback from customers indicated that participation in the trial had been a positive experience, on balance:

- 60% reported being very satisfied with their involvement in the trial with only 8% indicating that they were expressly dissatisfied;
- 43% joined the trial to either save money, save energy, or receive an incentive payment, 30% joined because they were curious and wanted to learn more about the concept, while 17% joined for environmental reasons; and
- 69% of participants would re-sign if the program was offered again, and notably 61% indicated they would participate again even if no incentives were available.

Endeavour Energy approached more than 50 residential customers via telemarketing and 600 letter mail-outs with the aim of recruiting 50 participants for the *Cool*Saver trial, but achieved a final number of 13 participants (2 ultimately cancelled). This result was attributed to the lower than anticipated number of customers in the community with a suitable DRED enabled air conditioner. The mail-out campaign only achieved one participant due to the limited number of DRED enabled air conditioners. Further, the level of the incentive may not have been sufficiently high to compensate customers for perceived effects on comfort levels. One of the cancellations was due to the participant being elderly and the other due to the house becoming too hot.

Reasons for joining the *Cool*Saver program were similar to Endeavour Energy's findings for the BSC trial. Participants were interested in saving money on their electricity bills, gaining a better understanding of how much electricity they consume in their household and an opportunity to do something positive for the environment. To a lesser degree, participants were also attracted to the *Cool*Saver out of curiosity and wanting to be involved in a new initiative.

> *"I was only just looking at website and interesting reading all the brochures, thought it was something new, it was only available in the suburbs where I was staying. It was being controlled by Integral Energy; I did not have to think about it and received an SMS as to when it was going to happen." CoolSaver participant.*

Source: Endeavour Energy: *Peak Saver and Cool Saver Year 1 Evaluation Report – cut down.* 2011.

Overall, more than three-quarters of *Cool*Saver participants indicated that their experience in the trial had met their expectations. Consumers liked the automated aspect of having their air conditioner controlled remotely and felt this made it easy to participate in the trial. While the level of information provided about the trial was good, some participants did not understand that events would typically be called on the hotter days. One fifth of participants noted that it was too hot during events and that reducing the output of the air conditioner by 50% made it too uncomfortable. Some participants were also concerned about DLC events occurring on consecutive days. Receiving prior notification of an event and better information on the impact of the control of their air conditioner on comfort levels were suggestions put forward on how to improve the program.

> *"They said that you won't notice any difference in the running of your ac and the temperature in the house but we certainly did." CoolSaver participant.*

Source: Endeavour Energy: *Peak Saver and Cool Saver Year 1 Evaluation Report – cut down.* 2011.

Western Power found that the incentive payment of $100 offered in the first year of the Perth Solar City air conditioner trial was too low to attract sufficient take up to meet the planned number of trial participants. The incentive payment is to be increased in the second year to $200 to help improve the participation rate. There were no customer complaints or concerns received from participants related to comfort conditions during DLC events over the first summer. However, internal temperature measurements will be taken in the second year of the trial to obtain actual data on the change in internal comfort conditions and the impact on participants.

The Energex Cool Change trial achieved a take up of 14%. Energex has found that just over half (52%) of consumers were motivated to participate as an opportunity to reduce their household electricity bills and save money.

In regards to comfort levels associated with controlling air conditioners, surveys conducted throughout the trial period have found that 94% of participants did not feel a significant impact to their comfort levels during air conditioner cycling periods.

> *"Everything has been perfect, haven't noticed at all. There has been no cut back in power, cooling or drag on the system. It's like it has never been done." Cool Change participant.*

Source: Energex. *Time for a Cool Change*. 2008.

Participants were generally very satisfied with their involvement in the trial with very few complaints received overall (7%). Of the small number of complaints received, 70% were later found to have been unrelated to the trial and mostly associated with existing technical faults or defects with the air conditioner. Almost all participants (90%) expressed a willingness to participate again with 88% reporting they would refer family and friends to the trial.

Energex also found useful insights regarding consumers' preferences on the structure of the incentive that would encourage participation. Choice modeling shows that consumers have a preference for incentives based on *ongoing* cost savings on their air conditioner use or their bill such as lower tariffs with no upfront costs for shifting to a new tariff, over once off vouchers, cash rebates or fixed bill discounts.[83]

5.3.2 Pool pump DLC trials and pilots

Overview

Pilots and trials of DLC of pool pumps have been conducted by Endeavour Energy (operating as Integral Energy), and Energex.

Endeavour Energy implemented a pool pump DLC trial in 2009 as part of its BSC project. The trial involved 642 participants selected from around 900 customers who were initially recruited to take part in the trial. Participants received a $25 bill discount for allowing their pool pump to be turned off by a 'thermaswitch' timer device on extreme temperature event days over the summer period between 1pm and 8pm.

In 2009, Energex expanded the Cool Change air conditioner trial to include switching of pool pumps. The pool pump trial has been operating for two summers and currently has 400 'PeakSave' switching devices installed at participating households. The 'PeakSave' device receives a signal from the AFLC ripple control system on event days to switch the pool pump off for up to three hours at a time between 4 pm and 8 pm, but participants can override the control for up to an hour over the peak period, if needed. Pool pumps were cycled on eight occasions over the 2009/10 summer and seven occasions over the 2010/11 summer.

83 Energex. *Energy Conservation and Demand Management*. 2011.

Based on the findings of the Cool Change trial, Energex has subsequently incorporated pool pump DLC into its large scale integrated community engagement initiative – Energy Conservation Communities (ECC). The trial, which was launched in 2010 in Brisbane's western suburbs, encourages participants to consider a range of actions to help mitigate the impacts of air conditioners, pool pumps, and electric water heating at peak times. Pool pump DLC participants receive a $250 gift card to either permanently switch their pool pump to off-peak, install a 5 star energy efficient pool pump or install a 'PeakSave' energy management device. Participants that elected to have the 'PeakSave' switch installed had their pumps cycled on seven occasions over the 2010/11 summer.

Table 10 outlines the key design features of these pool pump DLC trials and pilots.

Table 10: Summary of pool pump DLC pilots and trials

Pilot	Number of Participants	Enabling Technology	Bonus Incentive	Dispatch Events
BSC pool pump DLC trial	642	'Thermaswitch' load control switch, ripple control, interval meter	$25 bill credit up front and $75 at the end of the trial	12 max
Cool Change pool pump trial	400	'Peaksave' switch, AFLC control, interval meter	$60 gift card	7 (2010/11)
ECC pool pump trial	610	Off-peak tariff, 'Peaksave' switch, or 5 star energy efficient pump, interval meter	$250 gift card/voucher	7 (2010/11)

Outcomes and Impacts

The pool pump DLC trials conducted to date have provided estimates of the range of peak demand reductions that are potentially achievable from this DSP initiative.

The BSC pool pump DLC trial achieved average demand reductions of up 36%[84] in household peak demand and an average demand reduction of around 1 kW per pool pump relative to a non event day.

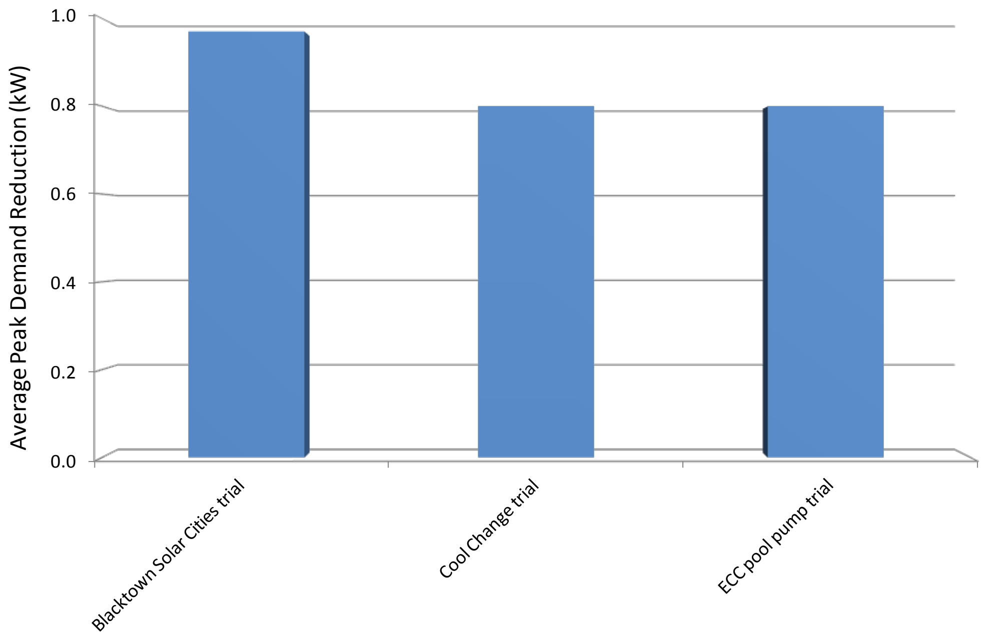
Energex's Cool Change pool pump DLC trial has found average peak demand reductions of about 0.8 kW after diversification from the 400 pool pump 'Peaksave' load control devices installed. The ECC pool pump trial found similar annual average demand reductions of 0.8 kW[85] from about 610 pool devices installed.

84 Results are for the 6 Jan 2009 pool pump control event day relative to the demand profile of a non pool pump control event day.

85 Note this value is under review and to be verified by Energex. The control devices installed in pools in the Cool Change and ECC trials are the same.

Figure 21 presents a comparison of the typical peak demand reductions per pool pump for each of the trials discussed in this section.[86]

Figure 21: Average peak demand reduction of pool pump DLC



Order of magnitude results for the total impacts achieved by the trials estimated by Futura's project team based on participant numbers and unit peak demand impacts are presented in Table 11.

Table 11: Pool pump trial demand reduction results summary

Pilot	Estimated per participant impacts (kW or kVA)	Estimated trial impacts (kW or kVA)
BSC pool pump DLC	0.97	620
Cool Change pool pump trial	0.8	320
ECC pool pump trial	0.8	490
Average	0.86	n/a

86 Note that data on peak demand impacts of pool pump DLC as a percentage of total household demand was not available for all the pool pump trials discussed in this section and therefore data is expressed in kW units only.

Customer response

Overall, the response from participants in the BSC pool pump DLC trial was very positive. Consumer research conducted with participants following the trial found results not too dissimilar to the air conditioner DLC findings in that:

- 72% of trial participants were very satisfied with their involvement in the trial with only 8% of participants reported being dissatisfied;
- 50% of participants joined the trial as a way of either saving money, saving energy or receiving an incentive payment; 32% joined because they were curious and interested in being involved in something new, while 10% joined for environmental reasons; and
- 76% would be willing to participate again, with more than 50% indicating that they would participate again even if no incentives were offered.

The Energex Cool Change trial also found high levels of satisfaction amongst participants, with 90% of participants indicating that they would be willing to participate in future. Further, 59% of participants permanently changed their pool filtering time, to mostly outside of the peak demand period as a result of their involvement in the DLC trial.

> *"At no stage have I ever had to think about the trial. That may sound odd but it's been a pleasure, absolutely zero problems or hassles. It's nice to be involved in something that's having a positive impact without having major side effects." Cool Change participant.*

Source: Energex. Cool Change Newsletter. 2010.

A flow-on effect of the Energex trial was that participants felt more educated about peak demand as an issue, and that the trial had made them think more generally about how they could save electricity around the home.

5.3.3 TOU tariff trials and pilots

Overview

Ausgrid (operating as EnergyAustralia) initiated an Advanced Metering Infrastructure (AMI) trial in 2006 that included the roll-out of 3,000 interval meters. The trial had a number of components and objectives. One of these, the customer research program, aimed to engage customers in energy matters and usage decisions by providing them with timely price signals and increased awareness of their consumption patterns. A second component of the trial was to attain operational improvements through remote meter reading and control. Providing a solution for the next evolution of DLC services, including hot water management was the third component. The fourth was facilitating the replacement of aging meters.

The customer research program was split into three phases. Work on phases 1 and 2 had been completed at the time of writing this report and included:

- phase 1 – assessing the effectiveness of TOU pricing relative to time-invariant Inclining Block Tariff (IBT) tariff pricing from a network perspective; and

- phase 2 – gaining an understanding of consumer's general preferences for alternative retail pricing structures using choice modeling.

Outcomes and impacts

Phase 1

During the rollout of the interval meters for the AMI trial some customers remained on IBT prices for a period of time before being transferred to TOU prices. Analysis of the 'before and after' meter data enabled a comparison between the consumption patterns of residential and small business customers on IBT and TOU tariffs to be made. This analysis was based upon interval consumption data collected from meters in the Ausgrid network in the period Winter 2006 to Winter 2009.

The analysis was based on the concept of a normalised CMD. A customer's CMD, as used in the Ausgrid analysis, was defined as the customer's half hour interval electricity consumption during the half hour interval when either the system or the customer's local zone substation has its seasonal maximum demand interval. Normalised CMDs were calculated using the seasonal average daily load for each class of customers (TOU or IBT) as the normalising factor. The normalisation procedure was used to correct for bias arising from the difference in the average size of the IBT and TOU customers, resulting from the program of interval meter roll-outs.

The study found that residential customers on the TOU tariffs reduced their normalised coincident maximum demand by about 4%, on average, compared with IBT customers. Interestingly, the impact on residential demand during peak tariff periods was greatest for customers who had been on the TOU tariff for the shortest amount of time, and was seen to reduce for customers who had been exposed to the tariff for longer periods.

The analysis did not find any statistically significant reduction in peak period demand for business customers on TOU tariffs compared with IBT customers.

Customer response

Phase 2

The phase 2 customer choice survey and modeling (which allows for consideration of the trade-offs between different attributes within a pricing structure) collected data from over 1,000 residential customers and 340 SMEs. The customer survey demonstrated a positive reaction to the new pricing concepts if there were compensating benefits. Notably, large numbers of both residential and SME customers indicated a willingness to change pricing structure in for savings of between 10% and 20%. In addition, survey participants indicated that the provision of information via an IHD was not critical; however, some form of website/portal would be important to ensure consumers are continuously kept up to date informed about their consumption.

5.3.4 STOU and DPP tariff trials and pilots

Overview

Essential Energy (operating as Country Energy), Endeavour Energy (operating as Integral Energy), and Ausgrid (operating as EnergyAustralia) have completed STOU and DPP trials, for which reported results are summarised below.

Essential Energy commenced the Home Energy Efficiency Trial (HEET) in December 2004 with 150 residential customers. The trial, which was the first in Australia to pilot DPP tariffs, was conducted in Queanbeyan and Jerrabombera – chosen because of climatic conditions and broad demographic spread. Participating customers received notification by email, SMS and a message to the IHD of a CPP event up to 24 hours prior to the event (a minimum of 2 hours notification was provided). The CPP rate of $0.38 per kWh was about five times higher than the off-peak rate of 7¢per kWh.

The WSPT developed by Endeavour Energy, included some 900 customers across three tariff treatments that included STOU, DPP, and DPP with an IHD, plus a control group of 340 customers. All customers in the treatment groups were provided with a web interface to enable them to see details of their electricity usage. Endeavour Energy installed an interval meter with two-way communications in participating customer's homes, while IHD monitors were provided to approximately half of the DPP participants. Customers on the DPP tariffs were notified in advance of a pending CPP event by automated voice message, SMS text message, or email message. Over the two year period of the WSPT, critical peak events prices averaged about 154¢ per kWh, while off-peak rates were 10¢ per kWh. Endeavour Energy's BSC DPP trial tested DPP pricing in the residential sector.[87]

Ausgrid initiated the business' Strategic Pricing Study in 2005. The SPS trial included 1,300 voluntary customers (42% business, 58% residential). The pilot tested STOU, DPP, and information-only tariffs, and involved the use of IHDs and online web access to consumption data. Under the DPP trial, customers paid less (about 6¢ per kWh in the off-peak or about 8¢ per kWh in the shoulder period) for their electricity, except when a peak demand event DPP was called. Electricity prices then increased to $1 per kWh (DPP Medium) or $2 per kWh (DPP High1 and High2) for the four hour peak period. DPP dispatch notifications were sent to participants through SMS, telephone, email, or the IHD.

Table 12 provides further information on the key design features of these STOU and DPP trials and pilots.

Table 12: Summary of DPP trials and pilots designs

Pilot	Number of Participants	Enabling Technology	Bonus Incentive	Dispatch Events	STOU or DPP Ratio
Heet DPP	150 residential	IHD Smart meter	$40 per Qtr	Max 12 summer and winter	5 x Off-pk
WSPT STOU	295 residential	Web interface Smart meter	$100 Join $200 Complete	n/a	Pk/Off-pk = 3
WSPT DPP 1	373 residential			Max 12 summer and winter	CPP = 20 x Off-pk
WSPT DPP 2	356 residential	Web interface IHD Smart meter			

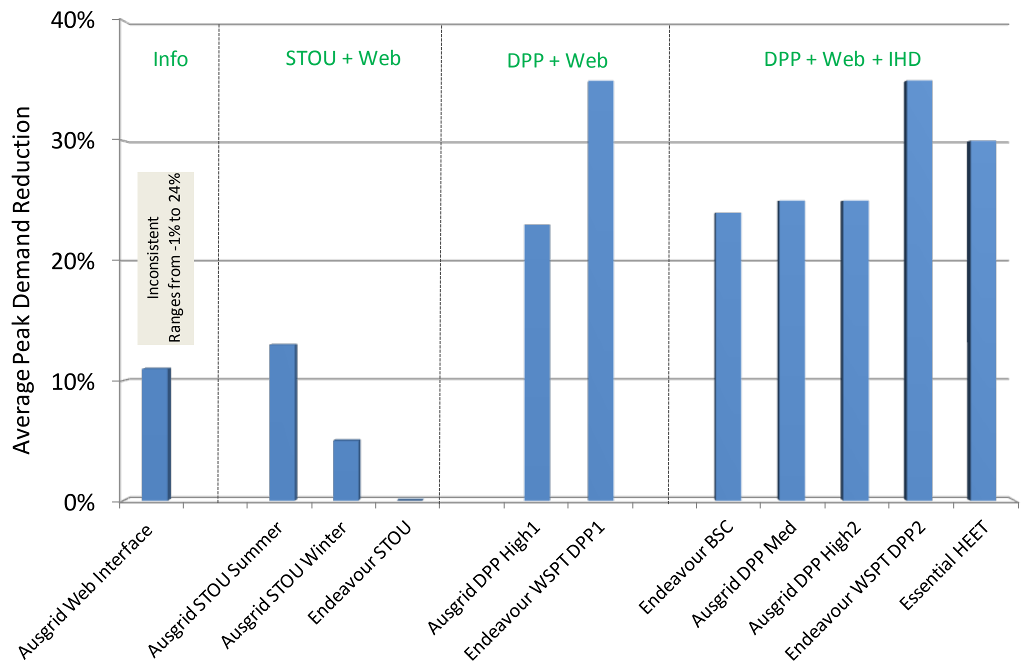
87 Additional public domain information on this trial is very limited, and a full case study has not been prepared.

Pilot	Number of Participants	Enabling Technology	Bonus Incentive	Dispatch Events	STOU or DPP Ratio
SPS Information	750 residential 550 business	Web interface Smart meter	$100 Join $200 Complete	n/a	n/a
SPS STOU				n/a	Pk/Off-pk = 6
SPS DPP High 1				Max 12 summer and winter	31 x Off-pk
SPS DPP Med		Web interface IHD Smart meter			13 x Off-pk
SPS DPP High 2					31 x Off-pk
BSC DPP	Varied 264 residential at completion	Web interface IHD Smart meter	$25 Join $100 Complete	Not published	Not published

Outcomes and impacts

A summary of the peak demand impacts, in terms of percentage average peak demand reduction, from each of the trials discussed above is presented in Figure 22.

Figure 22: Peak demand reduction results of STOU and DPP trials and pilots[88]



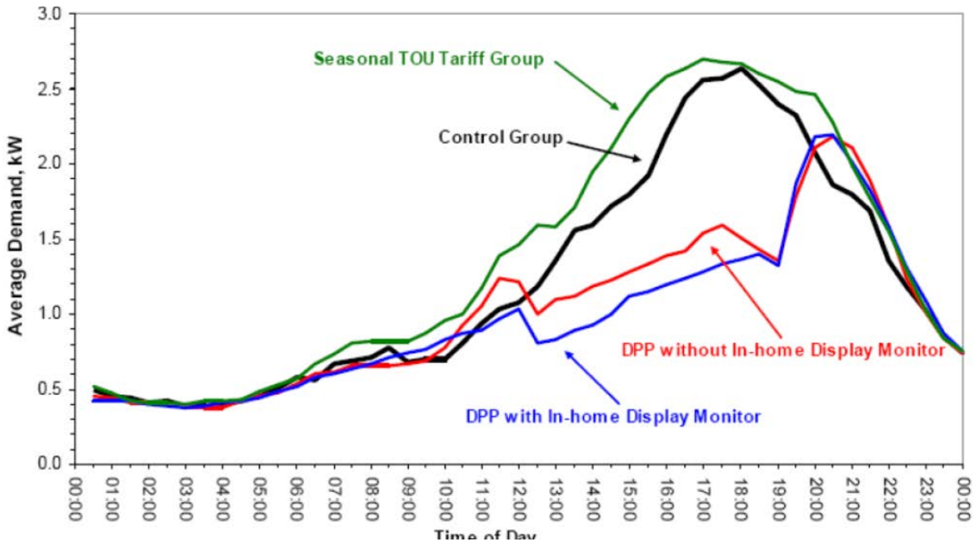
88 Ausgrid's SPS trial showed peak demand reductions of 36% in summer and 30% in winter during CPP dispatch events on specific days with extreme temperatures. These are not shown on Figure 22, which presents 'average' peak demand reduction responses.

Essential Energy found that it achieved a 25% reduction in demand on DPP days and an 8% reduction in overall energy consumption, representing a conservation effect.

Endeavour Energy's WSPT found the peak demand of participating customers was reduced by around 30% to 40%, with an average of about 35% (this percentage decrease equates to unit household reduction of approximately 1 kW). The reduction of household peak demand was found to be quite consistent across the duration of the dispatch time and the ambient temperature over the 23 DPP events called during the trial. Consistent with the Essential Energy result, the WSPT also found a conservation effect; notably, the energy consumption of the of DPP participants was about 3% lower than that of the control groups during dispatch events. Results for the STOU group were not readily quantifiable, as the STOU customers started out with total usage 6% higher than the control group's customer usage, masking the ability to compare usage patterns between the two groups. The trial did not find a statistically significant difference in the peak demand reduction for the DPP group with the IHD (41% reduction) compared to the DPP group with only a web portal (37% reduction). In fact, the impact of the IHD was found to reduce over time – 85% of participants had it plugged in at the start of the trial – this reduced to 58% as the trial progressed.

Figure 23 demonstrates the change in electricity usage patterns brought about by the DPP tariffs coincident with the summer system peak network loads.

Figure 23: Customer response to WSPT DPP trials



Source: Integral Energy. *Outcome of Integral's Pricing Trial*. 2008.

Results for Endeavour Energy's BSC DPP trial were generally in agreement with the impacts for the WSPT. Peak demand reductions from households were 24%, on average.

The key findings regarding impacts on consumer's peak demand from Ausgrid's multi-faceted SPS trial, included:

- the average peak demand savings for residential customers participating in the DPP trial were about 23% to 25%;
  - owing to the mild summer conditions experienced over the trial period, some CPP events occurred on days with relatively mild temperatures that are likely to be atypical of 'normal' summers,
  - the 'average' peak demand reductions therefore are potentially lower than what could be achieved under CPP dispatches during higher temperatures,
- in support of this observation, peak demand for residential customers on the trial was reduced by 36% and 30% in summer and winter, respectively, during specific extreme temperature CPP events; and
  - customers with air conditioners had a greater ability to respond to DPP events, mainly through energy conservation during the peak period,
- residential customers participating in the STOU trial achieved overall reduction in peak demand (not specific events) of 13% and 5% respectively.

The small business customers (5MWh to 160MWh per annum) showed no statistically significant response to the DPP tariffs during the trial.

Customer response

Essential Energy noted that customer education regarding their energy use and how to manage it was critical to achieving peak demand impacts from the HEET. Further, the trial demonstrated that energy use information needs to be presented in a simple, direct format, avoiding the use of industry jargon. A single point of contact for answering questions and handling complaints is also important.

Feedback from customers indicated that participation in the HEET had been a positive experience:

- over 95% believed their energy efficiency awareness levels had increased, and stated they were making conscious decisions about when to use energy, and indicated that they would continue to use the trial equipment if the option was available to them once the trial concluded; and
- customers also indicated that they were continuing to use their IHD to get cost and consumption information following conclusion of the trial.

According to Endeavour Energy's analysis most participants saved money, and on average, received a bill saving of about $200 compared to their normal time-invariant tariff (savings were consistent across income bands). Anecdotal feedback regarding customer's reactions to the WSPT trial was both positive and negative. On the positive side, customers realised that discretionary uses like washing and drying clothes, or doing the dishes, could be shifted to off-peak periods, so the DPP tariff offered an opportunity to save them money. There was also an indication that consumers could relate timely information on energy use to future bills. Negative comments on the trial related to the frequency of CPP dispatch events in winter being too close to each other, and short notification times not providing sufficient time to prepare for a CPP dispatch event.

Customers were paid a large incentive ($100 join/$200 complete) to participate in Ausgrid's trial; however, the business found that even with such a substantial incentive only about 10% consumers invited took up the offer.

Regarding information provisions to consumers the results of Ausgrid's SPS trials found:

- information only did not provide any consistent results with peak demand reductions from this group ranging from minus 1% to 24%;
- 30% of the customers with IHDs never attempted to switch them on, despite efforts to encourage them to do so (interestingly, customers who had an IHD were more likely to utilise the web portal); and
- there was no measurable difference in peak demand reduction between customers with IHDs and those without.

5.3.5 PTR trials and pilots

Overview

Australia's first (and only at this time) PTR program, the *Peak*Saver was implemented by Endeavour Energy during the 2010/11 summer as part of a DSP program to defer augmentation of the network's Rooty Hill zone sub-station. The *Peak*Saver program is voluntary opt-in, and participants choose what end use(s) they curtail in response to a dispatch event call. Participants receive a peak time rebate reward of $1.50 per kWh of energy saved below their calculated baseline (energy not consumed), up to a cap of $50 per dispatch event day.

Outcomes and impacts

The results showed positive participation from *Peak*Saver customers and higher than expected kVA average peak demand reduction per participant (1.7 kVA per household as compared to an estimated 1.0 kVA per household). An explanation provided by Endeavour Energy for the *Peak*Saver result is a high level of participant buy-in to the program. Average peak period reductions compared to baseline ranged from 29% to 51% of household load over 4 dispatch events.

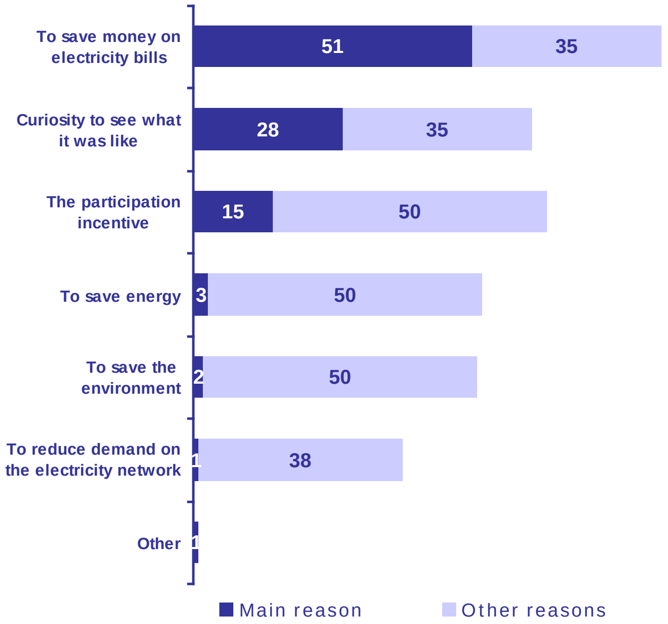
Research with program participants indicated that *Peak*Saver received a satisfaction rating of 77% and no material complaints. Customers were happy with the program and actively participated:

- 87% of participants took action to reduce their electricity use during peak period dispatch events, such as;
  - 'going out' to avoid using the air conditioning and electric cooking appliances, and
  - Shifting discretionary loads like pool pumps, dishwashers, clothes washers/dryers, etc to out of peak periods.

Customer response

The main reasons customers gave for participating in the *Peak*Saver program, as illustrated in Figure 24, were to save money, satisfy their curiosity, and the participation incentive.

Figure 24: Reasons for participation in Endeavour Energy's PTR program



Source: Endeavour Energy. *Customer Engagement in Smart Grid.* 2011.

Customer engagement lessons learned included:

- clear, honest messages regarding the program objectives is key, as is minimising the complexity of processes involved in signing up and participating;
- customers did not understand the link between PeakSaver dispatch events and very hot days suggesting that the context for the operation of the program (notably the constraints surrounding the use of electricity in peak demand period) and its objectives to alleviate these constraints are not understood by consumers; and
- customers wanted information on ways to reduce consumption on dispatch event days, particularly if they had received a low reward bonus for the preceding event.

Customer feedback also suggested that the *Peak*Saver did not appeal to those who are already energy efficient because they felt they could not save more energy and therefore would not receive a *Peak*Saver bonus.

5.3.6 Hybrid pricing trials and pilots

Magnetic Island peak demand reduction

Overview

As part of the Townsville Solar Cities project, in October 2010 Ergon Energy implemented an 18 month peak demand reduction trial on Magnetic Island to investigate a range of pricing initiatives designed to reduce peak demand and improve the efficient utilisation of the electricity network. An interesting aspect of this trial is the aim of evaluating the effectiveness of cost reflective pricing to get consumers to reduce their energy consumption between 6 pm and 9 pm *each day* over the trial period.

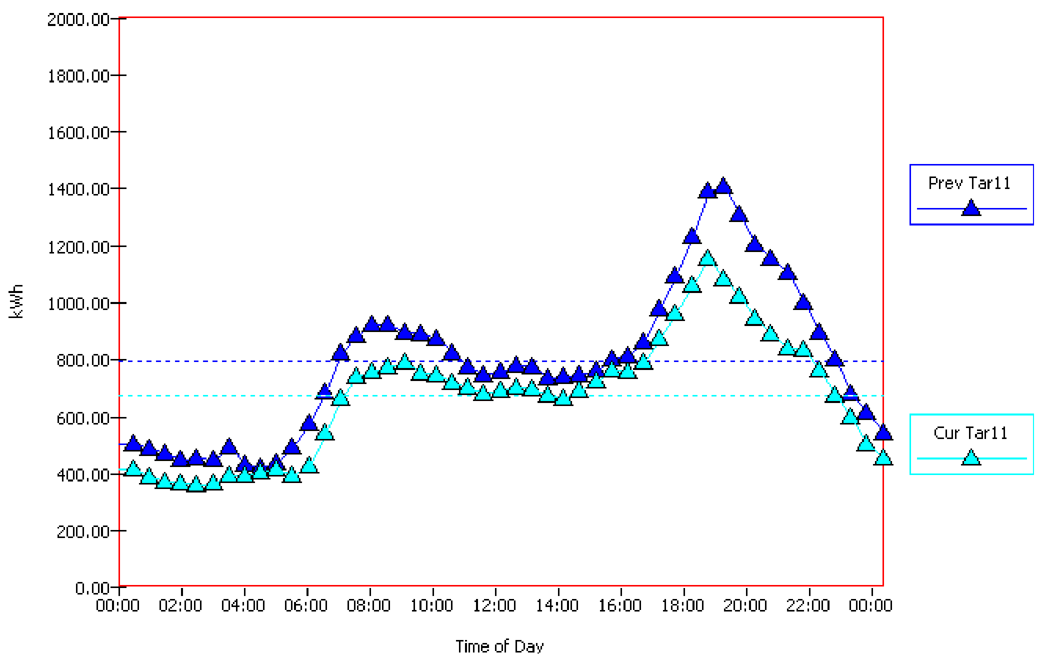
Smart meters and IHDs have been installed in just over 80 high energy using residences, and a baseline usage profile for each customer representing their electricity usage prior to joining the peak demand reduction program prepared. Rebates of up to $25 per month are offered to households that reduce their electricity consumption by at least 15% over the peak demand hours of 6 pm and 9 pm, with additional rebates available to households that sustain the reduction for three months.

Outcomes and impacts

The cumulative results for June 2011 for the trial participants show a total peak consumption reduction of 1,649 kWh or 23% over the 6 pm to 9 pm peak period.

Figure 25 depicts the change in the shape and magnitude of the daily peak load profile as a result of the trial.

Figure 25: Preliminary result for Ergon Energy's peak demand reduction trial



Source: Ergon Energy. *Peak Demand Reduction Trial.* 2011.

Customer response

Analysis of customer experiences will be undertaken at a later stage in the trial.

Rewards based tariff consumption

Overview

Energex and Ergon Energy's collaborative Rewards Based Tariff Consumption trials are also a new approach that are successfully using cost reflective prices to manage peak demand in the residential sector.[89]

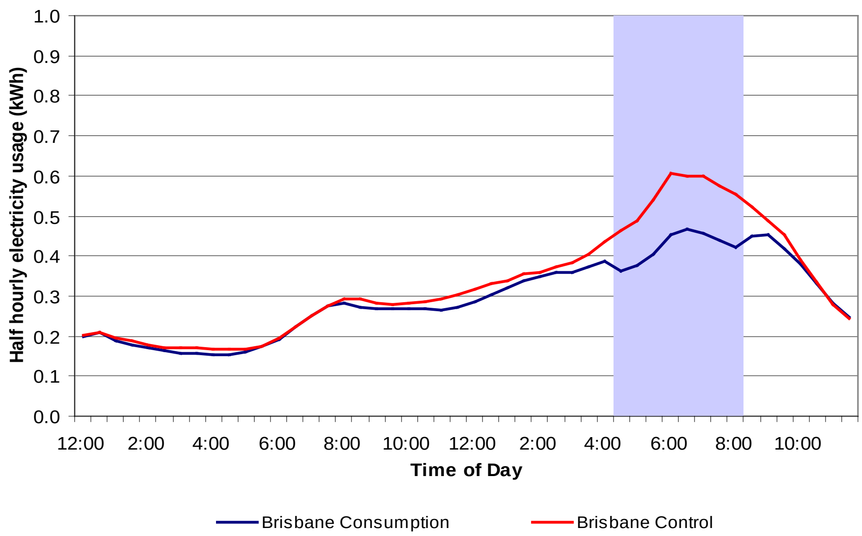
The trial (which at present is paper-based) consists of two components:

- a CPP rate that is 5 to 8 times higher than the general use flat T11 tariff that is dispatched on 15 peak days per year, in combination with an off-peak TOU rate that gives a 20% discount on the T11 rate; and
- a PTR incentive to reduce consumption based on a $75 bonus at the start of the year that rises/falls according to usage below/above set thresholds and 'theoretical DPP' prices.

Outcomes and impacts

The DPP trial demonstrated that customers are willing to change their behaviour in response to dynamic peak pricing signals, and has successfully reduced household peak demand for electricity. To illustrate, peak demand capacity requirements for participants in Brisbane (which is one of three trial areas) showed average decreases of 21% at the 6 pm peak over 5 summer and 2 winter day peak period dispatch events. Figure 26 provides the average load reduction profile for these events in comparison to the profile for the control, or non DPP customer group.

Figure 26: Average load reduction for Rewards Based Tariff trials in Brisbane



Source: Energex. AEMC *Rewards Based Tariffs Project. 2011.*

89 Energex. *Australian Energy Market Commission Rewards Based Tariffs Project.* 2011.

The trial has also demonstrated that it is possible to reduce peak demand by reducing other than base load energy use. For those customers that were unwilling to stop using their air conditioners during peak demand periods on hot summer days, they do appear to be willing to reduce their peak demand by electing to shift chores such as dishwashing, clothes washing and drying, and vacuuming out of the peak period.

The preliminary results for the TOU tariff were inconclusive with only a small amount of data collected and with a variation of only 1% to 3% of electricity use from the peak to the off-peak period.

Customer response

Early reports from participants have been positive, with little or no negative feedback: received:

- most found it easy to keep usage below the peak day thresholds; and
- many made permanent changes to day to day energy use habits.

In-depth market research and analysis will be used to explore customer opinions regarding their experiences in the trial, in future.

5.3.7 Peak demand load limiting

Overview

ETSA Utilities, in a joint initiative with the Land Management Corporation (LMC), piloted a load limiting demand management (DM) trial at Lochiel Park in South Australia.

The concept for the trial was a project based on the use of evaporative air conditioning installations of up to 2 kilovolt-amps (kVA) per household in place of reverse cycle air conditioning. As part of the LMC's proposal, ETSA Utilities was to develop a load management system which would be deployed and trialed on the site. The system was to be able to preset to an agreed maximum peak demand of up to 6 kVA per household allotment and to actively monitor this demand. If this preset level was breached, then the system would automatically turn off selected electrical circuits in order to avoid the peak demand level being exceeded. The circuits targeted for control included the air conditioner, wall oven and other non essential power circuits. A 'capacity based' tariff was developed that would result in consumers making savings on their electricity bills when compared to the time-invariant general use tariff provided they limited their household's demand to 6 kVA or less.

This trial was intended to have the load limiting devices installed in approximately 106 new homes in the Lochiel Park development, with the specific aims of:

- testing customer acceptance of load limitation;
- developing expertise in the design of load limitation tariffs;
- developing appropriate load limiting technology for deployment in South Australia; and
- assessing the potential for the widespread use of load limiting technologies and tariffs in the residential sector in South Australia.

Outcomes and impacts

Progressively the design specification for the Lochiel Park development was altered to allow for the installation of reverse cycle air conditioning. Over time the maximum demand for the air conditioners was changed from less than 2 kVA per home to 4 kVA and finally, allowed to be specified on the basis of dwelling size. As a result of these increases, load limitation was abandoned as being a viable option for the development because on extreme summer days the load limiting device to an individual allotment would be almost constantly switching circuits thus becoming more of a hindrance than a help to the homeowner.

ETSA Utilities was of the view that DSP based on load limitation could work within the context of a smart grid, stating that:

> *… systems can be put in place that respond to simple instructions given by consumers of their power demand preference profiles. With this preference profile in the background, energy is managed to save money and reduce the impact on the grid. Trials in the US have indicated that consumers saved approximately 10% on their electricity accounts. More significantly, peak load was reduced by 15%, bringing the constrained regional grid another 3-5 years of peak load growth and enabling the installation of cleaner, more efficient technologies for electricity supply.*

Source: ETSA Utilities. *Demand Management Program Interim Report No.3.* 2010.

5.3.8 Community based social marketing energy efficiency trials

Living Smart

Overview

Living Smart works directly with Western Australian households to reduce their electricity (and gas and water) bills, and be part of the solution to climate change. The program is an innovative CBSM behaviour change initiative that is part of the Perth Solar City initiative.[90] The specific objective of the program was to reduce the CO_{2e} emissions of program participants by one tonne per household per year.

Living Smart uses an individualised marketing approach to households, and tailors local community information, uses motivational dialogue, and provides encouragement and feedback to participants. The program starts with a letter and a phone call to assess the individual requirements of each household. Participants then choose from a menu of actions to address and are supported over the next year. Key features include:

- home delivery (by hand) of simple, practical ‘how to’ information;
- coaching calls and follow up telephone support;
- water, electricity and gas meter readings interpreted against the average suburb use and best practice use of the season;

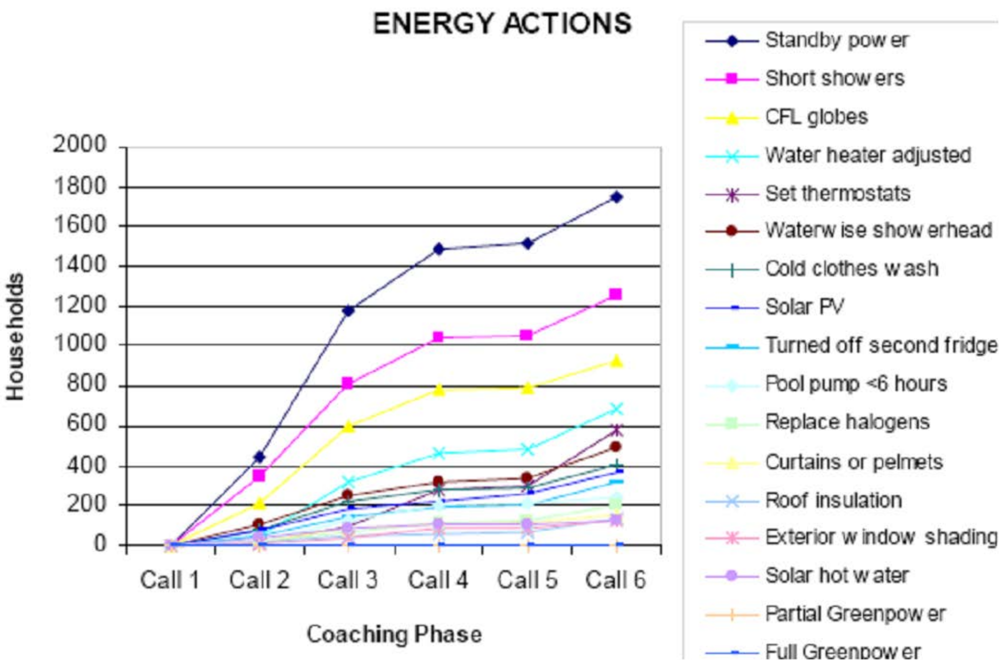
90 Energex and Ergon Energy are also employing CBSM techniques to increase the energy efficiency of consumers on their networks. Appendix B provides a case study of Ergon Energy’s project.

- home consultations to improve energy and water efficiency; and
- community workshops on sustainable living.

Outcomes and impacts

Through the Living Smart program over 6,000 householders in the Perth area have realised energy use reductions of some 9% per day, demonstrating the large CO_{2e} abatement potential that exists in households. Figure 27 provides an overview of the diversity of energy efficiency measures implemented by participants over time, and with increasing numbers of follow-up coaching calls.

Figure 27: Energy efficiency behaviours adopted by Living Smart participants



Source: Government of Western Australia Department of Transport. *Living Smart Households (Sustainability program) – Monitoring and Evaluation.* 2011.

Customer response

Community response to the program was very positive. Some comments from participants that express their reaction to the program follow.

> *"I have loved every minute of the Living Smart initiative. It has been an exciting project in terms of helping us to save money and it helps the environment."*
>
> *"Fantastic project! I've never had such low power bills. It really raises awareness."*
>
> *"Living Smart made me more aware of not taking long showers and not leaving lights on…It's a great initiative and everyone should have the chance to have what I had." Living Smart participants.*

Source: Government of Western Australia Department of Transport. *Living Smart Households (Sustainability program) – Monitoring and Evaluation.* 2011.

Townsville Energy Sense Community

Overview

Ergon Energy is in the process of implementing the Townsville Energy Sense Communities initiative. The project draws on knowledge, expertise and learnings derived to date from various energy conservation, demand management and technology innovation trials conducted by Ergon Energy and apply these to a suite of initiatives in order to defer the construction of several network infrastructure projects. The project will integrate smart meters with the communication infrastructure of the NBN.

Energy Sense Communities has a significant stakeholder, community and consumer engagement element. The project will seek to engage consumers within several focus areas including a greenfield residential corridor, existing residential areas – including areas targeted for rollout of the NBN – commercial and industrial growth areas, and the greater Townsville area.

The project has also recently become a demonstration site in the international EPRI smart grid demonstration project.

Outcomes and impacts

Outcomes and impacts of the Energy Sense Communities initiative are yet to be reported. It is anticipated that outcomes will inform future program initiatives and AER regulatory submissions.

Customer response

Analysis of customer experiences will be undertaken at a later stage in the project.

5.3.9 Smart grids and other emerging opportunities

Australian Standard AS 4755

DNSPs in a number of regions have demonstrated the successful management of residential space air conditioning loads during peak periods using AS 4755.3.1 interfaces. Further development of this capability will be an important factor in managing the contribution of air conditioners to peak demand loads, in future.

Standards Australia, government, and key energy industry stakeholders are working on extending the AS 47553.1 control interface for air conditioners to a wide range of appliances in order to incorporate demand response capabilities. These appliances include swimming pool pumps, and solar electric boost, and heat pump water heaters, which have historically been connected to off-peak tariffs.

Through this work, the DNSPs will be able to interface with these appliances using a range of communications protocols and technologies, and consumers will be provided with options for using standardised DLC products to control their appliances energy use, and produce bill savings.

This will be particularly important for managing water heating loads where the phase-out of greenhouse-intensive water heaters will lead to a reduction in the number of electric storage hot water services, reduce the total amount of controlled load available to the DNSPs, and potentially increase peak demand if the new water heating loads deriving from electric solar and heat pumps are not properly managed.

Home area networks

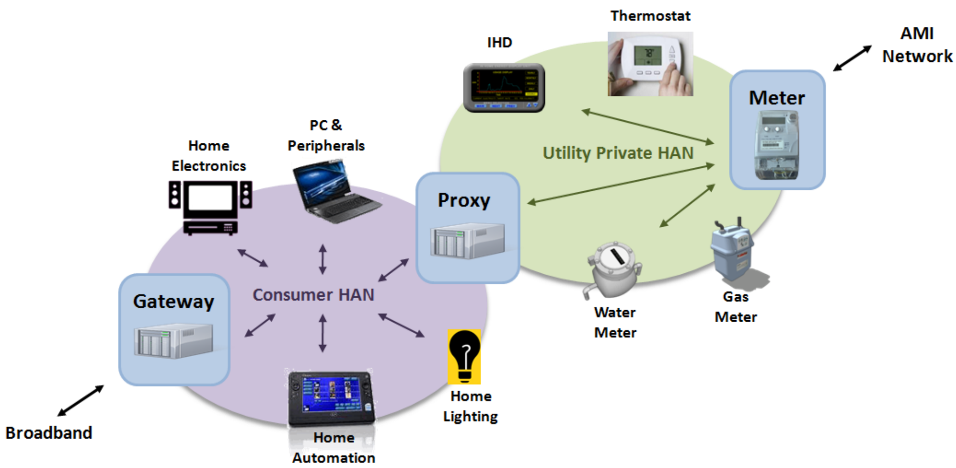
A Home Area Network (HAN) connects a smart meter to individual appliances and other devices in a home using wired or wireless technologies or a combination of both. Some of the key potential benefits of smart metering are attributed to its integration with the HAN and the corresponding energy management capabilities this provides to both consumers and the utility.

An important feature of the HAN is that it will allow consumers to receive real time energy and cost usage information down to the individual appliance level through devices such as a web portal or IHD. This will assist consumers in pinpointing high energy consuming appliances and empower them to take action to modify how they use these appliances, and monitor the effect on their energy costs.

The HAN also allows the utility to send control signals to individual appliances through its own private and secure part of the network. Control of the appliance can be performed via control modules that plug in between the power outlet and the appliance and are capable of switching the appliance on and off in response to prices or other preset conditions.

Figure 28 illustrates the basic components of a HAN, including the electricity meter, plug-in control modules, and the various devices and appliances linked via the network.

Figure 28: HAN architecture



Source: Futura Consulting. *Advanced Metering Infrastructure Program – Benefits Realisation Roadmap*. 2009.

There are several HAN trials of note that have been implemented or are in the planning stage. Examples of these include:

- Ausgrid is trialing HANs in 100 'smart homes' in Newington as part of its *SGSC* initiative. The HANs will provide real-time information on energy consumption of individual appliances and remotely monitor and control appliances online, including air conditioning, hot water systems, solar power systems, lighting, and entertainment and laundry appliances;[91] and

91 http://www.smartgridsmartcity.com.au/

- Endeavour Energy is planning to trial HANs as part of an integrated Smart Grid trial in the Windsor area of its distribution network. The trial will evaluate a range of consumer and grid applications, smart meters, communications and data collection, storage and analysis. Devices linked through the smart meter and HAN will provide participants in the trial with real time energy usage information, feedback on the energy savings resulting from changes in behavior and directly control air conditioners and pool pumps.[92]

Smart Appliances

Smart appliances are undergoing rapid development internationally. In the US there has been some limited trials of HAN connected 'smart' appliances, and in addition, in mid 2011, the US DOE published an RFT seeking comment regarding how it should consider smart appliances in future energy conservation standards and test procedures for the Appliance Standards Program, as well as in the test procedures for the ENERGY STAR Program.

A number of major appliance manufacturers appear to be very active in this area and are developing some very interesting features for their household ranges in order to maximise the benefits of utilities' time-based tariffs and rates to consumers. LG and GE have recently introduced several appliances that allow consumers to set their operating schedules to automatically delay or defer cycles during the more expensive peak demand times, and run in hours when demand and prices are low. Examples for the GE range and their key money and energy savings features are presented in Table 13.

Table 13: GE smart appliances energy and demand management features

Appliance	Money Savings	Energy Savings
Dishwasher	Run the dishwasher during low-cost hours with Delay Start Cycle	Avoid the energy-zapping dry cycles. This dishwasher automatically sets to Air-Dry during high-cost hours
Oven	Self-clean feature is temporarily disabled during high-cost times	Cooktop surface automatically reduces power use by 20% during high-cost hours Double-oven range automatically defaults to the smaller, less energy-consuming upper oven during peak use times
Washer and Dryer	Both the washer and dryer automatically delay start until energy rates go down, so you can set them to run during low-cost hours.	During high-cost periods, the washer automatically defaults to the Low Energy wash cycle Select Low Energy setting for the dryer during peak use hours
Refrigerator	Defrosting cycles are automatically delayed until low-cost times of day	Quick Chill and Quick Defrost features are disabled during high-cost hours, but only until the peak-use period is over

Source: Reproduced from http://www.geappliances.com/home-energy-manager/appliance-energy-consumption.htm.

92 Endeavour Energy. *Endeavour Energy's Smart Grid Initiatives (presentation to EESA).* 2011.

Distributed storage

Although as noted high up-front costs have been a barrier to the introduction of distributed storage technologies, pilots and trials to demonstrate the utility and cost-effectiveness of these technologies are gaining momentum within Australia with a focus on batteries. Trials of note that have recently been implemented or are in the planning stages include:

- Australian battery storage developer RedFlow is participating in a test to demonstrate the utility and cost-effectiveness of its prototype '200' unit which can provide up to 400 kWh of storage using 48 of its zinc-bromine battery modules (at a cost of around $600,000).[93] The system will be linked to a 339 kW section of the UQ St Lucia PV array (the largest in Australia). An identical 339 kW adjacent group of panels will feed their power directly into the grid as the power is generated. Comparisons will be made of the output of both systems to see which performs best in different situations, and cost-effectiveness investigated. The project will also assess how the stored energy can best be released back to the grid when most needed during peak load periods on the distribution network;
- Ausgrid, as part of the *SGSC* project, will be testing distributed generation, battery storage, and smart metering. These tests will aim to evaluate the importance that new storage technology may play in a broader, more integrated smart grid in terms of optimising the outputs from renewable generation sources, and fuel cell technologies. Over a two year period 40 RedFlow 5 kVA batteries will be installed in residences in the Newcastle area, along with 25 Bluegen gas fuel cells and 5mini-wind turbines to test whether these technologies (along with existing PV arrays) can help make the power supply more reliable, reduce peaks in energy demand and lower household electricity bills. A second trial will be conducted at Scone, where a two-year pilot of 20 RedFlow storage units at up to 16 properties will be used to demonstrate whether energy storage technology can make a rural electricity supply more reliable and give customers greater control over their household energy use; and
- SP AusNet is planning to trial the integration of distributed storage technology and PVs to reduce network loadings on Single Wire Earth return (SWER) lines in rural areas of the network. Specific objectives of the trial are to evaluate battery/inverter combinations installed at zone substation level that solve problems specific to Wire SWER lines, and the associated cost-benefit of the solutions. The project is in the preliminary planning stage. Technology and site assessments are underway with trials planned to start in 2012.

Cogeneration/trigeneration

Increasingly stringent mandated building rating schemes, forecasts of rising electricity and gas prices, combined with recent legislation by the Commonwealth Government to put a price on carbon are providing incentives to increase the uptake of this technology. Ongoing efforts to remove regulatory and market barriers to cogeneration/trigeneration projects are also leading to enhanced opportunities in this area, as is the development of

93 Source: http://www.climatespectator.com.au/commentary/australian-cleantech-redflow.

business models by market participants that maximise the financial and greenhouse mitigation benefits received by project proponents.

One of the largest forthcoming projects currently in train is the Sydney City Council's energy plan which calls for a network of trigeneration energy systems to provide clusters of buildings in the City of Sydney local government area (LGA) with low-carbon electricity, space heating, and space cooling. Based on the forecast mid-growth scenario to 2030, the system would include 360 MW (electrical output) of distributed generation displacing some 2,000 GWh to 3,000 GWh of grid supplied electricity per year, and reducing greenhouse gas emissions across the LGA by 18% to 26% below 2006 levels by 2030.[94] The project is forecast to to reduce peak summer demand for electricity in the LGA by up to a third – as well as supplying 70% of the City's electricity needs from local generation.

Origin Energy recently formed a partnership with major property developer Investa to implement a landmark trigeneration opportunity. The system uses a trigeneration plant to provide electricity, hot water, and chilled water for space conditioning in the base Coca-Cola Place building and, in addition, exports surplus electricity via Ausgrid's distribution network, to Investa's Deutsche Bank Place. This is a first for a commercial building in Australia; paving the way for precinct-based trigeneration systems that can serve multiple buildings.

In 2011, AGL Energy has announced plans to construct a state of the art co-generation facility for Qenos Pty Ltd at its Altona plant in Victoria. At an approximate cost of $45 million, the plant will have a nominal capacity of 21MW, and will represent Victoria's largest industrial co-generation plant to be built in a decade.

5.4 PEAK DEMAND REDUCTION POTENTIAL OF DSP PILOT MEASURES

The DSP pilots and trials conducted to date have been implemented on a relatively small scale and availability of published results has been fairly limited. Consequently, there has been limited analytical work undertaken to assess the quantum of DSP resource that might be realised from the roll out of DSP initiatives NEM wide. Ausgrid's *SGSC* will be one of the first trials to attempt to obtain data that can be utilised to quantify large scale impacts; however, field results will not be available in the near term. Results from the Solar Cities trials could, in future, also provide useful data for determining the potential impacts of broad based take-up of DSP options.

To provide an indication of what could be achieved from the broader application of some of the DSP initiatives currently being trialled and piloted, Futura's project team performed a modelling exercise to provide a very preliminary estimate of the NEM-wide peak load reduction potential from these DSP resources. Results are discussed in the next section.

94 City of Sydney. *Decentralised Energy Master Plan -Trigeneration 2010–2030*. 2010.

5.4.1 Modelling results

The modelling draws on data from the Victorian Government's Advanced Metering Infrastructure (AMI) program benefits realisation roadmap study.[95] The Victorian AMI roll-out program is a collaborative project involving government, electricity businesses, and consumer groups and will involve the accelerated replacement of mechanical accumulation metering technology with modern electronic meters with 2-way communications capability. Under Victorian law, electricity distributors are required to install a smart meter at every home and small business in Victoria by the end of 2013.

Part of the study examined the potential benefits, estimated peak demand impacts, and anticipated take-up rates of several cost effective DSP applications that could be enabled by the AMI program. The DSP consumer applications identified in the study that are anticipated to materially impact on reducing peak demand include:

- peak demand reduction from three-rate TOU tariffs;
- peak demand reduction from CPP tariff implementation;
- demand response from IHDs on CPP;
- demand response from DLC of air conditioners; and
- peak demand reduction through deferral of HAN enabled 'smart' refrigerator auto defrost cycle into the out of peak period.

Given uncertainties in the input assumptions regarding forecasting consumer acceptance and take-up of these DSP options, two sets of input assumptions were developed. One set represents an optimistic view of future consumer acceptance and take-up ('high' case) of DSP options and the other a less optimistic view ('low' case). The probable outcome is likely to be somewhere in between. Table 14 provides assumed take-ups for the high and low case for each option.

Table 14: Assumed proportion of households taking up the DSP option

Take-up	Three-rate TOU tariffs	CPP tariffs	CPP tariffs plus IHD	Air conditioner DLC	Refrigerator auto defrost DLC[1]
Low	85%	12%	8%	10%	5%
High	90%	20%	30%	20%	10%

Note 1: Percentages relate to proportion of refrigerators defrosting at peak times rather than take-up.

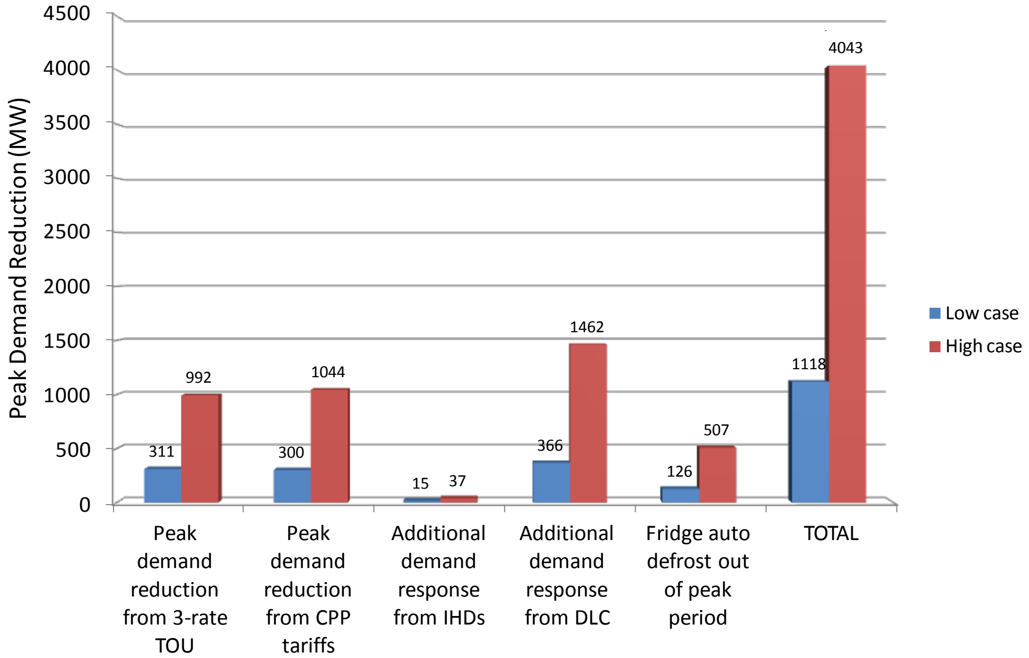
Extrapolation of the Victorian results to the NEM was undertaken on the basis of simple ratio of residential connections. A ratio of 3.7 was used for this purpose[96].

95 Futura Consulting. *Advanced Metering Infrastructure Program – Benefits Realisation Roadmap*. 2009.

96 The total number of residential connections in the NEM is estimated at about 3.7 times the number of Victorian residential connections (refer Table 14).

Figure 29 presents the results of the analysis for each DSP option and the aggregated impacts of all options combined, projected to 2020. The results indicate that by 2020 DSP in the residential sector has the potential to reduce peak demand by between 1,100 MW and 4,000 MW. This equates to between 2.4% and 8.8% of the projected 2020 NEM-wide summer peak maximum demand of 46,147 MW[97].

Figure 29: NEM DSP potential from residential pricing, DLC, and IHD initiatives (2020)



The analysis has some limitations in that not all potential DSP options were considered. For example, there is likely to be additional potential from DSP options such as pool pump DLC, hot water DLC and energy efficiency opportunities. It also ignores the significant additional potential from unrealised DSP opportunities in the C&I sector. Notwithstanding these limitations it does provide an order of magnitude estimate of the quantum of DSP that could be realised in the residential sector from pricing and other load management initiatives supported by interval metering infrastructure.

97 AEMC. 2011 ESOO. Table 3-5: 50% POE MD medium growth scenario at 2020-21.

6. Market Conditions to Enable DSP Opportunities

6.1 Introduction

This section describes some of the key market conditions necessary to enable greater take up of DSP in the NEM. These were identified from our review and analysis of the levels of DSP and measures currently implemented in the NEM, findings from the DSP trials, pilots and new initiatives presented in Section 5, feedback from interviews with stakeholders, and relevant public reports. The discussion on market conditions is presented under the following overarching themes:

- price signals and financial incentives;
- metering and enabling technologies;
- connection arrangements and standards;
- education and awareness raising; and
- regulatory and institutional support for DSP.

A discussion of the extent to which these market conditions are in place in the NEM is also provided.

6.2 Price signals and financial incentives

6.2.1 Market conditions necessary to enable DSP

While consumers are motivated to participate in demand response programs for various reasons – including financial, environmental, or social good – the opportunity to receive some form of financial benefit appears to be one of the most important drivers. For example, as noted earlier in the consumer research findings for Endeavour Energy's PTR trial two-thirds of participants signed up to either save money on their bill, or to receive the incentive.

Specific market conditions that need to be in place in the NEM in relation financial drivers for residential and C&I consumers are discussed in the next sections.

Residential sector consumers

Currently, an estimated 94%[98] of residential consumers in the NEM see either average-cost based flat or IBT tariffs that give them no indication that the cost of electricity changes over time, nor any incentive to vary their electric use in response to wholesale market conditions. These tariffs serve to insulate consumers from wholesale price volatility and prevent them from choosing to reduce demand when prices are rising dramatically or when network loadings are reaching capacity reliability limits.

98 Based on a Futura Consulting review of DNSP annual tariff reports, network pricing proposals and regulatory submissions.

The results of the pilots and trials reviewed in Section 5.3 generally indicate that residential consumers are willing to take up TOU and DPP tariff offers from their utility and subsequently change their electricity consumption behaviour in response to these tariffs. Consumers also appear to be willing to participate in incentive based PTR options that encourage behaviour change, as demonstrated in the Queensland DNSPs Rewards Based Tariff trial, or that DLC of appliances in return for a financial reward. The trials have also shown that information about the benefits of participating, how the program works and how consumers are able to participate needs to be explained through tailored marketing and educational materials using clear and concise messages that are contextualised to potential participants.

The market conditions that need to be in place include:

- widespread availability and consumer awareness of pricing based DSP options, such as TOU and DPP tariffs, and/or incentive based programs such as DLC or PTR offers;
- incentives within the regulatory and licensing frameworks for retailers, and NSPs to investigate, develop and implement these initiatives and actively market them to consumers;
- knowledgeable and well-informed consumers that have the capability and opportunity to take full advantage of available tariff and program choices supported by information and advice on the benefits of participating and the types of actions they can take once they have signed up;
- market mechanisms that ensure cost reflective network pricing signals are passed through and seen by consumers; and
- ensure that consumer protection and compensation frameworks for consumers who may have difficulty in modifying their consumption patterns and could be adversely affected by the implementation of cost-reflective pricing.

C&I sector consumers

Based on our findings in this study, there appears to be potential for additional DSP from consumers in the C&I sector in the NEM.

Importantly, the C&I sector is estimated to account for more than two-thirds of peak demand on the NEM system and therefore should represent an important focus for DSP pricing and incentive based offers. Many C&I facilities have large demand response capabilities – some in the order of hundreds of kilowatts or megawatts – that can be acquired at lower transaction costs than acquiring similar amounts of DSP from smaller mass market residential and SME customers. Potential participants within the C&I sector are also easier to identify and target for DSP offers. The success of SP AusNet's new DPP network tariff in achieving significant levels of demand response from C&I participants over the first year of the tariffs implementation demonstrates the potential that is available and can be quickly deployed.

However, the current levels of DSP from C&I consumers is limited due to several impediments. Some DSP opportunities may only be available to C&I consumers for short periods of time. For example, a DSP arrangement with a retailer may only be available to a C&I customer for the duration they remain the customer of that retailer. Further, an NSP may only require demand response to address a network constraint for one or two years prior to augmenting the network, after which point the demand response capability is no longer required. This discourages C&I consumers from investing capital and resources to establish and provide the market with longer term demand response resources.

The C&I sector is also comprised of a very diverse range of business types and sizes. Large C&I consumers have different levels of technical skills, capabilities and resources to be able to take-up and participate in DSP opportunities compared to smaller C&I consumers. In some regards the needs of smaller C&I consumers are quite similar to the residential sector. As noted by the Community Utilities Advocacy Centre (CUAC), there are low levels of energy literacy in many small C&I businesses, and in some C&I business segments there is a lot of scope for DSP.[99]

Anecdotal feedback from market participants also indicate that C&I consumers could benefit from a basic knowledge and understanding of how the NEM functions and the role of DSP within the market. This could assist C&I consumers in gaining a better understanding of the DSP opportunities available to them and may avoid potential confusion in the market when faced with DSP opportunities from different market participants.[100]

The market conditions that need to be in place for the C&I sector include:

- widespread availability and consumer awareness of cost reflective pricing based DSP options and incentive based programs that recognise the differing needs, characteristics and diversity of business types, to provide C&I consumers with;
    - sufficient value to encourage both short term and longer term participation in DSP,
    - contracting arrangements that provide sufficient notice for DSP actions to be initiated and do not place significant risks or penalties on consumers for non-performance,
    - relatively long term multi-year contracting arrangements that provide continuity of price signals and revenue streams against which consumers are able to amortise investments in technologies, software, training and systems to facilitate DSP as a firm capability in their business, and
    - a fair price or incentive for the DSP being offered that recognises the benefits being delivered to the market across the value chain,

99 In person meeting with Jo Benvenuti (Consumer Utilities Advocacy Centre) and D Prins (on behalf of Futura). 22 Sep 2011.

100 Personal communication between D Evans (Progressive Green retailer) and J Fazio (Futura Consulting), 12 Sep 2011.

- well informed consumers with a detailed understanding of their electricity consumption patterns and their capabilities to curtail or shift discretionary usage and a high level of interest in, and understanding of, the benefits of DSP across *all* key decision makers in the organisation;
- strong incentives within the regulatory and licensing frameworks for retailers and NSPs to investigate, develop and implement these initiatives and actively market them to consumers;
- consumers with technical skill, systems and training to take full or partial pool price exposure in their retail contracts to enable them to reduce load in response to high pool price events;
- consumers with basic level of knowledge of the fundamental aspects of the NEM, how the market functions, role of the main participants, and the relationship between demand and price and the role of DSP; and
- availability of product and service providers that can assist consumers to identify and assess operational strategies and/or technologies, assess the financial value of DSP to the business and provide information and advice on the available actions and options.

6.2.2 Market conditions not in place

Residential sector consumers

Most of the market conditions identified in relation to the availability of cost-reflective pricing and incentive based DSP for residential consumers are not widely in place in the NEM. Specifically:

- TOU tariffs are generally available to most consumers as an option to the standard IBT or time-invariant tariffs, although voluntary take-up to date has been relatively low.
    - in Victoria mandatory TOU tariffs have been considered as part of the AMI rollout but are currently subject to a moratorium,
    - DPP tariffs, DLC of appliances and PTR incentive based DSP options are generally still at the trial stage and not widely available,
- incentives such as the AER's Demand Management Incentive Scheme (DMIS), d-factor and Regulatory Investment Test for Distribution (RIT-D) do exist in the regulatory frameworks to encourage NSPs to investigate and implement DSP, but relatively modest levels of DSP have been achieved to date;
    - retailers are subject to meeting state based energy efficiency targets as part of their licensing conditions, but not specific peak demand reductions targets,

- many consumers are not well-informed about the benefits of DSP and how to take advantage of available tariff and program choices. Auspoll recently found that 60% of residential consumers are not aware of any government programs designed to assist households save energy[101];
- there are currently no requirements on retailers to pass through cost reflective network pricing signals to consumers;
  - although as network tariffs become more strongly cost reflective, retailers will have increasing commercial imperatives to minimise their volume risk by 'mimicking' the network tariff structures,
- policy direction from Commonwealth and State governments on the introduction of mandatory or voluntary cost reflective tariffs is not in place and may require assessment of the costs and benefits of each alternative to determine a preferred approach (in Victoria the introduction of cost-reflective tariffs has been delayed until 2013);[102] and
- consumer protection and compensation frameworks for low income consumers are not currently in place but have been reviewed by the MCE's Customer Protection and Safety Review[103] as part of the national framework for smart metering;

C&I sector consumers

The market conditions identified to encourage DSP from C&I consumers are not widely in place in the NEM. More specifically,

- while TOU and demand based tariffs are implemented for most C&I consumers more cost reflective options such as DPP options are yet to be widely deployed;
- incentive based DSP options are not widely available for small to medium C&I consumers;
- with the exception of a relatively small number of C&I consumers that have experience in DSP, most C&I consumers lack information on their electricity consumption patterns and their capabilities to curtail or shift electricity usage;
- most C&I consumers lack the skills, systems and training to take full or partial exposure in their retail contracts to wholesale market prices, although specialist retailers such as Progressive Green are emerging in the market to offer this service;
- most C&I consumers are unlikely to have a good basic level of knowledge of the fundamental aspects of the NEM although further research is required to identify specific knowledge gaps and educational needs.

101 Auspoll, *Energy Efficiency – A Study of Community Attitudes*, 2011

102 http://www.dpi.vic.gov.au/smart-meters/home/latest-news/smart-meter-rollout-update.

103 MCE, *Smart Meter Customer Protection and Safety Review*, August 2009.

6.3 METERING, ENABLING TECHNOLOGIES & COMMUNICATIONS INFRASTRUCTURE

6.3.1 Market conditions necessary to enable DSP

Most residential and SME consumers in the NEM currently lack the necessary metering and other technologies for participating in pricing and incentive based DSP initiatives. With the exception of Victoria, which is currently implementing the AMI program, and parts of Ausgrid's network territory in NSW, there is significant future investment required to install the necessary functionality to support the introduction of cost-reflective pricing, incentive based DSP programs and demand response enabling technologies.

Interval and smart metering

Manually read interval meters capable of measuring and recording a customer's electricity consumption over short time periods provide the basic foundation for supporting the implementation of pricing based DSP initiatives, and some incentive based DSP programs (such as PTR) which rely on measuring changes in a consumers energy usage in near real time. However, the capability of interval meters to provide consumers with real time information and control of their energy use is limited.

Smart meters (interval meters with two-way communications) provide greater functionality and potential for DSP than is possible from basic interval meters. Smart meters form the basic backbone of smart grid infrastructure. They enable the implementation of a wider array of applications that will provide consumers with the ability and tools to respond to prices and other DSP initiatives in near real time.

The benefits of smart meters have been extensively analysed and reported on in the NEM. In 2005 a cost-benefit analysis (CBA) for smart meters was undertaken in Victoria. In 2007, following the first stage of a national smart meter CBA, the MCE agreed to a national minimum functionality for smart meters. In June 2008, the MCE reviewed the second stage of the CBA and noted a wide range of potential net benefits, but that benefits and costs were not apparent across all jurisdictions. On this basis, the MCE supported the development of a national smart metering framework and smart meter deployments in Victoria and New South Wales. The Victorian CBA was also updated in 2009 as part of the development of a wider benefits realisation framework for the Victorian AMI infrastructure project. The basic meter specification for meters being rolled out in Victoria is a smart meter with two-way communications and load control functionality that are capable of interfacing with a range of future consumer applications to support DSP.

Most of the DSP pilots and trials conducted (or currently underway) in the NEM have utilised smart meters to support DSP pricing or incentive based measures. Ausgrid's *SGSC* trial, for example, will deploy smart meters with two way communications that will support a wide array of DSP consumer applications.

A market condition that is needed to support additional DSP is the deployment of interval or smart meters in customer's premises that are capable of measuring and recording electricity consumption in real time, support cost-reflective tariffs and provide the functionality to interface with the devices such as HAN, load control enabling technologies needed to support consumers in managing their energy use and costs.

Enabling technologies

Enabling technologies include a variety of tools and devices that will make it easier for consumers to receive and respond to price signals, adjust their energy consumption at times of peak demand and manage their overall energy usage and costs.

Examples of the types of enabling technologies that are likely to support DSP include technologies that:

- provide consumers with historical, real time and forecast information on their energy usage, motivate energy conservation behaviour and provide feedback on changes in their energy usage behavior, such as web portals and IHDs;
- can be programmed by the consumer or a DSP program host to monitor and reduce air conditioner and appliance usage during critical peak periods; and
- enable consumers to receive text and other messages so they are able to manually reschedule appliance usage or alter their energy consumption behavior in response to price.

However, to date, findings from several pilots and trials indicate that the low customer acceptance of IHDs seen in these trials combined with the high cost of the technology put their cost-effectiveness into question. Results from local trials currently underway will provide additional findings in this regard.

International experience, on the other hand has shown that IHDs used in conjunction with cost-reflective pricing can enhance the level of DSP. Consumers who actively used an IHD reduced their consumption of electricity on average by about seven percent.[104]

Therefore, subject to the outcomes of further trials and cost-benefit assessment, a market condition in support of DSP is that consumers have access to enabling technologies that provide energy usage information, communication and control capability to assist consumers in modifying their energy consumption, and in responding to prices or incentive based programs.

6.3.2 Market conditions not in place

Interval and smart metering

As noted above, smart meters are progressively being rolled out in Victoria with more than 900,000 meters installed to date. Ausgrid reports that they have installed an estimated 300,000 interval meters[105] in their service territory to support their TOU network tariff for residential and small business consumers.

Elsewhere in the NEM, interval and smart meters are largely not in place. Work is currently underway by the National Stakeholder Steering Committee (NSSC) to further assess benefits and costs and the potential for smart meter rollouts in other regions as part of the national framework for smart metering.

---

104 Faruqui, A et al, *The Impact of Informational Feedback on Energy Consumption - A Survey of the Experimental Evidence*, 2009

105 Ausgrid, *Network Pricing Proposal for the Financial Year Ending June 2012*, 30 April 2011.

Enabling technologies

Enabling technologies are also not in place at the present time as the rollout of these technologies is largely dependent on smart meter infrastructure being in place. In Victoria, the Department of Primary Industries (DPI) has recently announced changes to the smart meter rollout program following the outcomes of its recent independent review of the cost-benefit analysis. One of the outcomes of the review is that subsidised IHDs will be available to assist households manage their energy bills, with basic displays available at low cost by mid-2012.[106]

6.4 CONNECTION ARRANGEMENTS AND STANDARDS

6.4.1 Market conditions necessary to enable DSP

Distributed generation

The findings of our review into existing DG resources indicate that there is still considerable potential in the NEM to encourage demand response from existing resources, such as standby generators. In future, cogeneration and trigeneration are likely to play a larger role in the provision of energy services to consumers as a result of factors such as gas and electricity prices and mandated energy standards for commercial buildings.

The market conditions required to realise this potential include all those previously discussed for C&I consumers in Section 6.2.1 as well as several critical market conditions specific to DGs. These are discussed in further detail below.

A recent report by Climateworks Australia[107] identified several market conditions that are required to support greater utilisation of DG as a demand response resource, and in addition, a number of impediments that make it difficult for proponents to connect their generators to the distribution network. These include costly, inconsistent and non-transparent network connection processes and requirements, uncertain timeframes and milestones for connection approvals, lack of common contract terms and impediments associated with establishing larger DG projects capable of serving multiple sites.

DG owners and proponents of new installations should have a high level of knowledge and awareness of the opportunities and benefits available to them in utilising their generators as a DSP resource in the NEM. These might include offering the resource to retailers, NSPs or aggregators or potentially registering the resource directly in the NEM as a market or non-market generator. There is anecdotal evidence that even relatively large and sophisticated facility owners are not aware that small generators can be registered and operated in the NEM.

---

106 http://www.dpi.vic.gov.au/smart-meters/home/latest-news/smart-meter-rollout-update.

107 Climateworks Australia. *Unlocking Barriers to Cogeneration: Project Outcomes Report*. September 2011.

As noted in Section 4.3.3 standby generators are not typically set up to operate in parallel with the grid. Upgrading existing generators to incorporate this capability requires significant investment in feasibility studies, metering, and synchronising and fault protection equipment. Recouping these costs will depend upon the expected future hours of operation of the generator and the price obtained during the periods it is run.

Another issue noted previously is the potential impediments regarding Environment Protection Authority (EPA) emission and noise level regulations governing the operation of generators in urban areas. While the operation of generators in urban areas under genuine emergency conditions is generally acceptable to the EPA, there is uncertainty over whether the EPA would allow the operation of generators for DSP purposes.

The market conditions to enhance the take-up of DG in the NEM are:

- availability of streamlined, consistent and standardised DG connection processes, agreements and terms from DSNPs that cover connection enquiry processes, transparent fee structures for fault protection studies and other services, and guaranteed service standards;
- DNSPs that are adequately incentivised, resourced, and motivated to engage with DG proponents to provide improved and more streamlined DG connection services;
- market and metering arrangements that encourage economies of scale by allowing and supporting the aggregation of multiple sites so that larger DG systems are able to serve multiple sites;
- DG owners and proponents of new installations that are aware of the opportunities and benefits available to them for utilising their generators in the NEM, and know how to assess the costs and benefits of converting their generator to parallel operation; and
- EPA air quality emission and noise regulations that recognise and allow for the use of generators for short duration demand response purposes.

Standards for demand response enabled devices

Several of the DLC trials discussed in Section 5.3, such as ETSA's Peakbreaker air conditioner and Energex's Cool Change trials have utilised DRED control devices that are installed externally to the air conditioner. While effective in providing peak demand reductions, as noted by ETSA Utilities in their recent submission to the AEMC to the current Power of Choice review, external DRED devices may not be the most cost-effective approach to wide-scale deployment of DLC programs for air conditioners and other appliances.[108]

The Commonwealth Department of Climate Change and Energy Efficiency (DCCEE) has noted similar concerns and points out additional concerns associated with external DRED controllers voiding appliance warranties.[109]

108 ETSA Utilities submission to AEMC Issue Paper: Power of choice – giving consumers options in the way they use electricity, August 2011.

109 DCCEE Appliance Energy Efficiency Branch, *Energy Efficiency and Peak Load Reduction,* submission to the AEMC Power of Choice review, August 2011.

At the present time compliance with AS 4755 by appliance manufacturers is only voluntary. As discussed in Section 5.3.1, Endeavour Energy has successfully demonstrated in their recent *Cool*Saver trial that AS 755.3.1 compliant air conditioners can deliver material load reduction impacts. However, Endeavour Energy noted difficulties in recruiting adequate numbers of participants for the trial due to the low number of eligible AS 4755.3.1 compliant air conditioners in the market.

The DCCEE note that voluntary compliance with the standard introduces regulatory and commercial risks for utilities that may be considering offering DLC initiatives. DNSPs, for example, may be reluctant to invest in the marketing, administrative and backoffice systems required to support a DLC initiative if there are only a small number of compliant appliance models on the market. Appliance manufacturers also face commercial risks in adopting a standard that does not apply equally to their competitors.[110]

The market conditions to enhance the potential for DSP from DRED enabled appliances in the NEM are:

- mandated standards for manufacturers to incorporate DRED functionality in all major appliances covered by the AS 4755.3.1 framework; and
- in the absence of mandated standards (or as an interim measure prior to standards being mandated) the availability of incentives and awareness raising efforts to encourage consumers and builders to select AS 4755.3.1 compliant models over non-compliant models when purchasing new appliances.

Smart meter and HAN standards

Ideally, smart meters could incorporate functionality that would allow the smart meter to interface and be compatible with AS 4755 compliant appliances, as well as other communication interfaces such as the HAN. This capability potentially enhances DSP as not all consumers are likely to have a HAN.

As discussed in Section 5.3.9 the HAN provides the communication interface between the smart meter and the various enabling technologies and devices that will help consumers manage and control their energy usage and costs, thus enhancing the potential for DSP. However, at the present there is no nationally accepted standard for HAN technologies.

As noted by the BRWG:

> *in the absence of a mandated HAN standard in the National Electricity Rules, in a distributor lead rollout of SMI (Smart Metering Infrastructure) the final decision of the HAN technology would be made by the distributor and in other jurisdictions the decision would be made by the party rolling out the smart meters. Since consumers interact with retailers and there is no appliance interoperability across competing HAN standards, the lack of an agreed HAN standard would lead to ambiguity for the consumer to determine which HAN technology will work with their smart appliances in their jurisdiction.*[111]

110 ibid.

111 NSMP, *NSMP Business Requirements Work Stream Home Area Network Request for Information Working Paper,* March 2010.

The BRWG also noted that a HAN standard simplifies consumer education and acceptance.

The market conditions to enhance the potential for DSP from smart meter and HAN standards are:

- technical standards for smart meters that ensure smart meter compatible with DRED appliances; and
- common and mandated standards and specifications for the HAN across the NEM.

6.4.2 Market conditions not in place

Distributed generation

The market conditions identified above for DGs are in various stages of development. In summary these include:

- a streamlined, consistent and standardised connection process for DG's seeking a connection to the network is currently not in place; however, a proposed Rule change to Chapters 5 and 5A that will seek to incorporate recommendations from the Climateworks Australia report is currently being drafted for submission to the AEMC;
    - aspects of the National Connections Framework for electricity (NCF) that will form a new Chapter 5A of the NER that seek to address barriers to DG will go some way toward addressing this market condition when implemented,
- knowledge and awareness amongst DG proponents and owners of the various opportunities and benefits of utilising their generators in the market is likely to vary amongst proponents and owners; and
- the assessment of EPA emission and noise levels regulations over the use of diesel generators for DSP purposes will require exploratory work with state EPA bodies to scope out the extent of the issues and identify potential solutions.

Demand response enabled devices

As noted, the AS 4755.3.1 standard for air conditioners was released in 2008 and some air conditioners that comply with the standard are currently available in the market. Development of AS 4755 standards for pool pumps, electric water heaters and other appliances are at various stages of development through work currently being undertaken by the DCCEE and the Equipment Energy Efficiency (E3) Committee.

However, mandated requirements on manufacturers to incorporate DREDs in air conditioners are currently not in place in the NEM. As a next step, the costs, benefits and impacts of a mandated standard could be assessed through a Regulatory Impact Statement (RIS) process.

With the exception of trials, such as the *Cool*Saver, that have offered incentives to consumers with existing AS 4755.3.1 air conditioners, incentives and awareness raising campaigns on consumers and builders to purchase DRED enabled appliances are currently not in place.

Smart meter and HAN standards

In May 2011, the National Smart Metering Stakeholder Committee (NSSC) Business Requirements Working Group (BRWG) agreed to incorporate AS 4755.3.1 functionality in the national smart meter specification as an option for DNSPs wanting to directly send control signals from the meter to the AS 4755.3.1 functions on DRED air conditioners[112].

A common and mandated HAN specification and functionality specification across the NEM is currently not in place, however the National Smart Metering Program (NSMP) has evaluated potential HAN standards and has recently published a recommended standard.[113]

6.5 AWARENESS, EDUCATION AND INFORMATION

6.5.1 *Market conditions necessary to enable DSP*

Energy usage interval data and feedback information

A recent survey conducted by Auspoll of 1000 respondents showed that around half of all Australians don't know very much or 'nothing at all' about key aspects of their home energy use[114]. Several of the trials also showed that consumers often do not know the relative contribution of various appliances to their own demand, when their household's demand is the highest, the contribution each appliance makes to the bill and the options they have to alter their usage. For example, participants in Endeavour's *Peak*Saver PTR program were unable to relate the need to reduce household energy use during peak periods to minimise constraints on the network, and needed assistance in identifying ways to reduce their demand during these times.

Data from a consumer's interval meter offers opportunities to provide consumers with real time energy usage information and improves their understanding of energy usage behaviour. Examples include online web portals, IHDs and even hard copy reports that provide comparative benchmarking of a consumers energy use against a similar group of consumers, such as all consumers within a street or postcode.

Further, provided consumers have given prior consent to the release of their interval data access by retailers, NSPs and third parties to interval data could create markets for new products and services that will help consumers better understand and control their energy usage and unlock further DSP potential. For example, a third party provider of a customised web portal could assist in helping the consumer identify opportunities to respond to critical peak price signals while a supplier of solar PV systems could assist consumers to accurately determine the optimum sized solar system for their needs.

112 NSMP, Business Requirements Work Stream, *Smart Metering Infrastructure Minimum Functionality Specification,* 16 May 2011.

113 NSMP, Business Requirements Work Stream, *NSMP HAN Recommendation,* 16 May 2011.

114 Auspoll, *Energy Efficiency – A Study of Community Attitudes*, 2011.

The involvement of third parties (other than the retailer or DNSP) in providing value-added services based on analysis of consumer data also raises issues over data privacy and security. The regulatory system needs to protect consumers under this new regime, including ensuring security of data, as well as protecting against misleading sales practices, ensuring that consumers have access to low cost options.[115]

Market conditions that need to be in place include:

- availability and access to useful and effective information derived from interval data that is presented to consumers through a variety of formats including web based tools, IHDs or other formats that will enable consumers to better understand and manage their own energy usage and costs; and
- regulatory arrangements and frameworks that cover the collection, sharing and retention of data, data accuracy, protection and privacy of shared data and limitations and restrictions on third party data.

Consumer awareness of DSP options and choices

As noted in several of the market conditions identified in Section 6.2 on pricing and incentive based DSP initiatives, consumers will need to have access to information on when and how they use electricity and the actions they can take for modifying their usage. Consumers will also need to be made aware of the fundamentals of DSP, the benefits of DSP to themselves and the community, the various DSP pricing and technologies available and be given the encouragement to embrace these options.

It is also important that consumers are able to weigh up the costs and benefits when deciding on whether or not to take-up a DSP offering, and subsequently whether or not to respond to notifications from the utility to reduce load program events or adjust their consumption patterns in response to a tariff price signal.

CUAC has noted that when technologies are rolled out, there hasn't been appropriate communication to consumers regarding how they can use and benefit from the technology. Unless communication campaigns are consumer-focused, they leave consumers confused, not properly informed, and without a fundamental understanding of the benefits and value of the deployment. This can lead to consumer apathy and indecision.[116]

Market conditions needed to support DSP awareness raising are:

- ongoing government and/or NEM funded consumer multi-media education and awareness-raising campaigns on DSP (ideally this would be progressively staged over a period of time as different elements of smart grid and enabling technologies are rolled out and pricing and program offers are made available); and
- availability and distribution of multi-lingual information, advice and education on DSP through adequately funded, skilled and resourced local consumer organisations.

115 Ibid.

116 In person meeting with Jo Benvenuti (Consumer Utilities Advocacy Centre) and D Prins (on behalf of Futura), 22 Sep 2011.

Consumer engagement frameworks

Preliminary findings from the Townsville and Perth Solar Cities trials are indicating that effective consumer and social engagement significantly enhance DSP and support other DSP programs. Effective consumer engagement is also critically important in the rollout of advanced metering and other smart grid infrastructure. At the same time poorly executed or designed engagement has the potential to create confusion and negative perceptions amongst consumers which may, in turn, adversely affect their future level of interest in participating in subsequent DSP initiatives.

Therefore market conditions that support effective consumer engagement are:

- well timed and designed consumer engagement campaigns involving community leaders, business and consumer advocacy associations, and local government as well as consumers directly; and
- standards for consumer and social engagement frameworks to ensure consistent and effective implementation of short and long term campaigns that draw on international best practice.

Market participants highly skilled in DSP practices and methods

In addition to well informed and educated consumers it is equally important that NEM market participants involved in DSP initiatives are knowledgeable and skilled in the design, analysis, implementation and evaluation of DSP policy and program development. This would ensure a common level of awareness and understanding of DSP approaches across the NEM. Training and skill development could also target the specific needs of market participants and their varying roles and involvement in DSP development.

The market conditions that need to be in place include:

- NEM participants with competence and capabilities in DSP practices and methods, including the design, implementation, analysis and evaluation of DSP initiatives.; and
- availability of trained and accredited third party technology and service providers that are able to competently provide technical assistance and products that support consumers in responding to DSP opportunities.

Common reporting, analysis and sharing of DSP data and results

It is also important that information on current levels of DSP, results of pilots and trials and learnings from mature DSP initiatives, is collected and shared amongst market participants. This will help increase and accelerate the level of awareness and confidence in DSP as an integral and valuable resource and provide the basic data required to support improved and informed policy, planning and forecasting requirements.

Demand response program managers need to be able to reliably measure the net benefits of demand response options to ensure that they are both effective at providing needed demand reductions and are also cost-effective.

Market conditions that need to be in place include:

- availability of up to date, transparent and accurate information on the levels, sources and characteristics of DSP in the market including pilots and trials of new initiatives; and

- standardised methods and frameworks for quantifying, analysing and reporting on the results of DSP initiatives and assessing the potential of new initiatives.

6.5.2 Market conditions not in place

Virtually all the market conditions identified on DSP awareness, education and information are currently not widely and consistently practiced across the NEM. In summary:

- consumer awareness raising on DSP options and choices is occurring to varying degrees across different regions of the NEM depending on the availability and support for DSP initiatives in each region;
- consumer access to energy usage interval data and feedback information is currently limited but is likely to become more widespread as smart meters are rollout out;
- the level of competency and skill and specific training needs amongst various market participants in DSP practices and methods, requires further assessment, although current levels of capability are likely to be highest amongst participants that have established dedicated DSP functions such as Ausgrid, Endeavour Energy, Ergon and Energex; and
- frameworks on common reporting, analysis and sharing of DSP data and results are currently not in place.

6.6 Market, Regulatory and Institutional Support

Although not directly identified from the review of pilot and trials there are market conditions related to the strengthening of market, regulatory and institutional arrangements in the NEM that support DSP. These could enhance additional DSP from existing DSP opportunities, as well as ensuring that DSP potential identified from successful pilots and trials is able to be developed further and implemented across the NEM where cost-effective.

NEM market design

The relatively modest levels of DSP that has been realised to date in the NEM has been driven by either relatively few large business consumers with direct exposure to pool prices (that have the resources, skills and systems in place to manage their exposure to pool) or large business consumers that have been able to negotiate curtailable or pool price pass through arrangements with their retailers.

The design of the NEM, which is an energy only market that allows dispatchable generators to submit initial dispatch bid offers up to a day in advance, provides the fundamental design aspects to enable DSP resources to participate. Despite this there are limited opportunities for cost competitive demand response to easily participate in the market due to impediments such as market registration requirements.[117] Consequently, the current commercial opportunities are limited to consumers with demand response potential that can be contracted off-market to retailers or NSPs.

117 These include lack of commercial off-market opportunities for consumers that are willing to offer DSP, market entry fees and prudential requirements that must be maintained by market participants.

The inability of DSP to participate directly in the market also limits the incentives available to independent third party aggregators to work with consumers to identify additional cost effective DSP opportunities.

While it is outside the terms of reference of this report to undertake a review of the NEM market design, a market condition for increasing the commercial opportunities for DSP resources for larger business consumers in the NEM, is the ability of cost effective DSP to easily and directly participate in the wholesale energy and/or ancillary services markets. Further work to assess the costs, benefits and opportunities for DSP to participate in the wholesale energy and/or ancillary services markets is required.

Network service providers

DNSPs, to varying degrees, are involved in the implementation and trialing of new cost-reflective pricing and incentive based DSP initiatives as well as continuing to support legacy DSP initiatives such as voluntary TOU pricing options and controlled loads. There is also evidence to indicate that where incentives are available NSPs will undertake and invest in DSP activities, such as in NSW as a result of the d-factor, leading roles played by NSPs in Solar Cities projects and the scale and breadth of DSP activity currently underway in Queensland.

Regulated incentive mechanisms such as the Demand Management Incentive Scheme (DMIS), the new regulatory investment test for distribution (RIT-D) and National Planning Framework for Electricity Distribution Network Planning and Expansion processes should encourage DNSPs to explore further DSP opportunities.

DNSPs are also playing leading roles in roll out demand response functionality in the market, particularly with respect to investing in and rolling out the capital infrastructure elements, such as smart meters and smart grid technologies that have the potential to encourage DSP.

Market conditions that are needed to encourage DSP from NSP initiatives and expanding successful pilots and trials into full scale DSP offerings include:

- revenue regulation frameworks that do not impose disincentives and risks on network businesses to implementing DSP.[118] For example, under the price cap form of regulation initiatives that significantly reduce peak demand or energy consumption introduce potential risks in the network business being able to recover forecast revenues. Further, the current regulatory framework encourages DNSPs to increase their asset base even if this leads to inefficient capital investment;
- adequately funded and designed incentive allowances that provide appropriate targets and rewards for encouraging distribution businesses to actively invest in both short and long term DSP opportunities and localised and broad based initiatives;

118 In NSW when the form of network regulation was changed from revenue cap to a weight average price cap in the early 2000 IPART introduced the D-factor mechanism within the regulatory framework to overcome disencentives to DSP associated with the price cap.

- adequately staffed and trained personnel across the breadth of technical and non-technical skills and capabilities required to assess, design and implement DSP opportunities;
- cultural and organisational support for DSP across all key functional areas of the network business including financial, regulatory, planning and operations management that see DSP as a viable component of an integrated approach to planning and managing the network;
- business cultures that support and encourage collaborative approaches to exploring DSP and developing new DSP opportunities with other market participants; and
- regulatory approval and cost recovery for DNSPs for pricing and incentive based DSP initiatives by parties that have the appropriate skills and technical capabilities to evaluate DSP initiatives, approaches and technologies as part of a DNSPs regulatory funding submission.

Retailers

Electricity retailers in the NEM are involved in some form of DSP initiatives across most consumer segments. Examples of these include offering curtailability arrangements and pool price pass-through options in retail contracts with large C&I consumers, cogeneration design and implementation services, energy efficiency measures to meet obligations under mandated state schemes, sale of renewable energy products and services, and TOU pricing options.

However, there are intervening factors that may inhibit the retailers businesses from making DSP a business priority. Firstly, while there is some evidence that retailers are utilising DSP to hedge their exposure to high pool prices retailers have other alternatives available to them to manage financial risk. The most important are financial hedge contracts and utilising their own generation, both of which may be seen as providing a firmer and more reliable alternative to DSP for managing risk.

In addition, retailers have short-term relationships with many of their customers on market contracts, and therefore simply cannot afford to spend significant amounts of time and effort working with them to identify DSP opportunities. Nor are they likely to make major infrastructure investments to support DSP, such as installing smart meters in consumers' premises, if they have no ability to recover these costs in the event that their customers switch to a competing retailer.

Retailers have skills and capabilities in place that support DSP including a direct customer relationship, tariff development, marketing skills and offering products and services through their websites to assist consumers in managing their energy use. As such, they are well placed to play a role in encouraging consumers to engage in DSP.

The market conditions needed to enhance DSP from retailers include:

- active participation by retailers in developing and offering DSP products, services and tariffs to their customers;
- ability to recover costs of web portals, HANs providing of their DSP investment in their regulatory approvals; and

- business cultures that support and encourage collaborative approaches to exploring DSP options, supporting existing initiatives and trials and developing new DSP opportunities with other market participants.

DSP Aggregators and market intermediaries

It is important that there are independent third-party aggregators in the market that can provide a high quality service that is separate to the retail function in the market. Aggregators specialise in working with consumers to identify cost-effective demand response opportunities, design, finance and install any necessary equipment required to implement the demand response strategy, and aggregate the available demand response across a portfolio of retail consumers to offer this into the market.

Aggregators are also able to work with consumers on a much longer term basis to identify and implement medium to long-term DSP potential, whereas a retailer's relationship with that same consumer may be limited to the duration the consumer remains the retailer's customer.

As noted in Section 6.2 third party product and service providers are also able to play a valuable role in the market in providing consumers across all sectors with choice in the products and services they may need to manage their energy use in response to pricing and incentive based DSP initiatives.

A market condition is the active participation by demand aggregators and third party product and service providers in supporting consumers to identify and implement DSP opportunities.

Government program support

Commonwealth and State governments could encourage additional DSP by ensuring existing and proposed new energy efficiency and greenhouse gas reduction policies, programs and schemes incorporate specific peak demand reduction objectives within their scope. Examples of energy efficiency programs that could incorporate specific peak demand objectives include the EEO, ESS, and VEET schemes and the proposed National Energy Savings Initiative.

APPENDIX A: STOCKTAKE OF CURRENT AND PLANNED DSP PILOTS AND TRIALS

DSP Trial / Program Name	Sector	Proponent	Proponent type	State	Objective	DSP enabler	End-Uses targeted	Status
Microgeneration	Residential	ActewAGL	DNSP	NSW / ACT	Peak clipping	Distributed generation	n/a	Underway
Multi-utility smart metering trial	Residential	ActewAGL	DNSP	NSW / ACT	Energy efficiency	Information / feedback	all	Underway
Embedded generation trial	Business	Ausgrid	DNSP	NSW / ACT	Peak clipping	Distributed generation	n/a	Underway
Smart Grid,Smart City/Newington-DPP	Residential	Ausgrid	DNSP	NSW / ACT	Load shifting	Pricing	all	Underway
Smart Grid,Smart City/Newington-Dynamic Peak Rebates	Residential	Ausgrid	DNSP	NSW / ACT	Load shifting	Pricing	all	Underway
Smart Grid,Smart City/Newington-In home displays	Residential	Ausgrid	DNSP	NSW / ACT	Energy conservation	Information / feedback	all	Underway
Smart Grid,Smart City/Newington-residential distributed storage	Residential	Ausgrid	DNSP	NSW / ACT	Peak clipping	Distributed storage	n/a	Underway
Smart Grid,Smart City/Newington-residential PV	Residential	Ausgrid	DNSP	NSW / ACT	Peak clipping	Distributed generation	n/a	Underway
Smart Grid,Smart City/Newington-Seasonal TOU	Residential	Ausgrid	DNSP	NSW / ACT	Load shifting	Pricing	all	Underway
Smart Grid,Smart City/Newington-web portals/HAN control	Residential	Ausgrid	DNSP	NSW / ACT	Load shifting	Information / feedback	all	Underway
Strategic Pricing Study - DPP	Business	Ausgrid	DNSP	NSW / ACT	Load shifting	Pricing	all	Completed
Strategic Pricing Study - DPP high with IHD	Residential	Ausgrid	DNSP	NSW / ACT	Load shifting	Pricing	all	Completed
Strategic Pricing Study - DPP high without IHD	Residential	Ausgrid	DNSP	NSW / ACT	Load shifting	Pricing	all	Completed
Strategic Pricing Study - DPP medium with IHD	Residential	Ausgrid	DNSP	NSW / ACT	Load shifting	Pricing	all	Completed
Strategic Pricing Study - information only	Residential	Ausgrid	DNSP	NSW / ACT	Energy conservation	Information / feedback	all	Completed
Subsidised off-peak connections	Residential	Ausgrid	DNSP	NSW / ACT	Load shifting	Pricing	water heating	Underway
Blacktown Solar Cities - business energy effi-	Business	Big Switch	Non-NEM	NSW / ACT	Energy efficiency	Energy efficiency	all	Underway

DSP Trial / Program Name	Sector	Proponent	Proponent type	State	Objective	DSP enabler	End-Uses targeted	Status
ciency trial								
Blacktown Solar Cities - ceiling insulation	Residential	Big Switch	Non-NEM	NSW / ACT	Energy efficiency	Energy efficiency	air-conditioners	Underway
Blacktown Solar Cities - home energy audits	Residential	Big Switch	Non-NEM	NSW / ACT	Energy efficiency	Information / feedback	all	Underway
Blacktown Solar Cities - commercial PV trial	Business	BP Solar	Non-NEM	NSW / ACT	Peak clipping	Distributed generation	n/a	Underway
Blacktown Solar Cities - residential PV trial	Residential	BP Solar	Non-NEM	NSW / ACT	Peak clipping	Distributed generation	n/a	Underway
Blacktown Solar Cities - aircon cycling	Residential	Endeavour Energy	DNSP	NSW / ACT	Peak clipping	Direct load control	airconditioners	Underway
Blacktown Solar Cities - dynamic peak pricing	Residential	Endeavour Energy	DNSP	NSW / ACT	Load shifting	Pricing	all	Underway
Blacktown Solar Cities - energy efficiency packs	Residential	Endeavour Energy	DNSP	NSW / ACT	Energy efficiency	Energy efficiency	all	Underway
Blacktown Solar Cities - pool pump load control	Residential	Endeavour Energy	DNSP	NSW / ACT	Load shifting	Direct load control	pool pumps	Underway
Blacktown Solar Cities - STOU pricing	Residential	Endeavour Energy	DNSP	NSW / ACT	Load shifting	Pricing	all	Underway
*Cool*Saver-DRED aircon control	Residential	Endeavour Energy	DNSP	NSW / ACT	Peak clipping	Direct load control	air-conditioners	Underway
Futureview	Residential	Endeavour Energy	DNSP	NSW / ACT	Energy conservation	Information / feedback	all	Underway
*Peak*Saver-PTR	Residential	Endeavour Energy	DNSP	NSW / ACT	Load shifting	Pricing	all	Underway
Powerview	Residential	Endeavour Energy	DNSP	NSW / ACT	Energy conservation	Information / feedback	all	Underway
Smart grid pilot-DRED enabled airconditioners	Residential	Endeavour Energy	DNSP	NSW / ACT	Peak clipping	Direct load control	airconditioners	Underway
Smart grid pilot-HAN device control	Residential	Endeavour Energy	DNSP	NSW / ACT	Load shifting	Direct load control	smart appliances	Underway
Smart grid pilot-pool pump control	Residential	Endeavour Energy	DNSP	NSW / ACT	Load shifting	Direct load control	pool pumps	Underway
Smart grid pilot-PTR	Residential	Endeavour Energy	DNSP	NSW / ACT	Load shifting	Pricing	all	Underway

DSP Trial / Program Name	Sector	Proponent	Proponent type	State	Objective	DSP enabler	End-Uses targeted	Status
Smart grid pilot-web portal	Residential	Endeavour Energy	DNSP	NSW / ACT	Energy conservation	Information / feedback	all	Underway
Western Sydney Pricing Trial - DPP	Residential	Endeavour Energy	DNSP	NSW / ACT	Load shifting	Pricing	all	Completed
Western Sydney Pricing Trial - DPP&IHD	Residential	Endeavour Energy	DNSP	NSW / ACT	Load shifting	Pricing	all	Completed
Western Sydney Pricing Trial - Seasonal TOU	Residential	Endeavour Energy	DNSP	NSW / ACT	Load shifting	Pricing	all	Completed
Intelligent Community Initiative - dynamic pricing	Residential	Essential Energy	DNSP	NSW / ACT	Peak clipping	Pricing	all	Underway
Intelligent Community Initiative - In home displays	Residential	Essential Energy	DNSP	NSW / ACT	Energy conservation	Information / feedback	all	Underway
Intelligent Community Initiative - residential PV	Residential	Essential Energy	DNSP	NSW / ACT	Peak clipping	Distributed generation	n/a	Underway
Alice Springs Solar Cities - business energy efficiency	Business	Alice Springs Town Council	Non-NEM	NT	Energy efficiency	Energy efficiency	all	Underway
Alice Springs Solar Cities - residential energy efficiency	Residential	Alice Springs Town Council	Non-NEM	NT	Energy efficiency	Energy efficiency	all	Underway
Alice Springs Solar Cities - residential PVs	Residential	Alice Springs Town Council	Non-NEM	NT	Peak clipping	Distributed generation	n/a	Underway
Alice Springs Solar Cities - res cost reflective tariffs	Residential	Power and Water Corp	Non-NEM	NT	Peak clipping	Pricing	all	Underway
Alice Springs Solar Cities - smart meters & IHDs	Residential	Power and Water Corp	Non-NEM	NT	Energy efficiency	Information / feedback	all	Underway
Commercial & Industrial initiative - curtailable loads	Business	Energex	DNSP	QLD	Load shifting	Network support arrangements	curtailable loads	Underway
Commercial & Industrial initiative - embedded generation	Business	Energex	DNSP	QLD	Peak clipping	Network support arrangements	generators	Underway
Commercial & Industrial initiative - energy efficiency & PFC	Business	Energex	DNSP	QLD	Energy efficiency	Energy efficiency	all	Underway

DSP Trial / Program Name	Sector	Proponent	Proponent type	State	Objective	DSP enabler	End-Uses targeted	Status
Conversion of hot water service tariffs	Residential	Energex	DNSP	QLD	Load shifting	Pricing	water heating	Underway
Energy Conservation Communities - DRED aircon	Residential	Energex	DNSP	QLD	Peak clipping	Direct load control	airconditioners	Underway
Energy Conservation Communities - hot water	Residential	Energex	DNSP	QLD	Load shifting	Direct load control	water heating	Underway
Energy Conservation Communities - pool pumps	Residential	Energex	DNSP	QLD	Load shifting	Direct load control	pool pumps	Underway
Hot water optimisation	Residential	Energex	DNSP	QLD	Load shifting	Direct load control	water heating	Underway
Instantaneous hot water DRED DLC	Residential	Energex	DNSP	QLD	Peak clipping	Direct load control	water heating	Planning
Residential Solar PV with storage	Residential	Energex	DNSP	QLD	Peak clipping	Distributed generation	n/a	Planning
Residential Targeted Initiatives - aircon DLC	Residential	Energex	DNSP	QLD	Peak clipping	Direct load control	airconditioners	Underway
Residential Targeted Initiatives - pool pumps	Residential	Energex	DNSP	QLD	Load shifting	Direct load control	pool pumps	Underway
Residential Targeted Initiatives - water heating	Residential	Energex	DNSP	QLD	Load shifting	Direct load control	water heating	Underway
Smart appliance / HAN trial	Residential	Energex	DNSP	QLD	Load shifting	Direct load control	smart appli-ances	Planning
Energy information web-site (EIW) - business info	Business	Energex / Ergon Energy	DNSP	QLD	Energy efficiency	Information / feedback	all	Underway
Energy information web-site (EIW) - residential info	Residential	Energex / Ergon Energy	DNSP	QLD	Energy efficiency	Information / feedback	all	Underway
Reward based tariff trials	Residential	Energex/Ergon	DNSP	QLD	Load shifting	Pricing	all	Underway
Chilled Water Air Conditioning on Single Wire Earth Return (SWER) Networks	Business	Ergon Energy	DNSP	QLD	Load shifting	Thermal energy storage	airconditioners	Completed
Commercial Building Management Network-Automated DR	Business	Ergon Energy	DNSP	QLD	Peak clipping	Direct load control	HVAC / other	Underway

DSP Trial / Program Name	Sector	Proponent	Proponent type	State	Objective	DSP enabler	End-Uses targeted	Status
Embedded generation trial	Business	Ergon Energy	DNSP	QLD	Peak clipping	Distributed generation	n/a	Underway
Energy Conservation Communities (Mt Isa / Mackay)	Residential	Ergon Energy	DNSP	QLD	Peak clipping	Pricing	all	Underway
Energy Savers pilot project	Residential	Ergon Energy	DNSP	QLD	Energy efficiency	Energy efficiency	all	Completed
Grid Utility Support System – Phase 2	Business	Ergon Energy	DNSP	QLD	Peak clipping	Distributed generation	n/a	Underway
North QLD load management harmonisation project	Residential	Ergon Energy	DNSP	QLD	Load shifting	Direct load control	water heating	Underway
Residential Air Conditioning Cleaning and Maintenance Trial	Residential	Ergon Energy	DNSP	QLD	Energy efficiency	Energy efficiency	airconditioners	Completed
Residential Targeted Initiative - Airconditioner DLC trial	Residential	Ergon Energy	DNSP	QLD	Peak clipping	Pricing	airconditioners	Underway
Residential Targeted Initiative - Pool pump and filtration DLC trial	Residential	Ergon Energy	DNSP	QLD	Load shifting	Pricing	pool pumps	Underway
Toowomba Power factor correction trial	Business	Ergon Energy	DNSP	QLD	Peak clipping	Power factor correction	all	Underway
Townsville Commercial NDM pilot	Business	Ergon Energy	DNSP	QLD	Energy efficiency	Network support ar-rangements	all	Underway
Townsville Energy Sense Communities	Residential	Ergon Energy	DNSP	QLD	Peak clipping	Pricing	all	Planning
Townsville Energy Sense Communities	Business	Ergon Energy	DNSP	QLD	Peak clipping	Pricing	all	Planning
Townsville Solar Cities - business solar PV	Business	Ergon Energy	DNSP	QLD	Peak clipping	Distributed generation	n/a	Underway
Townsville Solar Cities - energy assessments (business)	Business	Ergon Energy	DNSP	QLD	Energy efficiency	Energy efficiency	all	Underway
Townsville Solar Cities - energy assessments (residential)	Residential	Ergon Energy	DNSP	QLD	Energy efficiency	Energy efficiency	all	Underway

DSP Trial / Program Name	Sector	Proponent	Proponent type	State	Objective	DSP enabler	End-Uses targeted	Status
Townsville Solar Cities - housing design trial	Residential	Ergon Energy	DNSP	QLD	Energy efficiency	Energy efficiency	all	Underway
Townsville Solar Cities - peak demand reduction trial	Residential	Ergon Energy	DNSP	QLD	Load shifting	Pricing	all	Underway
Townsville Solar Cities - residential solar PV	Residential	Ergon Energy	DNSP	QLD	Peak clipping	Distributed generation	n/a	Underway
Townsville Solar Cities - smart meter & IHD trial	Residential	Ergon Energy	DNSP	QLD	Energy conservation	Information / feedback	all	Underway
Adelaide Solar Cities - business energy efficiency	Business	Big Switch	Non-NEM	SA	Energy efficiency	Energy efficiency	all	Underway
Adelaide Solar Cities - home energy audits	Residential	Big Switch	Non-NEM	SA	Energy efficiency	Energy efficiency	all	Underway
Adelaide Solar Cities - commercial PV	Business	BP Solar	Non-NEM	SA	Peak clipping	Distributed generation	n/a	Underway
Adelaide Solar Cities - residential PV	Residential	BP Solar	Non-NEM	SA	Peak clipping	Distributed generation	n/a	Underway
Commercial load shifting - TES SME trial	Business	ETSA Utilities	DNSP	SA	Load shifting	Thermal energy storage	air-con/refrigeration	Completed
Commercial load shifting - TES trials	Business	ETSA Utilities	DNSP	SA	Load shifting	Thermal energy storage	air-con/refrigeration	Completed
CriticalPeak Pricing - commercial trial	Business	ETSA Utilities	DNSP	SA	Load shifting	Pricing	all	Completed
CriticalPeak Pricing - residential trial	Residential	ETSA Utilities	DNSP	SA	Load shifting	Pricing	all	Completed
Direct load control - Commercial BMS trial	Business	ETSA Utilities	DNSP	SA	Peak clipping	Direct load control	HVAC / other	Completed
Direct load control - commercial load limitation	Business	ETSA Utilities	DNSP	SA	Peak clipping	Direct load control	HVAC / other	Completed
Direct load control - domestic load limitation	Residential	ETSA Utilities	DNSP	SA	Peak clipping	Direct load control	all	Completed
Direct load control - phase 1 trial	Residential	ETSA Utilities	DNSP	SA	Peak clipping	Direct load control	airconditioners	Completed
Direct load control - phase 2 trial - business	Business	ETSA Utilities	DNSP	SA	Peak clipping	Direct load control	airconditioners	Completed

DSP Trial / Program Name	Sector	Proponent	Proponent type	State	Objective	DSP enabler	End-Uses targeted	Status
Direct load control - phase 2 trial - residential	Residential	ETSA Utilities	DNSP	SA	Peak clipping	Direct load control	airconditioners	Completed
Direct load control - phase 3 trial	Residential	ETSA Utilities	DNSP	SA	Peak clipping	Direct load control	airconditioners	Completed
DLC with AMI trial (DRED aircon trial)	Residential	ETSA Utilities	DNSP	SA	Peak clipping	Direct load control	airconditioners	Underway
Domestic load shifting - TOU trial	Residential	ETSA Utilities	DNSP	SA	Load shifting	Pricing	all	Completed
Load reduction trial 1 (standby generators)	Business	ETSA Utilities	DNSP	SA	Peak clipping	Network support arrangements	generators	Completed
Powerfactor correction trial - tariff rationalisation project	Business	ETSA Utilities	DNSP	SA	Peak clipping	Power factor correction	all	Completed
Adelaide Solar Cities - DPP pricing	Residential	Origin Energy	Retailer	SA	Load shifting	Pricing	all	Underway
Adelaide Solar Cities - home energy efficiency retrofits	Residential	Origin Energy	Retailer	SA	Energy efficiency	Energy efficiency	all	Underway
Adelaide Solar Cities - IHDs	Residential	Origin Energy	Retailer	SA	Energy conservation	Information / feedback	all	Underway
Adelaide Solar Cities - TOU pricing	Residential	Origin Energy	Retailer	SA	Load shifting	Pricing	all	Underway
Hot water heating study	Residential	Aurora Energy	DNSP	TAS	Load shifting	Direct load control	water heating	Underway
Moreland Solar Cities - cogeneration	Business	Moreland City Council	Non-NEM	Victoria	Peak clipping	Distributed generation	n/a	Underway
Moreland Solar Cities - low income energy audits	Residential	Moreland City Council	Non-NEM	Victoria	Energy efficiency	Energy efficiency	all	Underway
CentralVictoriaSolarCity - cost reflective tariff	Residential	Origin Energy / Powercor	DNSP	Victoria	Peak clipping	Pricing	all	Underway
CentralVictoriaSolarCity - residential PV	Residential	Origin Energy / Powercor	DNSP	Victoria	Peak clipping	Distributed generation	n/a	Underway
Battery storage initiative	n/a	SP AusNet	DNSP	Victoria	Peak clipping	Distributed storage	all	Planning

DSP Trial / Program Name	Sector	Proponent	Proponent type	State	Objective	DSP enabler	End-Uses targeted	Status
Commercial & Industrial CPP tariff	Business	SP AusNet	DNSP	Victoria	Peak clipping	Pricing	all	Underway
In Home Displays	Residential	SP AusNet	DNSP	Victoria	Energy conservation	Information / feedback	all	Underway
CentralVictoriaSolarCity - business energy efficiency	Business	SRA	Non-NEM	Victoria	Energy efficiency	Energy efficiency	all	Underway
CentralVictoriaSolarCity - residential energy audits	Residential	SRA	Non-NEM	Victoria	Energy efficiency	Information / feedback	all	Underway
Distributed generation initiative	Business	United Energy	DNSP	Victoria	Peak clipping	Distributed generation	n/a	Planning
Residential DM trials - various approaches	Residential	United Energy	DNSP	Victoria	Peak clipping	Direct load control	airconditioners	Planning
Residential DM trials - various approaches	Residential	United Energy	DNSP	Victoria	Load shifting	Direct load control	pool pumps	Planning
Perth Solar Cities - Living Smart	Residential	EMRC	Non-NEM	WA	Energy conservation	Information / feedback	all	Underway
Perth Solar Cities - residential eco-consultations	Residential	Mojarra	Non-NEM	WA	Energy conservation	Information / feedback	all	Underway
Perth Solar Cities - In home displays	Residential	Synergy	Retailer	WA	Energy conservation	Information / feedback	all	Underway
Perth Solar Cities - commercial PV	Business	Western Power	DNSP	WA	Peak clipping	Distributed generation	n/a	Underway
Perth Solar Cities - residential PV	Residential	Western Power	Non-NEM	WA	Peak clipping	Distributed generation	n/a	Underway
Perth Solar Cities - aircon DLC trial	Residential	Western Power / Synergy	Non-NEM	WA	Peak clipping	Direct load control	airconditioners	Underway

APPENDIX B: DSP PILOTS AND TRIALS CASE STUDY PROFILES

Air Conditioner Direct Load Control – ETSA Utilities

Overview

Residential air conditioners are a major contributor to peak loads in South Australia. This was a driving factor in the implementation of the DLC trials implemented by ETSA Utilities.

Aims

Specific issues ETSA Utilities' DLC trials included an assessment of:

- the cost-effectiveness of different DLC control technologies;
- customer acceptance and take-up at various types and levels of initiative;
- load reduction impacts;
- impact of cycling on air-conditioning operation; and
- customer comfort, customer satisfaction; and the willingness of customers to stay on the program.

Scope

ETSA Utilities developed a series of five DLC projects involving domestic consumers to achieve the trial aims outlined above:

- direct load control phase I;
- direct load control phase II; II(a), and II(b); and
- direct load control phase III.

The key objectives of the trials were to to develop an understanding of various DLC technologies and air conditioner control strategies in order to maximise the load reduction obtained without impacting on the comfort and amenity of participants. Each of the successive phases incorporated increasingly sophisticated controllers developed by ETSA Utilities.

Recruitment

The phase 1 trial included 20 domestic sites in the Adelaide metropolitan area. In phase 2 some 4,000 customers in the in the suburb of Glenelg expressed interest in participating. Just over half of the respondents had air conditioners suited to DLC. Phase 3 included 1000 domestic customers with the majority of the sites were in the new northern Adelaide suburb of Mawson Lakes, where larger air conditioning units could be trialled. Ultimmatly the DLC trials iinlcuded about 2,000 residential and commercial participants in the suburbs of Glenelg, Mawson Lakes, Northgate and the regional town of Murray Bridge.

Customers participating in the phase 2 and 3 trials received $100 in incentive payments.

Intervention

DLC of air conditioners

Budget

Confidential

Outcomes

ETSA Utilities found an average 19% reduction in peak demand (0.45 kW) from 68 households in the Glenelg area. To achieve this reduction the air conditioners were cycled 15 minutes off every 30 minutes over a 3.5 to 4 hours period commencing at 3:45 pm. Higher peak demand reductions of 1.34 kW per participant were achieved in Mawson Lakes due to targeting larger centrally ducted air conditioners.

Customer response and lessons learned

ETSA Utilities found that the level of customer interest and willingness to participate in the air conditioner DLC trials varied greatly across the trial locations, and in some areas and regions that recruitment was somewhat problematic. For example, in Glenelg interest and take-up was significantly higher than in Mawson Lakes and Northgate. In addition, in some areas (Mawson Lakes and Northgate) only 20%of air conditioners were suitable to participate in the trials for technical reasons. Overall take-up up for the trials were estimated at 10%, on average, by ETSA Utilities, and:

- importantly, the switching (cycling levels) trialled did not negatively impact on customer's comfort levels;
    - for the Glenelg trial switching cycles of 15 minutes off every 30 minutes were able to be sustained without experiencing any change in their comfort levels within participant's homes, whereas at Mawson Lakes a less 'severe' switching cycle of 7.5 minute off every 30 minutes over 4 hours appeared to be the most acceptable to participants, and
- consumers in older houses with smaller rooms that heated up more slowly during a DLC event experienced fewer impacts on household amenity compared with more modern open plan homes with large rooms and expanses of glass.

Sources:

ETSA Utilities. *Demand Management Program Interim Report No. 2.* 2008.

ETSA Utilities. *Demand Management Program Interim Report No. 3.* 2010.

Blacktown Solar City Air Conditioner and Pool Pumps DLC – Endeavour Energy

Overview

As part of its involvement in Blacktown Solar City (BSC), Endeavour Energy (then Integral Energy) undertook several trials to evaluate the potential for demand response from direct load control of residential air conditioners and swimming pool pumps. The trial was conducted between 2008 and 2009.

Aims

The aims of the trial were to determine the potential peak demand reduction impacts and consumer acceptance of remotely cycling residential air conditioners. The trial also tested a new type of swimming pool timer for controlling pool pump operation over the peak period, known as a Thermaswitch, that is activated according to both temperature and time of day.

Scope

The air conditioner remote cycling trial involved 594 residential participants that commenced the trial, of which 529 (89%) completed the trial.

A total of 661 participants commenced the pool pump trial, of which 642 (97%) completed the trial.

Recruitment

More than 10,000 households in the Blacktown area were invited to participate in the two trials. A total of 1,490 customers were initially recruited for the air conditioner trial and 847 for the pool pump trial, representing a 15% and 8% take-up rate, respectively.

Intervention

The trials involved the following technologies and interventions:

- external load control switch, ripple control, and interval meter for monitoring and verifying the load reductions;
- participants in the air conditioner cycling trial received a $25 credit on their bill at the commencement of the trial and $75 at end of the trial; and
- participants in the pool pump trial received a $25 bill discount for allowing their pool pump to be turned off by a ‘thermaswitch’ timer device on hot days over the summer period between 1 pm and 8 pm.

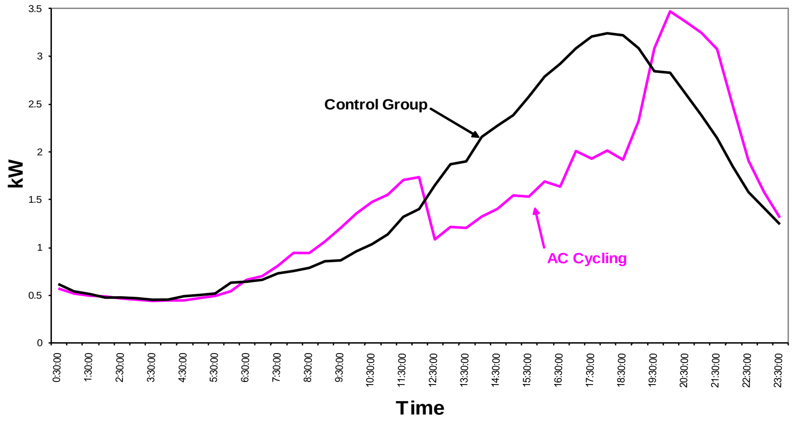
Budget

Not available. Cost effectiveness analysis of the trial is yet to be undertaken.

Outcomes

The BSC trial achieved a 27% reduction in peak demand equating to an average demand reduction of 1.2 kW per participant. Air conditioners were cycled over a seven hour control period between 1 pm and 8 pm on event days.

The following chart provides illustrative load profiles for the air conditioner cycling and control groups during the dispatch event called on the 14 Jan 2009.



Source: Endeavour Energy. *Customer Engagement in Smart Grid.* 2011.

The BSC pool pump trial achieved average demand reductions of up 36% in household peak demand and an average demand reduction of around 1 kW per pool pump.

Customer response and lessons learned

Feedback from participants in the BSC air conditioner trial indicated that:

- 60% of customers were very satisfied with their involvement in the trial, while only 8% indicated that they were expressly dissatisfied;
- 43% joined the trial to either save money, save energy or receive an incentive payment, 30% joined because they were curious and wanted to learn more about the concept, while 17% joined for environmental reasons;
- 69% of participants would re-sign up if the program was offered again, and
- 61% indicated they would participate again even if no incentive payments were offered.

Overall, satisfaction with the BSC pool pump trial was also very positive, with:

- 72% of trial participants were very satisfied with their involvement in the trial with only 8% of participants reported being dissatisfied;
- 50% of participants joined the trial as a way of either saving money, saving energy or receiving an incentive payment; 32% joined because they were curious and interested in being involved in something new, while 10% joined for environmental reasons; and
- 76% would be willing to participate again, with more than 50% indicating that they would participate again even if no incentives were offered.

Sources:

Wyld Group, *Mid-term Review of the Solar Cities Program*, 2011,

Integral Energy. '*You've Helped Make a Real Difference*' (brochure). 2009.

Endeavour Energy. *Customer Engagement in Smart Grid*. 2011.

Air Conditioner DLC trial – Perth Solar City – Western Power

Overview

Air conditioner loads are a significant contributor to peak demand on the Western Power network. An air conditioner DLC program has been implemented by Western Power as part of the Australian Government's Perth Solar City program to investigate the potential for DLC to reduce or defer network capital expenditure. The trial ran over the 2010/11 summer and will also run over the 2011/12 summer.

Aims

Aims of the trial are to:

- investigate the potential and cost-effectiveness of peak load reduction from DLC of residential air conditioners within a smart grid environment;
- evaluate customer acceptance of air conditioner DLC offerings including rebate levels;
- increase system utilisation and reduce peak demand;
- gain experience in the technical, costs and operational aspects of DLC; and
- help inform future government policy.

Scope

The trial involved 203 residential consumers in the first year. The total target number is 375 over the two years of the trial.

Recruitment

Participants in the first year were recruited by Synergy, the electricity retailer, through a mail-out campaign. Other recruiting methods such as telemarketing are being investigated for the second year of the trial.

Intervention

The trial comprised:

- an annual rebate of $100 per household;
- external demand response enabled device (DRED) to adjust the airconditioner thermistor on a 15 min on / off cycle up to a maximum of 10 events each summer;
- load control events are usually called on days forecast to be above 35 deg C;
- smart meter with wireless communications through the Zigbee home area network; and
- customer education and engagement.

Budget

Not available. Cost effectiveness analysis of the trial is yet to be undertaken.

Outcomes

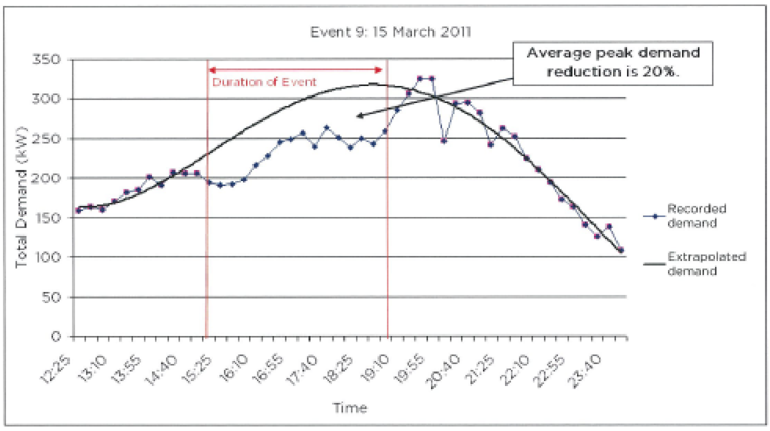
Consumer behaviour

The DLC strategy eliminates the need for consumer interaction or for consumers to alter their behaviour as control of the air conditioner is undertaken remotely.

Peak Demand and Energy Reduction Impacts

The following diagram shows the aggregate daily load profile of a segment of the trial group on one of the control days relative to a baseline.

Average load reduction over the peak period is 20% or an estimated 0.6 kW per participant.



Source: Western Power. *Building a Smart Grid in Western Australia.* 2011.

Customer response and lessons learned

The key findings from the first year of the trial are:

- there were no customer complaints or concerns received from participants related to comfort conditions during DLC events;
- the duration of the control period was initially kept short and then gradually increased as experience was gained ;
- while there were no complaints, internal temperature measurements will be undertaken in the second year of the trial to obtain actual data on the change in internal comfort conditions, and
- the rebate level has been increased in the second year to $200 to help increase the participation rate.

Sources:

Western Power. *Building a Smart Grid in Western Australia.* 2011.

Personal communication with Stephen Iacopetta, Western Power.

Cool Change Air Conditioner and Pool Pump DLC – Energex

Overview

The Cool Change - energy Smart Suburbs Peak Demand Trial was Energex's first energy conservation and demand management initiative to be launched and reported to be the largest trial of its kind in Australia. The trial was launched in 2007 and is planned to run over four years.

Aims

The aim of the trial to reduce energy use during peak demand times by 'cycling' residential air conditioners and curtailing pool pumps that are operating over the peak period, without impacting on customer comfort or convenience. The trial supports Energex's overall demand management strategy which aims to:

- make better use of public resources;
- encourage energy efficiency and energy conservation in the community; and
- minimise the impact of price increases on future electricity bills.

Scope

The technique of 'cycling' the compressor of air conditioner compressor for short periods of time over the peak period is the key technical element of the trial. This technique has been used internationally and in South Australia, with the objective of managing the normal on/off cycling of the air conditioner compressor. Being the first trial of air conditioner compressor cycling, Energex took a very conservative approach.

Households with swimming pools not already supplied by an off-peak tariff were eligible to apply.

Recruitment

The trial is being conducted in the suburbs north of Brisbane – Arana Hills, Albany Creek, Everton Hills, Ferny Hills, Bridgeman Downs, Everton Park, Ferny Grove, McDowall and Bunya, an area that comprises 16,000 residences. Of these:

- over 2,300 residences, 14% of all residences in the trial area, responded to the invitation to be included in the air conditioner trial in over the first summer (2007/08), with 909 residences selected from 2,300 respondents.
- in the second summer of the air conditioner trial (2008/09), 950 new customers joined, bringing the total participants to over 1,800; and
- in the third summer (2009/10) the trial was expanded to include pool pump load control for the first time, with over 600 participants elected to have a device installed to their pool filtration system.

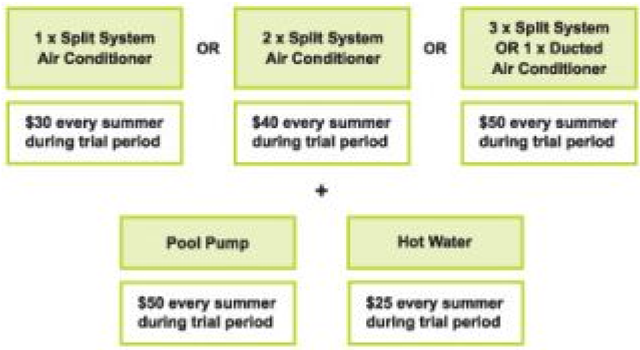
By 31 March 2011 there were 1,795 air-conditioner and 400 pool pump load control devices installed.

Intervention

Participants receive their choice of a $100 Coles/Myer or Bunnings gift voucher upon successful installation of a device.

Participants receive cash incentives from $30 to $125 dependant on the number of air conditioners and pool pumps that are included in the trial. This is distributed as a cheque, posted at the end of the summer in each trial year that devices are installed.

The cash rebate is calculated as follows:



Source: Energex website

Energex also offered and in most cases install a pack of 10 energy-efficient compact fluorescent light (CFL) bulbs.

Depending on the model and type of air conditioning unit, an external load control device that is fitted either to a wall adjacent to the outdoor unit or located inside or near the indoor unit. During the trial, air conditioning units may be cycled off at the compressor for several minutes in 30 minute blocks while the fan continues to circulate air. In normal operation, the air conditioner's compressor cycles frequently. The trial devices simply mimic that function on the few days of extreme peak demand. As the device does not affect the operation of the air conditioner’s fan, Energex do not anticipate any impact on customer comfort.

The PeakSave device is installed on pool pumps and allows Energex to switch off the pool pumps for up to four hours during the peak periods. The maximum number of events is capped at 15 – 20 times a year between the peak periods of 3 – 8 pm for up to four hours at a time.

The device also includes an inbuilt timer, a boost button override allowing participants to turn the power back on over the peak period if required for up to one hour, and a special electrical plug that allows for easy disconnection.

Participants are able to opt out of the Cool Change trial at any time by advising Energex in writing that they wish to withdraw and the load control devices are removed from appliances at no cost.

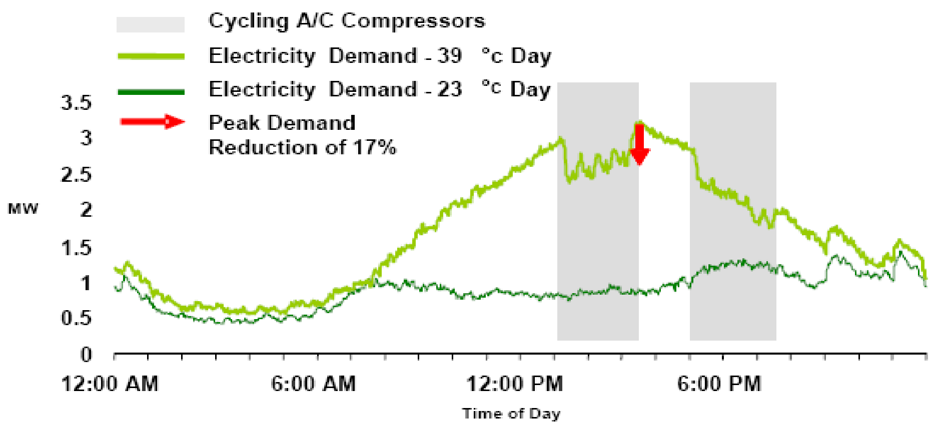
Budget

Not available. Cost effectiveness analysis of the trial is yet to be undertaken.

Outcomes

Energex’s Cool Change air conditioner trial found annual average demand reductions of 17% in 2007/08, 20% in 2008/09 and 13% in 2009/10. This equates to 17% demand reduction and 0.9 kW per participant averaged over the three summers of the trial.

The following chart Energex Cool Change illustrates the impacts of air conditioner cycling over the peak period.



Source: Energex. *Time for a Cool Change*. 2008.

Energex's Cool Change pool pump DLC trial has found average peak demand reductions of about 0.8 kW after diversification from the 400 pool pump 'Peaksave' load control devices installed to date.

Customer response and lessons learned

Air conditioner trial

Surveys conducted throughout the trial period over the first summer (2007/08) found that over 90 per cent of participants on the air conditioner trial reported either no or negligible impact on internal comfort within their homes as a result of their air conditioners being cycled.

Energex also found that participants were generally very satisfied with their involvement in the trial with very few complaints received overall (7%). Of the small number of complaints received 70% were later found to have been unrelated to the trial and mostly associated with existing technical faults or defects with the air conditioner.

Almost all participants (90%) expressed a willingness to participate again with 88% reporting they would refer family and friends to the trial.

Pool pump trial

Over 90% of participants on the pool pump trial indicating that they would be willing to continue to participate in future.

Significantly, 59% of participants permanently changed their pool filtering time, to mostly outside of the peak demand period as a result of their involvement in the trial.

Sources

www.energex.com.au/sustainability/energy-conservation-and-demand-management/cool-change-energy-smart-suburbs/how-the-trial-works

Energex. *Cool Change Trial Brochure* – November 2009.

Energex. *Time for a Cool Change*. 2008.

*Cool*Saver Air conditioner DLC– Endeavour Energy

Overview

This three-year program was implemented in FY2010/11 as part of an integrated DSP program to defer augmentation of the Rooty Hill zone sub-station. The program is being implemented under the AER's DMIA scheme.

Aims

The aims of the project are to:

- develop systems and processes to make future air conditioner DLC programs more cost-effective to implement;
- gain consumer acceptance of the approach; and
- develop in-house capabilities and experience for smart grid customer application readiness.

Scope

The *Cool*Saver program seeks to obtain 500 kVA of peak load reduction from 200 households (i.e. an average of 2.5 kVA per household). The program is being conducted in Rooty Hill, Dean park, Glendenning, Hassall Grove, Mount Druitt, Oakhurst, Plumpton, Quakers Hill, Colebee, Acacia Gardens, Arndell Park, Doonside and Woodcroft.

Customers invited to participate in the *Cool*Saver were those with an existing AS4755.3.1 Demand Response Enabled Device (DRED) enabled ducted air conditioner capable of reducing its energy consumption by 50% upon receipt of a signal from Endeavour Energy. Only certain air conditioner models in the Actron Air and Daikin range were found to meet these requirements at the time of the trial.

The *Cool*Saver is open to residential customers who live in owner occupied homes. Customers in rental accommodation are unable to participate in the *Cool*Saver program.

Recruitment

The *Cool*Saver program is being rolled out over a three year period, as follows:

- 50 customers were targeted in year 1 (2010-11), although only 11 customers signed up to participate;
- 72 additional customers are being targeted in year 2 (2011 - 12); and
- 78 in year 3 (2012 - 13), giving a total of 200 customers for the program.

Recruitment is being undertaken via telemarketing calls, an online application form and direct mail-out.

Intervention

Eligible participants receive a rebate of $60 for taking part each year for up to two years, and a free air conditioner service worth over $100 as a sign up bonus.

The air conditioner is also fitted with a free retrofit kit and relay that receives and activates the DRED function, by a qualified technician.

A smart meter measuring half hourly consumption is installed in participant's premises, and while not essential for the program's operation, was used to monitor and verify the load reduction.

Load curtailments events are initiated when the Rooty Hill zone sub-station might become overloaded (typically this occurs on summer days when temperatures are over 35degrees Celsius). The exact days will be selected by Endeavour Energy up to a maximum of 6 dispatch events during the summer period from 1 November to 31 March (excluding weekends and public holidays), between 2 PM and 7 PM.

Due to the automated load control system customers are not required to take any action during *Cool*Saver load reduction events. Customers were also not notified of a planned load curtailment for the same reason.

Budget

Confidential

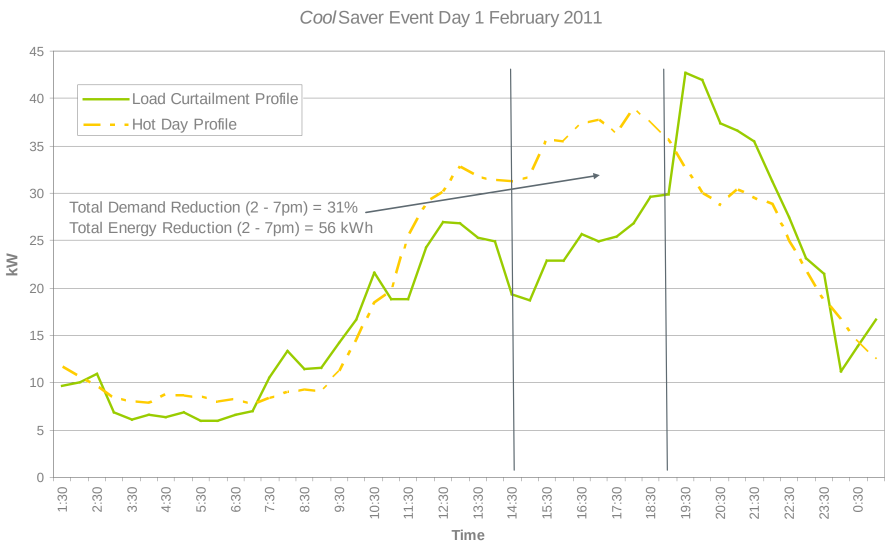
Outcomes

There were four events conducted out of a possible six during the 2010/11 summer being:

Results for the 25 January 2011 and 1 March 2011 were excluded from the analysis due to lower than expected temperatures on those days which reduced the probability of air conditioners operating.

The average demand reduction (excluding 25 January 2011 and 1 March 2011) is 1.3 kVA per household and the average peak demand reduction (excluding 25 January 2011 and 1 March 2011) is 1.7 kVA per household. With more customers participating in the program for the 2011/12 summer, a more reliable figure will be determined.

The aggregated load profile and baseline for the peak day dispatch event of Tuesday 1 February 2011 is presented below, as an illustrative example.



Source: Endeavour Energy. *Peak*Saver & *Cool*Saver *RESIDENTIAL DEMAND MANAGEMENT PROGRAMS Year 1 Evaluation Report.* 2011 (Cut-down Version).

Overall the results showed a lower than expected kVA demand reduction per participant for *Cool*Saver (1.3 as compared to 2.5), which is possibly attributed to *Cool*Saver participant air conditioning capacities being smaller than expected, ranging from 4kW to 6kW electrical input rating.

Customer response and lessons learned

Follow-up research with program participants indicated that *Cool*Saver received a satisfaction rating of 78% and no material complaints.

There were no material complaints made by participants. Comments received directly following a number of the *Cool*Saver events included:

- 1 Feb 2011 event – customer felt that since the meter was changed, their air conditioner has not been operating the same;
- 3 Feb 2011 event – customer wanted to know if the equipment fitted would void the warranty of the air conditioner. Endeavour Energy's response was to inform the customer that the warranty was not void and that the kit installed was provided by the air conditioner manufacturer.

The main reasons customers gave for participating in the *Cool*Saver program are presented graphically on the next page; were:

- saving some money on their electricity bills, or a combination of saving money along with a curiosity at how much power they use
- environmental concerns; and
- to a lesser extent, participants were attracted to the programs because they were new concepts.

The key findings for *Cool*Saver are:

- The disappointing take-up rate in the first year of 11 participants (out of a planned 50) was attributed to the target market being greatly over estimated. Targeting AS4755.3.1 air conditioners severely restricted the potential target audience due to the small number of compliant units on the market;
- Customers generally did not understand the link between calling an event and a very hot day;
- Customer also would like more information on how the program works, notification of a peak event and what to expect when their air conditioner power consumption is reduced by 50%; and
- The offer may not have been very attractive, trade-off between comfort and incentives.

Sources

Endeavour Energy. *Peak*Saver *& Cool*Saver *RESIDENTIAL DEMAND MANAGEMENT PROGRAMS Year 1 Evaluation Report.* 2011 (Cut-down Version).

http://www.endeavourenergy.com.au/wps/wcm/connect/EE/NSW/NSW+Homepage/communityNav/CoolSaver/.

TOU Tariff Trial – Ausgrid

Overview

Ausgrid (operating as EnergyAustralia) initiated an Advanced Metering Infrastructure (AMI) trial commenced that including a rollout of over 3000 smart meters.

Aims

The AMI trial commenced in 2006. Key objectives included:

- engaging customers in energy matters and usage decisions by providing them with timely price signals and increased awareness of their consumption patterns;
- attaining operational improvements through remote meter reading and control;
- investigating solutions for the next evolution of DLC services, including hot water; and
- facilitating the replacement of aging meters.

Scope

The customer engagement portion of the AMI technology trial was split into three phases. Work on phases 1 and 2 had been completed at the time of writing this report and included:

- phase 1 – assesses the effectiveness of TOU pricing from a network perspective by comparing customer's seasonal CMD on TOU tariffs and on flat tariffs; and
- phase 2 – gains an understanding of customer's general preferences for alternative retail pricing structures using choice modeling.

Recruitment

Customers with new and replacement meter installations were mandated on to the TOU tariff.

Intervention

N/A

Budget

Confidential

Outcomes

During the roll-out of the interval meters for the AMI trial some customers remained on IBT prices for a period of time before being switched across to TOU prices. According to Ausgrid's' reported consumer research related to the AMI trial, "…this has enabled a comparison between the consumption patterns of customers on IBT and TOU tariffs with manually read interval meters who had been on one of the network tariffs listed below:"[119]

- EA010 – IBT tariff for residential customers;

119 Ausgrid. *Network Pricing Study Customer Research Program.* 2011.

- EA050 – IBT tariff for business customers;
- EA025 – currently TOU tariff for residential customers; in the past denoted as TOU tariff for residential and business customers; and
- EA225 – currently TOU tariff for business customers."

The analysis was based on the concept of a normalised CMD. A customer's CMD as used in Ausgrid's analysis was defined as the customer's half hour interval electricity consumption during the half hour interval when either the system or the customer's local zone substation has its seasonal maximum demand interval. Normalised CMDs were calculated using the seasonal average daily load for each class of customers (TOU or IBT) as the normalising factor. The normalisation procedure was used to correct for bias arising from the difference in the average size of the IBT and TOU customers, resulting form the program of interval meter roll-outs.

The study found that there "…was a reduction in the residential customers, CMD for TOU customers compared with IBT customers, with the average difference for the Summer 2008/09 and Winter 2009 being 4% with a range of 1.9% and 6.3%. In addition the CMD impact appears to reduce over time and seems only to impact larger TOU residential customers." Sensitivity analysis, which is presented below, substantiated that the results were robust with respect to sample selection.

Retail Tariff	Range (%)	Average (%)
Base analysis – Difference between normalised CMDs at time of seasonal system peak	1.9 – 6.3	4.0
Sensitivity analyses		
EnergyAustralia retail customers only	2.5 – 6.5	4.3
Customers present for the entire season	1.6 – 5.2	3.9
Difference between normalised CMDs on 2nd highest seasonal system peak	2.7 – 5.3	4.3
Difference between normalised CMDs on 3rd highest seasonal system peak	2.9 – 5.2	4.2

Source: Ausgrid. *Network Pricing Study Customer Research Program.* 2011.

The study did not find any statistically significant reduction in the normalized CMD for business customers on TOU tariffs compared with IBT customers.

Customer response and lessons learned

The customer choice survey and modeling (which allows for consideration of the trade-offs between different attributes within a pricing structure) collected data from 1,023 residential customers and 340 SME customers. The market research demonstrated a positive reaction to the new pricing concepts if there were compensating benefits. Notably,

- in the survey both residential and SME customers indicate a willingness to change pricing structure in large numbers for savings of between 10% and 20%;

- critical day pricing, critical peak period pricing, and capacity charging options were fairly equally supported by residential customers;
- critical Peak Pricing was the main alternative option supported by almost 40% of SME customers;
- the ability to maintain control over consumption was an essential requirement for residential and SME customers; and
- the provision of information via an IHD is not critical, but the use of some form of website/portal is important to ensure customers are informed about their consumption.

Sources

Source: Ausgrid. *Network Pricing Study Customer Research Program.* 2011.

Home Energy Efficiency Trial Pricing Trial – Country Energy

Overview

Essential Energy (formerly Country Energy) commenced the HEET program in December 2004. The trial which was conducted in Queanbeyan and Jerrabombera (chosen because of climatic conditions and broad demographic spread of customers) lasted for 18 months.

Aims

The purpose of the HEET was to enable Essential Energy to better understand the business' residential customers' propensity to change their electricity consumption patterns, if provided with more information about their consumption and its relative cost at different times of the day and year. This aim was underpinned by Essential Energy's:

- recognition of the interest amongst shareholders, stakeholders, regulators and customers in energy efficiency;
- commitment to developing cost effective energy efficiency options; and
- desire to lead the industry by conducting Australia's first trial of AMI technology.

Scope

The trial involved 150 residential customers taking single phase supply who were supplied with smart meters, and a Powerline Interface Module comprising GSM phone modem –two way communications to utility – and Narrowband power line carrier modem –injecting PLC signal to household power circuits

Recruitment

Specifics not publicly available.

Intervention

Essential Energy provided trial participants were provided with an IHD enabling feedback technology that:

- displayed cost and consumption information;
- provided comparisons between hourly, daily, weekly and monthly energy usage and cost; and
- could operate on any power point in trial locations using PLC.


Source: Hamilton Ben. *The Country Energy Home Energy Efficiency Trial. 2005.*

Contestable pricing structures incorporating a CPP were also developed to support the aims of the trial, as follows:

- under trial conditions, CPP could only be activated a maximum of 12 times per year during peak summer afternoon periods and winter evening peak periods;
- participating customers received notification by email, SMS and a message to the In House Display of a CPP event up to 24 hours prior to the event (a minimum of 2 hours notification was provided); and
- CPP events were shown as a red light and an audible signal on the IHD.

The structure of the HEET CPP tariff is presented below.

PRICING STRUCTURE	Cents/kWh or Cents/Day excl GST
Off peak	7.03 c/kWh
Shoulder	12.7 c/kWh
Peak	18.87 c/kWh
Critical Peak	37.74 c/kWh
Service Availability Charge (cents/day)	39.78 cents per day

** A 5% step increase will occur on 1 January 2006*

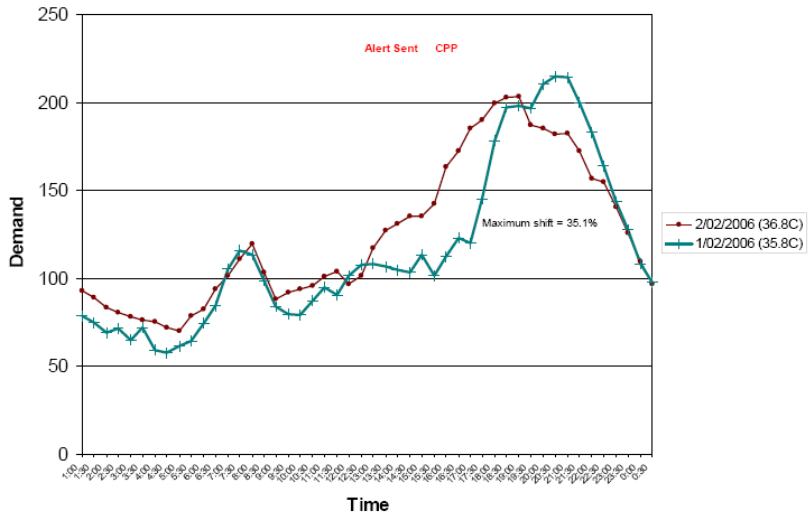
Source: Hamilton Ben. *The Country Energy Home Energy Efficiency Trial. 2005.*

Budget

Confidential

Outcomes

The trial yielded demand reduction of up to 30% during the CPP and an average overall reduction of 8% in usage over the life of the trial. Essential Energy noted that customer education was critical to achieving these results. A typical load profile illustrating the shift in demand from out of the peak period is presented below.



Source: Hamilton Ben. *The Country Energy Home Energy Efficiency Trial.* 2005.

Customer response and lessons learned

This technology used in the trial (smart meters, Powerline Interface Module comprising GSM phone modem –two way communications to utility – and Narrowband power line carrier modem –injecting PLC signal to household power circuit, and home energy monitor with PLC receiver, LED tariff displays, and usage and cost information) could work equally well as either a retail or a network initiative

Feedback from customers indicated that participation in the trial had been a positive experience:

- 99% believed their energy efficiency awareness levels had increased;
- 96% stated they were making conscious decisions about when to use energy;
- customers indicated that they were continuing to use their IHD to get cost and consumption information;
- 81% either welcomed or tolerated CPP alerts;
- 98% indicated that they would continue to use the trial equipment if the option was available to them once the trial concludes.

Key messages related to engaging customers interest and participation in the program included

- keep the proposal simple –the 'average' residential customer is on a continuous tariff, and doesn't have a detailed understanding of time of use tariffs and interval metering; and
- customer information is crucial;
  - keep it simple,
  - provide a dedicated contact point,
  - review, revise, reissue based on customer feedback, and
  - listen to what your customers are telling you!

Sources

Hamilton Ben. *The Country Energy Home Energy Efficiency Trial.* 2005.

Country Energy. *The Country Energy Home Energy Efficiency Trial.* 2006.

Western Sydney Pricing Trial – Endeavour Energy

Overview

Endeavour Energy (formerly Integral Energy) conducted the WSPT over the two-year period from 1 August 2006 to 31 July 2008.[120]The program was based on two pricing regimes developed using a forward looking long run marginal cost pricing model and targeting constraints in the Western Sydney area. The area was experiencing a long peak from early afternoon to early evening during summer and a shorter peak early evenings during winter as a result of the high penetration of reverse cycle air-conditioning across the residential sector and the model allowed for a price signal to be developed matching the local load profile of the network.

Aims

The trial was established to assess customer behaviour and demand response to cost reflective tariffs, and information provision through the installation of IHD feedback enabling technologies. It also sought to assess the impact of notice period and temperature on the levels of demand response. The implications of reduced demand for electricity demand and consumption levels were also examined.

Scope

The WSPT involved placing around 900 residential customers in the Western Sydney region onto either a dynamic peak pricing (DPP) with an underlying TOU tariff or a seasonal peak STOU tariff for a two year duration. Participation numbers in each of the three pricing measures was as follows:

- 373 customers on DPP;
- 356 customers on DPP with IHDs; and
- 295 customers on STOU pricing;

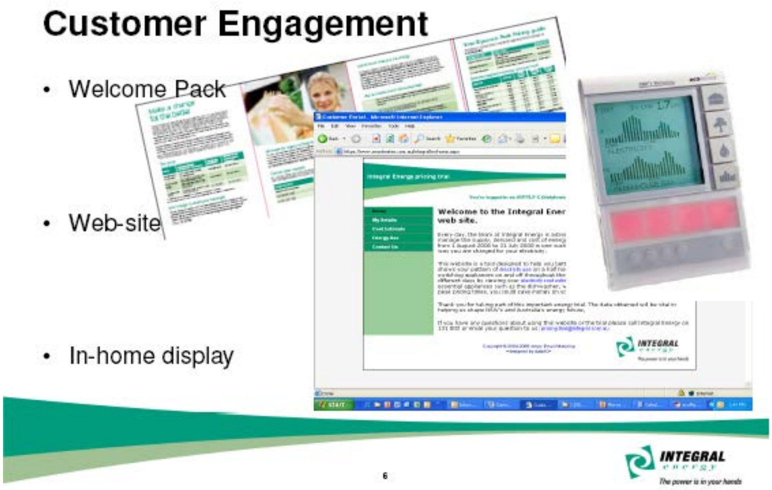
To facilitate the assessment of the effectiveness of these more sophisticated tariffs in achieving desired DM outcomes, Endeavour Energy established a control group of around 340 residential customers. These customers remained on Integral Energy's regulated retail tariff for the duration of the trial.

Recruitment

Participants in the trial were eligible for two incentive payments. The first was an up-front joining bonus of $100 for customers who decided to participate, paid as a credit on their electricity bill. The second was a $200 completion bonus credited to participants that remained on the tariffs for the full two years of the program (participants withdrawing from the program prior to its completion were ineligible for the $200 payment).

To facilitate customer engagement, all customers received a welcome pack and were provided with a web interface to monitor their energy usage on-line.

120 After the two-year trial was completed, Integral Energy offered customers anoptional one-year extension, during which they would stay on the treatment pricing, but would not receive any further financial incentives. Most of the trial customers opted to remain on the tariff for the one-year extension period; only about 80customers opted out.



Source: Lette Steve. Outcome of Integral's Pricing Trial. 2008.

Intervention

The applicable times for each pricing period for the DPP were:

- DPP period – 1pm to 8pm on specific working days;
- shoulder period – 1pm to 8pm on all other working days; and
- off-peak period – all other times.

The pricing schedule applied to each of the treatment groups and the control group are presented in the table below.

	Jul 07	Aug 07 – Jun 08	Unit
Dynamic Peak Pricing (DPP)			
Peak	151. 846	157.160	c/kWh
Shoulder	9.786	10.128	c/kWh
Off-Peak	7.564	7.828	c/kWh
System Access	35.342	36.500	c/day
Seasonal Time of Use (STOU)			
Peak	27.636	28.603	c/kWh
Off-Peak	8.859	9.169	c/kWh
System Access	35.342	36.500	c/day
Control Group - Inclining Block Tariff (IBT)			
Block 1 (first 1750 kWh per quarter)	13.329	13.329	c/kWh
Block 2 (remaining consumption)	14.409	14.409	c/kWh
System Access	39.874	39.874	c/day

Source: Energy Market Consulting Associates. *Smart Meter Consumer Impact: Initial Analysis A Report to the Ministerial Council on Energy Standing Committee of Officials* .2009.

The DPP and DPP IHD trials operated on the premise of up to 12 dynamic peak period events being called each year of the trial, with each event lasting a maximum of 4 hours. Participants were notified either the day before an event or .

The STOU schedule had a summer peak period from 1pm to 8pm working days over the period November to March 31, and a winter peak period from 5pm to 7pm commencing on 1 June and finishing on 32 August. All other times constituted the off-peak period.

All participating customers along with those in the control group received an interval meter to enable future analysis of demand, consumption, and cost across the times for the various tariffs and applicable pricing periods.

Budget

Confidential

Outcomes

Comprehensive marketing enabled a greater than 15% take-up in the trial, on average. This is significantly higher than many customer engagement strategies achieve.

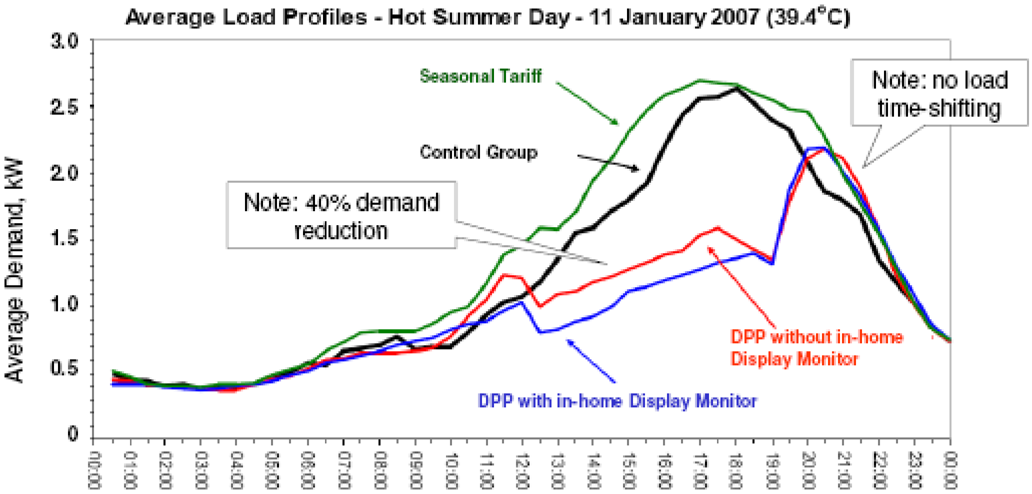
Based on analysis of the twenty three DPP events called during the trial, the peak demand of participating was reduced by around 30% to 40%, on average (the reduction was quite consistent across time and temperature. This percentage decrease equated to a per household reduction on approximately 1 kW (Peak demand savings were found to be consistent across customer income levels). Based on the participation numbers for the DPP component of the trial a total peak period of approximately 0.65 MVA was achieved. In terms of energy consumption the DPP participants used approximately 3% less electricity than the control group during dispatch events.

The impact of the IHD was found to reduce over time – 85% of participants had it plugged in at the start of the trial – this reduced 58% as the trial progressed.

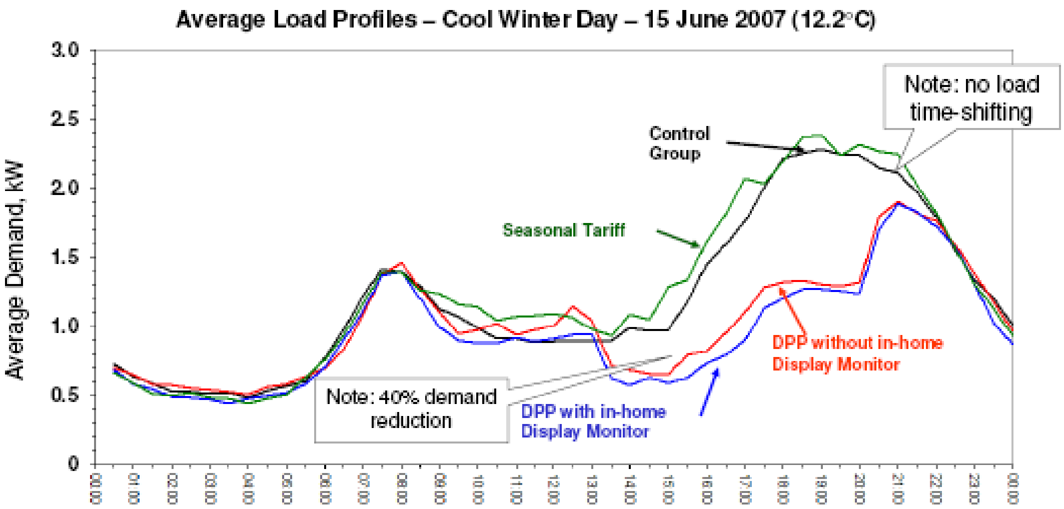
Results for the STOU group were not readily quantifiable, as the STOU customers started out with total usage 6% higher than the control group's customer usage, masking the ability to compare usage patterns between the two groups.

On average the DPP IHD customers saved about $200 over the two-year trial period, as compared to the control group, as a result of behaviour change to manage peak demand in their house.

The figures on the next page demonstrate the change in electricity usage patterns brought about by the DPP tariffs coincident with the summer and winter peak system peak loads.



Source: Lette Steve. Outcome of Integral's Pricing Trial. 2008.



Source: Lette Steve. Outcome of Integral's Pricing Trial. 2008.

Customer response and lessons learned

Anecdotal feedback from customers was both positive and negative:

- positive;
  - the trial has changed when discretionary end uses like clothes washing or running the dishwasher are completed because participants recognised that they could save money,
  - raised awareness of energy use quantities and patterns via the IHD provided a good indication of forthcoming bills,
- negative;
  - too many events were called too close to each other,
  - notification on the day of the DPP dispatch event doesn't give enough time to plan.

Sources

Zammit Maree. *Responding to the challenge of residential energy demand: Blacktown Solar City Program.* 2008.

NSMP National Stakeholder Steering Committee. *Pilots and Trials 2008 Status Report to the Ministerial Council on Energy.* 2009.

Energy Market Consulting Associates. *Smart Meter Consumer Impact: Initial Analysis A Report to the Ministerial Council on Energy Standing Committee of Officials*. 2009.

Strategic Pricing Study – Ausgrid

Overview

Ausgrid (formerly Energy Australia) has undertaken a two-year trial known as the Strategic Pricing Study (referred to as the SPS). Customer participation in the study commenced in early 2006.

Aims

The key objectives of the SPS were to:

- test and compare new DPP and TOU tariffs (take-up, kW peak demand reduction and kWh reduction for residential and business customers);
- measure peak load reductions associated with the tariffs – estimate capital and maintenance deferrals, deliver lower energy cost;
- measure price elasticities (% change in consumption for a % change in price - including own price, cross price and substitution elasticities);
- examine effect of education and information in the absence of price signals; and
- gain experience in managing customer communications.

Scope

The trial covered 750 residential customers and 550 business customers. Participants were divided into a control groups and five treatment groups, as follows:

- enhanced billing information only (billed on an inclining block tariff);
- seasonal time of use tariff;
- DPP tariff medium; and
- DPP tariff high with and without in-house display.

	Online Usage and Costs	In-house Display	Enhanced Billing Information
Info Only	√	X	√
Seasonal TOU	√	X	√
DPP - $1/kWh	√	√	√
DPP - $2/kWh	√	X	√
DPP $2/kWh No IHD	√	√	√

Source: Beeman, E. and Coleman, H. *Customer Feedback and Pricing Learnings in support of an Advanced Metering Infrastructure*. Date not provided.

Recruitment

Participants were given a 'signing bonus of $100 at the beginning of the trial and $100 at the end.

Intervention

The trial utilised two STOU tariffs – Power Smart (for residential and business customers with annual usage under 40MWh p.a.) and Load Smart (for business customers consuming over 40Wh p.a.). The STOU tariffs had an enhanced peak price apply during working weekdays in the summer and winter months only, and a peak price reduced to shoulder levels in the other months.

Two DPP tariffs overlaid on the STOU tariffs and time bands were also used in the study:

- DPP 1 Power Smart (for residential and small business); and
- DPP 2 Load Smart (for larger business).

As noted, both DPP tariffs were further broken down into two subgroups, with a medium and a high critical peak price to consumers. The rates for the two Power Smart tariffs are presented below.

DPP Power Smart Medium

	SAC ($/day)	Peak (c/kWh)	Shoulder (c/kWh)	Off Peak (c/kWh)
NUoS	0.128	40	3.13	2.885
Retail	0.192	60	6.37	4.615
Total	0.32	100[1]	9.5	7.5

Note 1. 10 times the shoulder rate

Source: http://www.ceem.unsw.edu.au/windworkshop/AMIworkshop3-1ChrisAmos.pdf.

DPP Power Smart High

	SAC ($/day)	Peak (c/kWh)	Shoulder (c/kWh)	Off Peak (c/kWh)
NUoS	0.128	80	2.8	2.3
Retail	0.192	120	5.7	4.2
Total	0.32	200[2]	8.5	6.5

Note 2. 23 times the shoulder rate

Source: http://www.ceem.unsw.edu.au/windworkshop/AMIworkshop3-1ChrisAmos.pdf.

All participants received a smart meter, and were also provided with access to a web portal that provided historical usage data. Approximately half of the customers in the trial received an IHD with real-time usage and current tariff information from the meter.

Participants were normally given 24hours notification (but 2 hours was a minimum) via in-house display (where applicable), SMS, phone message, and/or email.

Budget

Confidential

Outcomes

Take-up rates for the trial were 10% for the residential sector and around 5% to 6% for the business sector.

In terms of peak demand and energy consumption impacts:

- summer event reductions for DPP tariffs (with and without IHD) averaged 23%, and winter event reductions for DPP tariffs (with and without IHD) averaged 25%;
- the residential STOU tariff achieved an overall reduction in peak demand of 13% in summer during the top twenty demand days and 5% in winter during the top twenty demand days;
- for 0MWh p.a. to 160MWh p.a. business customers no response to dynamic tariffs was achieved on the DPP tariff or the STOU tariff - it may be that they would respond to price signals over the longer term;

The key results for the residential sector based on the thirteen DPP events during the two year trial are summarised below.

Tariff	Average across all DPP events	Extreme Temperatures		Assessment
		Winter (5°C)	Summer (31°C)	
Information Only	11%	11%	13%	Inconsistent, ranges from -1% to 24%
DPP Medium with IHD	25%	30%	36%	No difference in response between medium $1/kWh and high $2/kWh
DPP High with IHD	25%			
DPP High without IHD	23%			IHDs add minimal response

Source: Energy Australia. *EnergyAustralia's FY11 Network Pricing Proposal.* 2010.

Customer response and lessons learned

According to Ausgrid's documentation on the trial, the key learnings from the study were:

- domestic customers who signed up to the trial respond well to dynamic tariffs, and were willing to reduce their air conditioning usage on hot days - the further away from the comfortable 18° to 22° Celsius range, the greater the demand response;
- despite the apparent complexity of dynamic tariffs, customers were able to understand the concept;
- the dynamic price could probably be set at 50 c/kWh to 70c/kWh and still achieve comparable reductions - the demand response to prices above $1/kWh appeared to be saturated;
- there was very limited difference in demand response between the DPP in-house display (IHD) and non IHD group, indicating IHD's may not have a material effect on the demand response; and

- customers with air conditioners had a greater ability to respond to DPP events, mainly through energy conservation during the afternoon peak (there was little evidence that customers are shifting consumption to either the shoulder or off-peak periods in response to DPP events during summer).

Finally, innovative network tariffs have the potential to play a role in demand management; however, more work is required to better understand the equity, economic, financial and regulatory implications of these tariffs.

Sources

Energy Australia. *Comments on cost-benefit analysis of smart metering and direct load control; Final report for the Ministerial Council on Energy Smart Meter Working Group*. 2008.

Energy Australia. *EnergyAustralia's FY11 Network Pricing Proposal.* 2010.

Beeman, E. and Coleman, H. *Customer Feedback and Pricing Learnings in support of an Advanced Metering Infrastructure.* Date not provided.

*Peak*Saver PTR – Endeavour Energy

Overview

This three-year program was implemented in FY2010/11 as part of an integrated DSP program to defer augmentation of the Rooty Hill zone sub-station. The program is being implemented under the AER's DMIA scheme.

Aims

The aims of the project are to:

- educate consumers;
- gain consumer acceptance of the approach;
- develop systems and processes to make future PTR programs more cost-effective to implement; and
- develop in-house capabilities for smart grid customer application readiness.

Scope

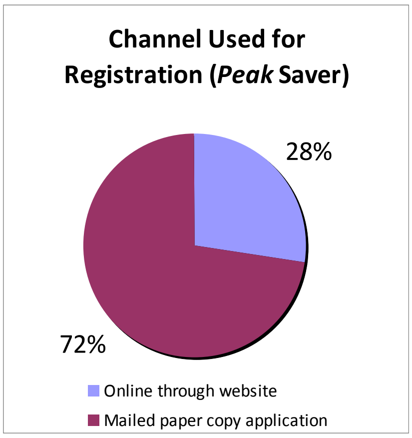
The program seeks to obtain 500 kVA of peak load reduction from 500 households (i.e. an average of 1 kVA per household). The *Peak*Saver program is being conducted in Rooty Hill, Dean Park, Glendenning, Hassall Grove, MountDruitt (certain areas), Oakhurst and Plumpton. Householders with air conditioning who reside in one of these suburbs are eligible to participate in the program.

Recruitment

The *Peak*Saver program is being rolled out over a three year period, as follows:

- 30 customers were targeted in year 1 (2010-11);
    - some recruitment was done through the Endeavour Energy website, and
    - 39 customers signed up to participate; one of those later cancelled.
- 100 additional customers are being targeted in year 2 (2011 - 12); and
- 370 in year 3 (2012 - 13), giving a total of 500 customers for the program.

Recruitment is being undertaken via an online application form and direct mail-out.



Source: Source: Endeavour Energy. *Customer Engagement in Smart Grid*. 2011.

Intervention

The *Peak*Saver initiative is based on a PTR approach. Participation is voluntary opt-in, participants choose what end use(s) they curtail in response to a dispatch event call from Endeavour Energy. Participants receive a peak time rebate reward of $1.50 per kWh of energy saved below their calculated baseline, up to a cap of $50 per dispatch event day. There is no penalty if there is no load reduction (or if load is increased) during a dispatch event.

Each participant's baseline is calculated by considering the following parameters:

- energy used during the defined peak dispatch event period (i.e. between 2pm and 7pm) on business days in the lead up to the dispatch event day, and
- energy used during the morning of both the Event day and three business days leading up to the dispatch event day.

Dispatch events are called when the Rooty Hill zone sub-station might become overloaded (typically this occurs on summer days when temperatures are over 35degrees Celsius). The exact days will be selected by Endeavour Energy up to a maximum of 6 dispatch events during the summer period from 1 November to 31 March (excluding weekends and public holidays), between 2 PM and 7 PM.

Customers are notified of a forthcoming event via SMS, email and/or a recorded telephone voice message one day prior to each dispatch event day.

There is no enabling technology feedback device in the participant's home as part of the program. An interval meter capable of measuring half hourly consumption is installed in participant's premises to monitor and verify customer's baseline usage and load response.

Budget

Confidential

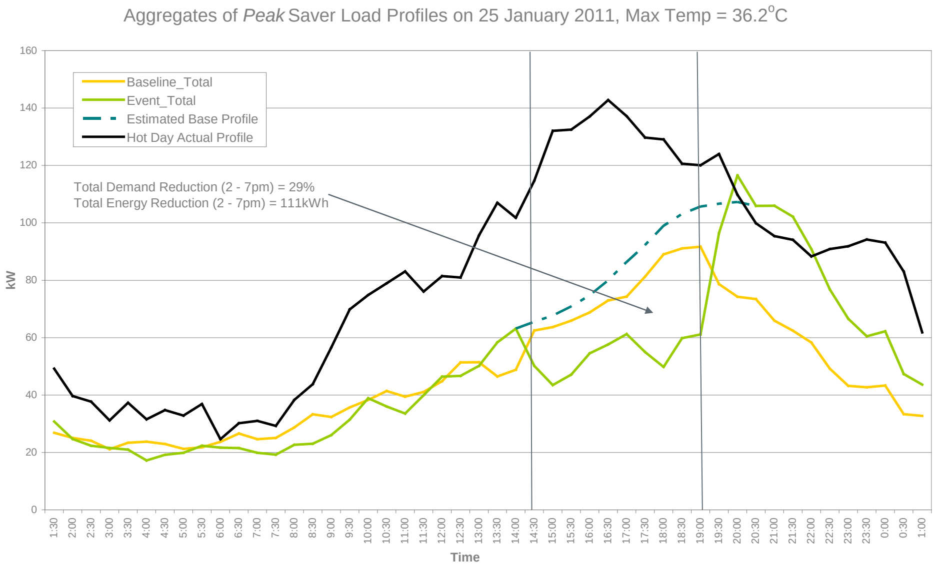
Outcomes

There were four events conducted out of a possible six during the 2010/11 summer being:

- Tuesday 25 January 2011
- Tuesday 1 February 2011
- Thursday 3 February 2011
- Tuesday 1 March 2011

Over the four dispatches for the 2010/11 summer the *Peak*Saver achieved average critical peak period demand reductions ranging from 29% to 51%. Counter-intuitive to expectations the highest demand response occurred following a prolonged hot spell (when customers might have been expected to balk at the idea of not using their air conditioning).

The results showed positive participation from *Peak*Saver customers and a higher than expected kVA demand reduction per participant (1.7 kVA as compared to 1.0 kVA). An explanation for the *Peak*Saver result is a high level of participant buy-in. The aggregated load profile and baseline for the peak day dispatch event of Tuesday 25 January 2011 is presented below, as an illustrative example.



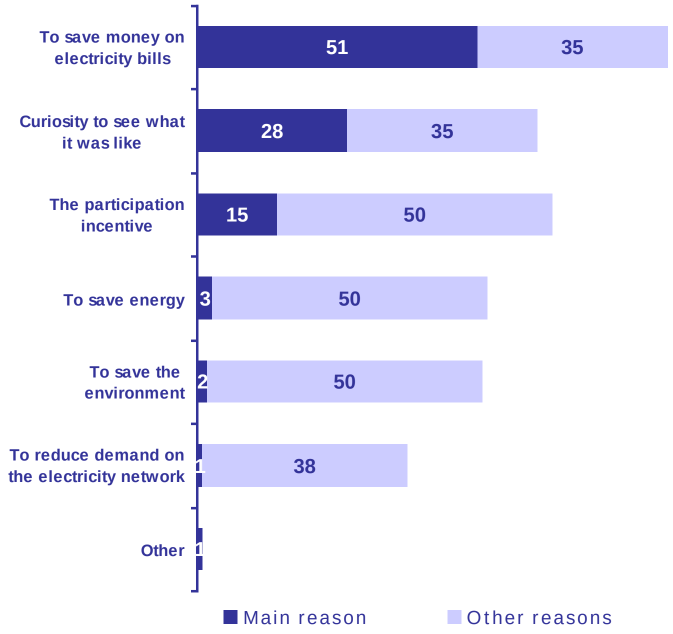
Source: Endeavour Energy. *Peak*Saver & *Cool*Saver *RESIDENTIAL DEMAND MANAGEMENT PROGRAMS Year 1 Evaluation Report.* 2011 (Cut-down Version).

Customer response and lessons learned feedback

Follow-up research with program participants indicated that *Peak*Saver received a satisfaction rating of 77% and no material complaints. In addition, customers were happy with the program and actively participated:

- 87% of participants took action to reduce their electricity use during peak period dispatch events. Actions cited included;
  - ‘going out’ to avoid using the air conditioning and electric cooking appliances and
  - shifting discretionary loads like pool pumps, dishwashers, clothes washers/dryers, etc to out of peak periods.

The main reasons customers gave for participating in *Peak*Saver program are presented graphically on the next page.



Source: Endeavour Energy. *Peak*Saver & *Cool*Saver *RESIDENTIAL DEMAND MANAGEMENT PROGRAMS Year 1 Evaluation Report.* (Cut-down Version). 2011.

Customer engagement lessons learned included:

- clear, honest messages regarding the program objectives is key, as is minimising the complexity of processes involved in signing-up, and participating;
- customers did not understand the link between PeakSaver dispatch events and very hot days suggesting that the context for the operation of the program (notably the constraints surrounding the use of electricity in peak demand period) and its objectives to alleviate these constraints are not understood; and
- customers wanted information on ways to reduce consumption on dispatch event days, particularly if they had received a low reward bonus for the preceding event.

Customer feedback also suggested that the *Peak*Saver is not appealing to those who are already energy efficient because they feel they cannot save more energy and therefore will not receive a *Peak*Saver bonus.

Sources

Endeavour Energy. *Peak*Saver *&Cool*Saver *RESIDENTIAL DEMAND MANAGEMENT PROGRAMS Year 1 Evaluation Report.* 2011 (Cut-down Version).

http://www.endeavourenergy.com.au/wps/wcm/connect/EE/NSW/NSW+Homepage/communityNav/PeakSaver/.

Endeavour Energy. *Customer Engagement in Smart Grid.* 2011.

Peak Demand Reduction Trial, Magnetic Island Solar Suburb, Townsville Solar City – Ergon Energy

Overview

As part of the Townsville Solar Cities project, Ergon Energy has implemented a Peak Demand Reduction Trial on Magnetic Island to investigate a range of pricing initiatives designed to reduce peak demand and improve the efficient utilisation of the electricity network. The trial was launched in October 2010 and will run for 18 months.

Aims

Average peak demand periods occur over the evening time periods 6pm-9pm seven days a week, 365 days per year. Aims of the trial are to:

- evaluate the effectiveness of cost reflective pricing to reduce electricity consumption during the daily peak period by at least 25%,
- improve understanding of customer behaviour towards shifting energy usage during peak demand periods;
- evaluate customer willingness to change their behaviour over a sustained period of time;
- evaluate the impact of incentive payments in modifying consumer behaviour,
- assess the potential for widespread deployment; and
- determine any barriers that occurred during the trial period that resulted in targeted figures not being achieved.

Scope

The trial involves 84residential participants with the following characteristics:

- smart meter and in-house display installed at their premises (installed as part of the trial);
- high electricity users; and
- availability of 12 months of historical interval data for developing a baseline.

Participants are encouraged to reduce their energy consumption between 6pm and 9pm *each day* over the trial period.

Recruitment

Participants were recruited from a subset of customers who had previously participated in an energy assessment and were deemed as suitable for having a smart meter installed.

Intervention

The main enablers and interventions:

- rebates are offered to households that reduce their electricity consumption by at least 15% over the peak demand hours of 6 pm and 9 pm with additional rebates available to households that sustain the reduction for three months. Rebate cheques are distributed every 3 months; and

- a smart meter was installed at least 12 months prior to the trial in order to obtain interval data on the participants historical usage and develop a baseline for verifying changes in consumption over the peak period.

Budget

The costs of the trial to 30 June 2011 were in the order of $272,438.

Outcomes

Consumer behaviour

For the months of June 2010 against June 2011 the following occurred:-

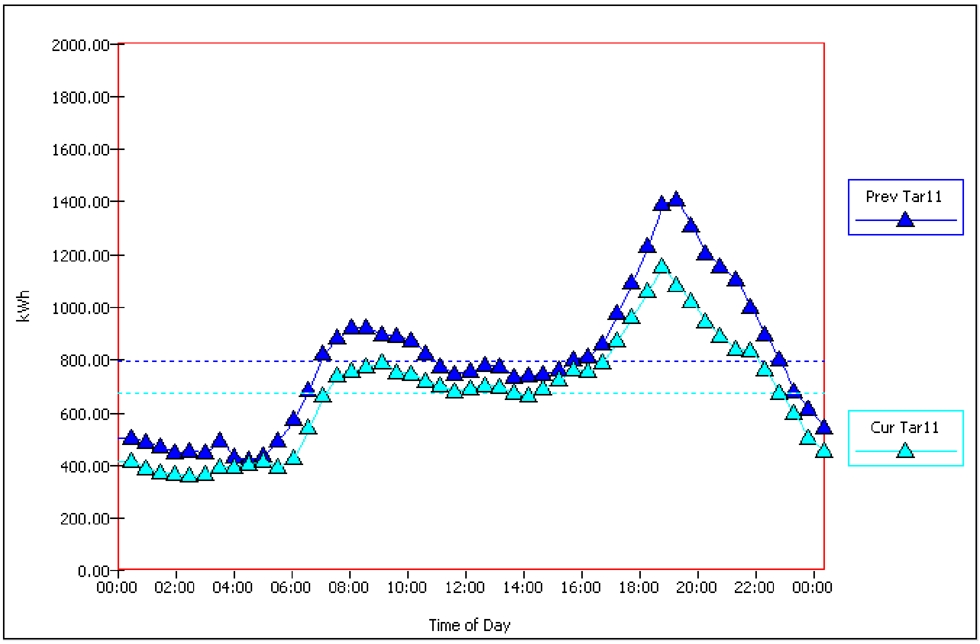
- 46 (54%) participants were eligible for rebates by reducing their peak load by 15% or greater,
- 12 (15%) participants reduced their peak load but did not reach the 15% target, and
- 24 (29%) participants increased their peak usage in 2011.

Overall 69% of participants reduced their peak demand in 2011

Peak Demand and Energy Reduction Impacts

Results for June 2011 versus the same time June 2010 for the 84 trial participants show:

- total peak consumption reduction of 1,649 kWh or 23% over the 6 – 9pm peak period; and
- total monthly consumption reduction of 5,951 kWh or 16%.



Source: Ergon Energy. *Peak Demand Reduction Trial June 20, 2011 Monthly Report – Solar Cities Tariff Trial 1*. 2011.

Customer response and lessons learned

The first 7 months of the 18 month trial have indicated that participants are willing and able to shift or lower their Tariff 11 load from the peak demand period of between 6pm and 9pm daily.

Key lessons reported to date as follows:

- privacy issue in relation to the release of interval data analysis - a software engineer has been engaged to assist with data analysis, and each customer must be asked to allow the engineer to see their data.
- quantity and quality of interval data collected due to smart meter issues section 6.1 above - the consistent retrieval of data has limited the number of potential participants, and is a risk to the ongoing analysis of results.

Sources:

Ergon Energy. *Townsville Queensland Solar City Annual Report.* 2010.

Source: Ergon Energy. *Peak Demand Reduction Trial June 20, 2011 Monthly Report – Solar Cities Tariff Trial 1.* 2011

Personal communication with Ian Cruickshank, Ergon Energy.

Rewards Based Tariffs Project – Energex and Ergon Energy

Overview

This is a joint trial in collaboration between Energex and Ergon Energy with over 3,800 participants, which is currently in progress.

It is a two-year trial, due to conclude in 2012.

Aims

- Create community and awareness and discussion – through a stakeholder communications plan and use of the media
- Improve understanding of customer attitudes and understand volunteers' actions – through behaviour response analysis, surveys, hotline and email feedback
- Validate network benefits (tariff) – through agreed methodology, $/MW, financial effects
- Guide distribution pricing policy development – through trial learnings, government and internal stakeholders.

Scope

Over 3,800 interval meters have been installed (as at August 2011) in Brisbane, Cairns and Toowoomba. Interval meters were required to support complex tariffs.

The trial is paper-based. Customers continue to receive actual bills from their Retailer, but also receive performance statements from the DNSPs.

Recruitment

The program allows customers to contact the Peak Rate Rewards Team by telephone, email or postal address.

Intervention

There are two parts to the trial:

- a consumption based tariffs trial with time-of-use and dynamic peak price signals. It excludes existing controlled load tariffs (T31, T33). It is revenue neutral at the network level; and
- a capacity based tariffs trial which rewards customers for keeping their usage below a threshold during peak periods.

The consumption based tariffs trial combines dynamic peak pricing & time of use:

- 350 days of the year have a day rate from 8am to 8pm (normal price) and a discounted night rate overnight from 8pm to 8am; and
- the other 15 days of the year are "maximum demand days" where the day rate is only from 8am to 4pm. From 4pm to 8pm there is a peak day rate for usage above 2.7 kWh, which is a multiple of the normal day price. On these days the night rate is the same as on other days. Only the 4pm to 8pm price differs on these days.

Performance statements provide customers feedback based on theoretical prices, as illustrated below.

TRIAL PERFORMANCE STATEMENT

Statement Period: 28 Days Start: 01 Feb 2011 End: 28 Feb 2011

Trial Premise

NMI:

PERFORMANCE CALCULATION

Opening Balance		$ 84.48
Earned	+	$ 7.10
Lost	-	$ 31.25
Closing Balance		$ 60.32*

For more information, contact the trial team on 1300 364 910 or go to energex.com.au/peakrewards or ergon.com.au

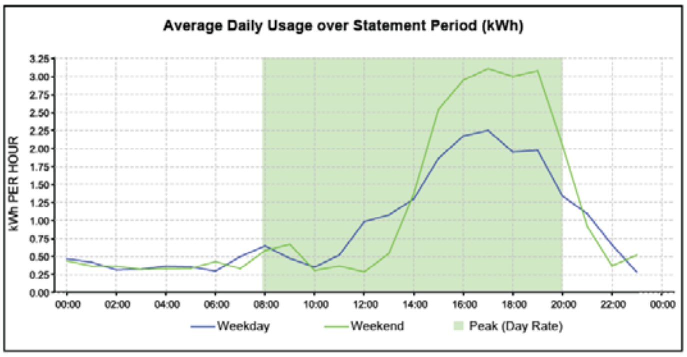
Bonus EARNED (Normal Days)**

Normal Periods	Rate ($/kWh)	Use (kWh)	Total ($)
Day Rate (Peak)	$ 0.19	429.63	$ 83.39
Night Rate (Off Peak)	$ 0.16	182.97	$ 28.42
Total Cost under Trial			$ 111.81
Less Standard QLD Cost	$ 0.19	612.60	$ 118.91
TOTAL DIFFERENCE EARNED			$ 7.10

Bonus LOST (Maximum Demand (Peak) Days) **

Threshold	Rate ($/kWh)	Use (kWh)	Total ($)	Effect on Bonus
Below 2.7kWh	$ 0.19	9.38	$ 1.82	$ 0.00
2.7kWh & above	$ 1.55	23.00	$ 35.71	-$ 31.25
Total Cost under Trial			$ 37.54	
Less Standard QLD Cost	$ 0.19	32.38	$ 6.28	
TOTAL DIFFERENCE LOST			$ 31.25	$ 31.25

Maximum Demand (Peak) Days - You are charged higher prices between 4pm-8pm on Maximum Demand (Peak) Days if you use more electricity than the threshold limit of 2.7kWh per hour. See the back of this statement for further details on your performance on Maximum Demand (Peak) Days.



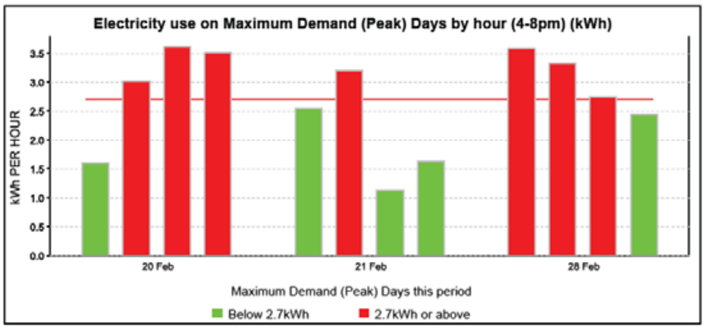
*Please note: your total performance bonus is capped at a minimum of $25 and a maximum of $125 per year, payable upon completion of a survey.
**Please note: the figures in this table have been rounded to the nearest cent.

Toward Q2 Tomorrow's Queensland | Queensland Government | energex positive energy | ERGON. ENERGY

15/03/2011 V2.1

Maximum Demand (Peak) Days

- The graph below shows your electricity usage, in kilowatt hours (kWh), between 4pm and 8pm on Maximum Demand (Peak) Days.
- The four bars for each day show your electricity usage in kWh for each hour between 4pm and 8pm (i.e. 4-5pm, 5-6pm, 6-7pm and 7-8pm).
- The horizontal line (where shown) represents the threshold limit applied on Maximum Demand (Peak) Days.
- Green bars indicate where your electricity usage was below your threshold of 2.7kWh. Red bars indicate where your electricity usage was equal to or above your threshold limit of 2.7kWh per hour. You will be charged a higher theoretical price for those hours which are equal to or above the threshold.



- The table below also shows your electricity usage (kWh), between 4pm and 8pm on Maximum Demand (Peak) Days.
- The four boxes for each day show your electricity usage in kWh for each hour between 4pm and 8pm.
- Green boxes indicate where your electricity usage was below your threshold of 2.7kWh. Red boxes indicate where your electricity usage was equal to or above the threshold limit of 2.7kWh. You will be charged a higher theoretical price for those hours which are equal to or above the threshold.

Maximum Demand (Peak) Day	Electricity used on Maximum Demand (Peak) Days (kWh)				Effect on Bonus
	4-5pm	5-6pm	6-7pm	7-8pm	
Sun, 20 Feb 11	1.61	3.02	3.61	3.51	-$ 13.78
Mon, 21 Feb 11	2.55	3.20	1.14	1.63	-$ 4.35
Mon, 28 Feb 11	3.58	3.33	2.75	2.45	-$ 13.12
Total bonus lost during Maximum Demand (Peak) Days					-$ 31.25

Below 2.7kWh   2.7kWh or above

Budget

Confidential

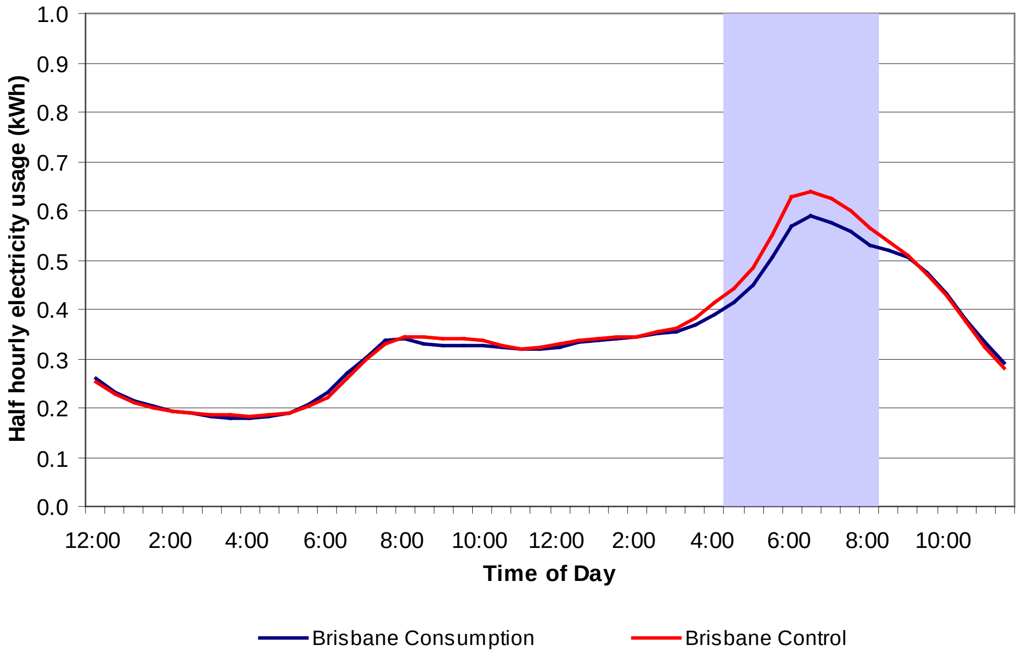
Outcomes

Dynamic Peak Pricing Preliminary trial results

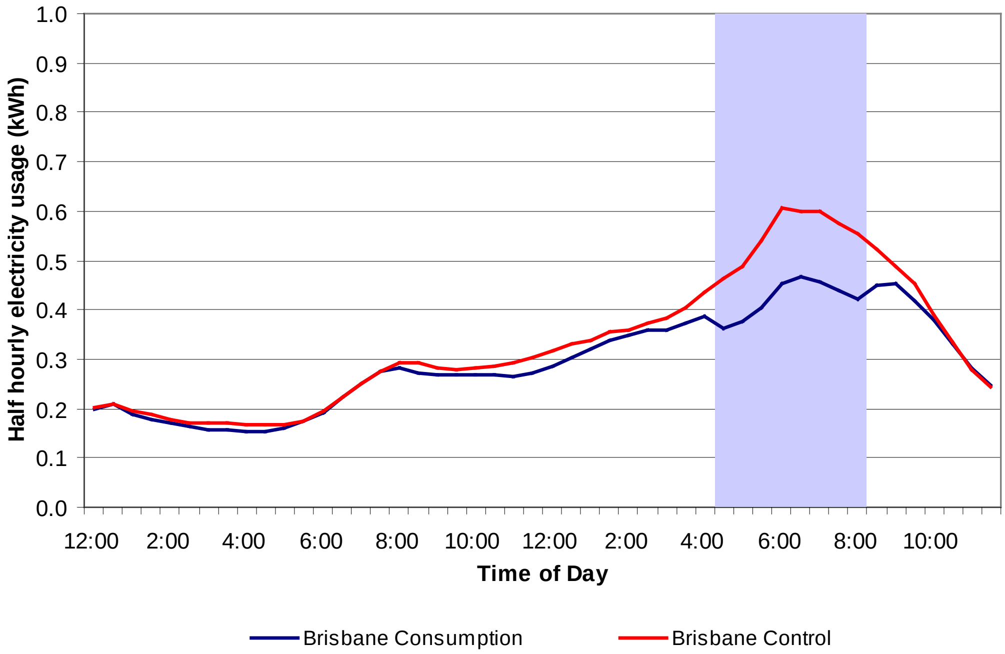
Preliminary results show positive customer response:

- customers are willing to change their behaviour in response to dynamic peak pricing signals;
- in line with other research findings;
- response appears to be weather related, with higher temperatures resulting in higher capacity to respond;
- response observed on both weekdays and weekend; and
- lower response observed on lower demand days.

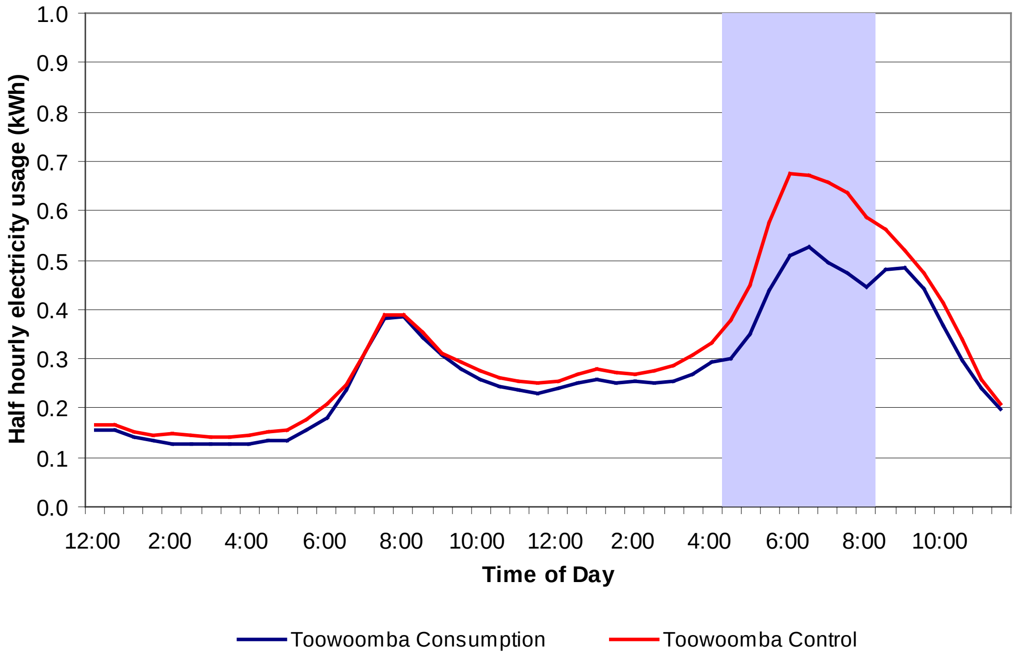
Brisbane – indicative only - First 6 months to 30th June - excludes Maximum Demand Price Days:



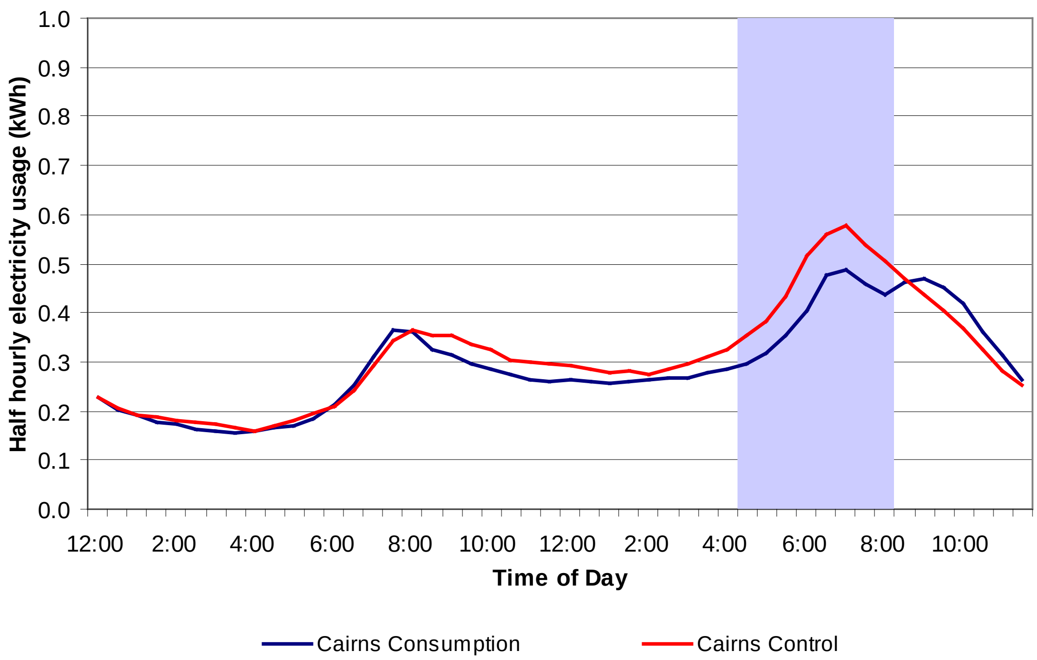
Brisbane - Average response – 7 event days (5 Summer, 2 Winter):



Toowoomba: Average response – 8 event days (2 Summer, 6 Winter):



Cairns: Average response – 6 event days (5 Winter, 1 Autumn)



Cairns: customers responded on 5 consecutive days:

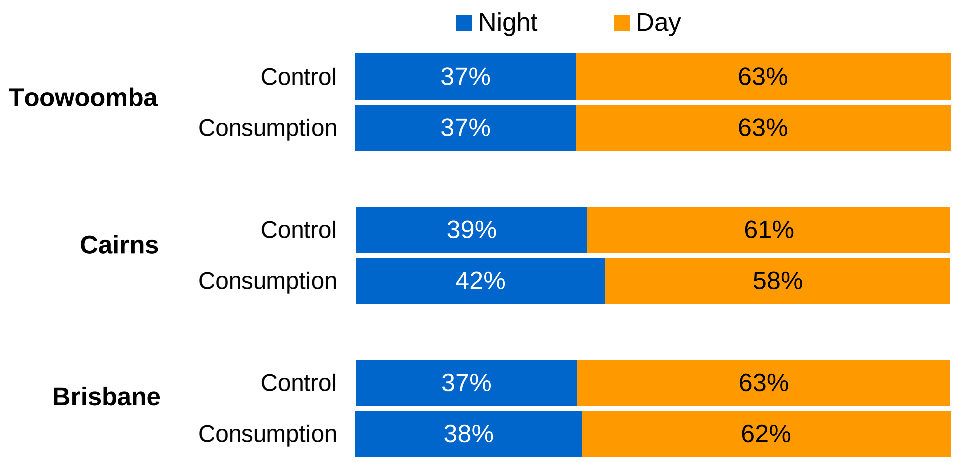
- All events met the winter temperature triggers
- Positive response on all days, limited fatigue observed

TOU preliminary results

Preliminary results show some positive response to time of use pricing signal:

- some positive response to time of use signal to date;
- in line with other research findings;
- but not as much impact as DPP; and
- some indication of shifting of load to outside of peak periods, however has not resulted in secondary peak.

Response to time of use price signal



Next steps

- Further analysis:
- Additional events
- 5 consecutive days in Cairns – only limited fatigue
- Capacity based tariff results
- Customer behaviours and perception of tariffs:
- Newsletter survey and opt out survey
- End of year survey
- Further events to be called this year
- Independent review of results (QUT)

Sources

Energex presentation to AEMC *Rewards Based Tariffs Project*, 25 August 2011

The trial is also referred to as the Peak Rate Rewards Trial at http://www.energex.com.au/sustainability/energy-conservation-and-demand-management/peak-rate-rewards

Perth Solar City– Living Smart– Perth Solar City Consortium

Overview

The Perth Solar City was launched on 5 November 2009. The consortium comprises Western Power, Botanic Gardens and Parks Authority, Mojarra, the Eastern Metropolitan Regional Council (EMRC), Prospero Productions, Solahart, SunPower and Synergy. Perth Solar Cities is being conducted within the Town of Bassendean, City of Bayswater, City of Belmont, Shire of Kalamunda, Shire of Mundaring and the City of Swan. Smart grid and DSP initiatives being trialled include cost reflective pricing, smart metering, load control, home area networks, communications infrastructure, energy efficiency and behaviour change initiatives, and residential and commercial solar PV systems.

This profile reports on preliminary impact results of the home eco consultation and residential behaviour change initiatives. Initial findings of the residential air conditioner direct load control (DLC) trial are presented separately.

Aims

Objectives of the Perth Solar Cities project are to:

- identify and understand barriers to energy efficiency, peak demand management and renewable energy take-up;
- test and evaluate new technologies, and
- inform future government policy development.

Scope

The home eco consultation and residential behaviour change initiatives target residential consumers. Reported take-up to 2010 against program targets are shown below:

Trial:	Take-up to 2010	Target
Residential eco consultations	975	3,500
Behaviour change program participants (Living Smart)	6,300	6,000
Smart meters	8,285	8,700
In Home Displays	-	2,200
Residential PV systems	218	825
Solar hot water systems	189	1,200

Recruitment

A total of 10,000 households were contacted by personnel letter and phone resulting in 6,300 households recruited for the Living Smart initiative.

Intervention / s

Living Smart (behaviour change initiative)

- telephone coaching and tailored information packs sent to households;

- benchmarked meter reading analysis provided and discussed;
- actions agreed through social contacts;
- facilitated by coaches;
- follow up calls every 6 weeks; and
- providing households with the right solutions at the right time

Eco Consultations

- free 90 minute in home audit and consultation of electricity and water use; and
- provides opportunities and tools to enable electricity savings.

Budget

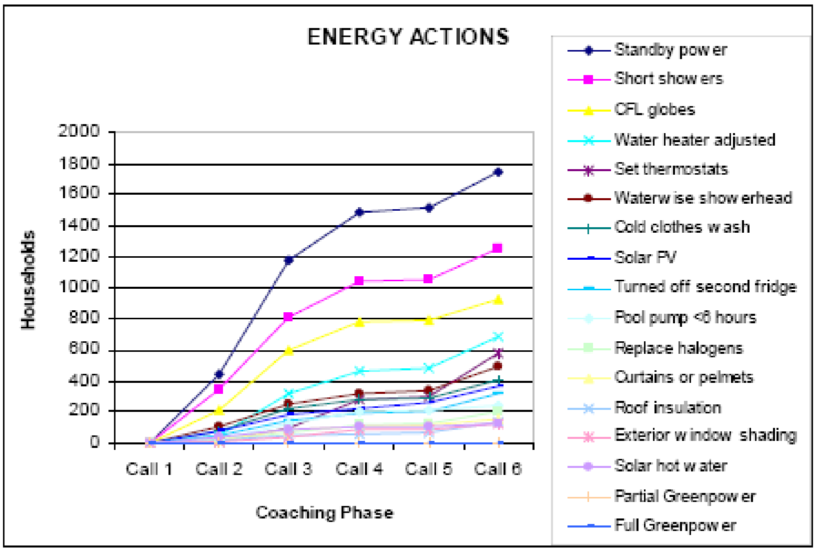
The total budget for the Perth Solar Cities project is $73.5 million. Details of budgets for each of the initiatives is not available.

Outcomes

Analysis to date of participants who undertook energy assessments show:

- 14,000 kWh in electricity savings per day or 2.9 kWh / household / day; and
- 7,782 energy saving actions taken by households to manage their energy summarised. The following chart provides a profile of the types of actions performed by participants.

The range of energy efficiency actions taken by participants in the Living Smart programs are illustrated below.



Customer response and lessons learned

Market research conducted to date on customer reasons for participating in the program are summarised below.

motivators	
save money	53%
environmentally friendly	41%
to be more energy efficient	26%
save energy	24%
barriers	
costs too much	51%
no perceived benefits	11%
time poor	10%

Community response to the program was very positive. Participant responses included;

"*I have loved every minute of the Living Smart initiative. It has been an exciting project in terms of helping us to save money and it helps the environment."*

"Fantastic project! I've never had such low power bills. It really raises awareness."

"Living Smart made me more aware of not taking long showers and not leaving lights on…It's a great initiative and everyone should have the chance to have what I had."

Sources

Western Power. *Building a Smart Grid in Western Australia* 2011.

Government of Western Australia Department of Transport. *Living Smart Households (Sustainability program) – Monitoring and Evaluation (August 2011)*. 2011.

Wyld Group. *Mid-Term Review of the Solar Cities Program Report.* 2011.

http://www.climatechange.gov.au/government/programs-and-rebates/solar-cities.aspx.

Energy Assessments, Magnetic Island Solar Suburb, Townsville Solar City – Ergon Energy

Overview

As part of its lead role in implementing the Townsville Solar City's project, Ergon Energy has implemented a comprehensive free energy assessment program on Magnetic Island as part of the Magnetic Island Solar Suburb trial. The energy assessment program was launched in 2008 and continues to 2013.

Aims

The overall aims and objectives of the Magnetic Island Solar Suburb are to:

- reduce peak demand by 27%, which occurs between 6.30 pm and 8 pm;
- reduce electricity consumption by 25%;
- reduce greenhouse gases by 50,000 tonnes over the life of the project; and
- defer the augmentation and capital expenditure involved with the installation of a third 11kV cable to Magnetic Island and additional in-island generation capacity.

Specific aims of the energy assessment program of the Magnetic Island Solar Suburb trial include:

- encouraging consumers to shift load to better manage peak demand;
- motivate customer response to energy management opportunities; and
- reduce electricity consumption and greenhouse gas emissions by encouraging the uptake of energy efficient options.

Scope

The energy assessment program targets the residential and commercial sectors.

The eligible market for the free assessment is 100% of the Magnetic Island customer base representing 1,820 residential and commercial properties. Take-up to against program target are shown below:

Trial:	Take-up to 2010/11	Target
Residential energy assessments	1,185	1,735
Commercial energy assessments	115	195
Smart meters	1,508	1,400
In Home Displays	187	1,100

Recruitment

The trial has utilised several methods for recruiting consumers for energy assessments and to become involved in the trial, including:

- an initial survey encouraging respondents to register;
- in-person attendance at the Smart Lifestyle Centre;

- cold calling; and
- referrals.

Interventions

An overarching community engagement program was implemented to involve the community and raise awareness and create touch points through:

- Smart Lifestyle Centre provides a focal point for the project and comprises an office and information centre where residents and visitors can learn more about energy efficiency;
- surveys, events, sponsorship, newsletters, support of local groups and committees, media and a range of promotional material; and
- future addition of a Solar Skate Park to the Smart Lifestyle Centre.

For residential consumers the energy assessment program consisted of the following interventions:

- free in-home energy assessment by trained assessors including education and tips on energy conservation and load shifting actions and tips
- installation of free energy efficient items by the assessor during the visit including compact fluorescent lights (CFLs), water efficient shower heads and tap aerators
- provision of free shower timers, room thermometers and trigger hose nozzles for the home owner to install at a later date, and
- financial incentives based on a voucher system where vouchers are valued at $/kW alleviated to offset the costs of purchasing high efficiency appliances and removing old appliances such as refrigerators
- assessment to determine suitability for an In-House Display (IHD) unit, smart meter and rooftop PV.

For commercial consumers the energy assessment program consisted of the following interventions:

- free customised on-site energy assessment by trained assessors including education and tips on energy conservation and load shifting actions and tips
- provision of technical and financial assistance to upgrade appliances, heat pump hot water systems, efficient lighting and other energy efficient technologies.

Budget

The total budget for the Townsville Solar Cities project is $31 million.

The project budget for demand side management initiatives is reported as $3.13 million with $2.16 million spent to 2010. Of this total:

- 60% accounts for employee related costs;
- 28% for direct purchases including incentives/vouchers; and
- 12% for other costs.

Budget for smart meter/IHDs is $2.21 million with $1.99 million spent to 2010.

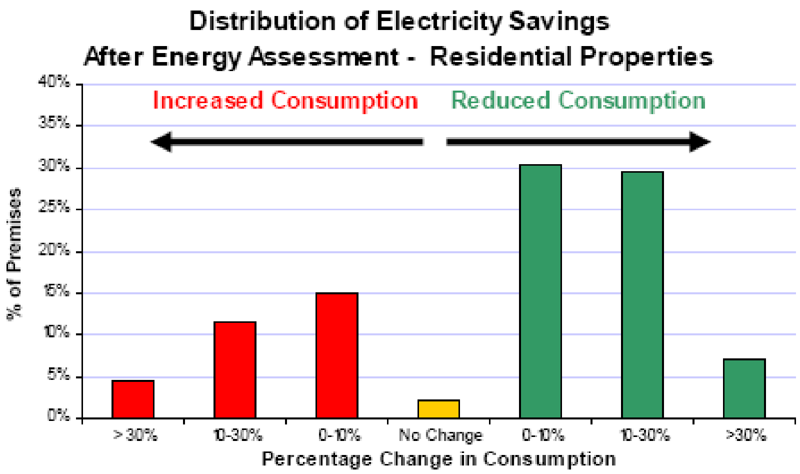
Outcomes

Consumer behaviour

Ergon Energy's preliminary findings to 2010 show that of the 1,820 residential and business customers on Magnetic Island;

- 71% customers (63% residential and 8% commercial) have been assessed,
- 4% declined an assessment (all residential),
- 21% were not contactable or not assessable, and
- 4% were to be assessed.

An assessment of the electricity consumption of 409 residential properties showed that 68% of customer reduced their consumption after the energy assessment, as shown in the following chart.



Source: Ergon Energy

Key findings in regards consumer behavioural changes indicate that:

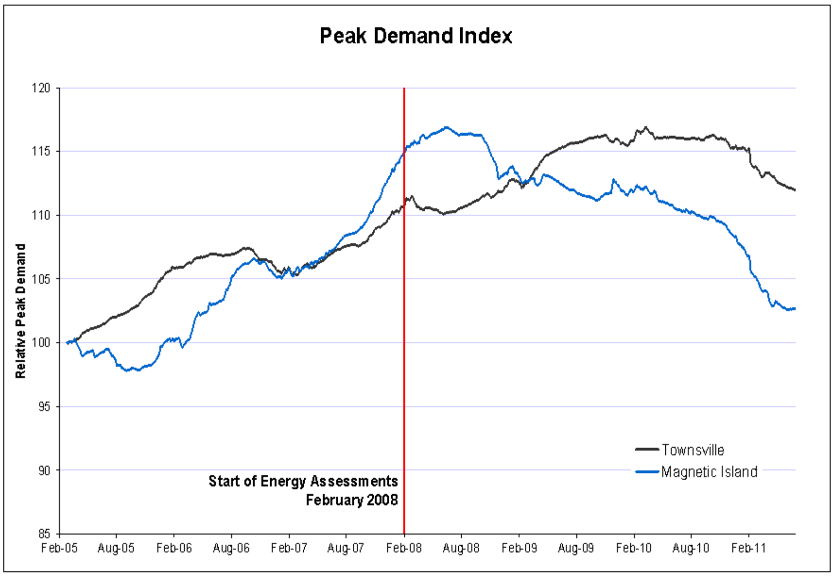
- the energy assessment and government rebates have led to a positive change in the attitudes and behaviours of residents and businesses towards electricity use;
- the energy assessment package (IHD, rebates, household recommendations) was an effective tool for sustaining reductions in energy use;
- of those that took it up, 56% of residents agree/strongly agree that the IHD was helpful in changing the way they used electricity and less than 2/3rd continued to use it for monitoring their energy use; and
- residents that did not have an energy assessment may have been hampered by factors such as rental dwelling and/or poor dwelling design.

Reported peak demand and energy reduction impacts, included:

- peak demand reductions to 30 December 2010 on Magnetic Island were 33% on business as usual projections leading to deferral of a third 11kV cable to Magnetic Island and additional in-island generation capacity; and

- energy consumption during calendar year 2009-10 equated to a 27 % reduction since the start of the project compared to business as usual forecasts.

The following graph shows the relative peak demand on Magnetic Island compared to Townsville and the change since the start of the energy assessments.



Source: Ergon Energy. *Townsville Queensland Solar City Annual Report.* 2010.

Customer response and lessons learned

Lessons learnt by Ergon Energy in its implementation of the energy assessment program include:

- a local project office and staff who live in the community has been vital to the success of the project; and
- financial incentives in the form of rebates to encourage take-up of energy efficient appliances or adopting energy efficiency improvements need not be large, small incentives have been shown to be just as affective in removing barriers.

Sources

Ergon Energy. *Townsville Queensland Solar City Annual Report.* 2010.

Distributed Storage Trial – SP AusNet

Overview

SP-AusNet is planning to trial the integration of distributed storage technology and photovoltaics to reduce network loadings on SWER lines in rural areas of the network. The project is in the preliminary planning stage. Technology and site assessments are underway with trials planned to start in 2012.

Aims

The trial will:

- evaluate battery/inverter combinations to solve specific problems with SWER lines and to manage substation level loads; and
- investigate the costs and benefits of utilising distributed battery storage and PV systems for network support.

Scope

Not available.

Recruitment

The trial will not involve customer participation as the distributed storage technology will be implemented at the substation level.

Intervention

Not applicable.

Budget

Not available.

Outcomes

Not applicable.

Customer response and lessons learned

Not applicable.

Sources:

Personal discussion with T. Hallam, SP AusNet 12 Oct 2011.

This page left blank intentionally.