Department of Climate Change and Energy Efficiency – Appliance Energy Efficiency Branch

Information for the Australian Energy Market Commission in response to the Issues Paper:

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

August 2011

Energy Efficiency and Peak Load Reduction – the work of DCCEE and Equipment Energy Efficiency (E3) Program

This submission is made by the Appliance Energy Efficiency Branch of DCCEE. The Branch supports the Equipment Energy Efficiency (E3) Committee of Commonwealth, State, Territory and New Zealand Officials, which oversees the trans-Tasman energy labelling and minimum energy performance standards (MEPS) program.

The national program was first endorsed by energy ministers in 1992, and has been operating continuously under various names and governance structures ever since (now as Measure 2.2 of the National Strategy on Energy Efficiency). The E3 program has grown to cover mandatory energy labelling and/or MEPS for 18 categories of household, commercial and industrial sector products, including air conditioners.[1]

In 2004, following a number of electricity supply problems related to demand from air conditioning, E3 was asked to examine the contribution of household air conditioners to peak demand, and whether this could be addressed through more stringent energy efficiency standards. The conclusion was that energy efficiency measures alone (for buildings or for the air conditioners themselves) could not compensate for the projected growth in summer peak demand from residential air conditioning, and that only the direct management of air conditioner operation during the peaks would be effective.[2]

The Australian Greenhouse Office, which was managing the E3 program at the time, set up a forum of stakeholders, including air conditioner manufacturers and electricity distributors and retailers, to consider how demand response capabilities could be incorporated into air conditioners and utilised by electricity suppliers, for the benefit of consumers.

In 2005 Standards Australia set up a new committee EL-054 *Remote Demand Management of Electrical Appliances* to develop demand response standards for air conditioners, pool pumps and other products that contribute significantly to peak electricity loads (eventually published as AS/NZS 4755 – see below).

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[1] The full scope of the E3 program is described in the E3 Achievements 2009/10 report, available at http://www.energyrating.gov.au/library/pubs/201103-achievements.pdf
[2] http://www.energyrating.gov.au/library/pubs/200422-ac-demandmanagement.pdf

The aim is to ensure that the four selected appliance types are manufactured with interfaces which will allow them to be controlled remotely. This would provide energy users who wish to automate the peak load control of their appliances, or who wish enter into arrangements with their utilities (in return for some incentive) with a low cost and reliable technical means, to be able to do so. Appliances with these interfaces are referred to as ‘smart’ appliances.

This would allow users to lock in cost savings through the purchase and activation of a ‘smart’ appliance, rather than having to remember to adjust settings or manually turn appliances off in response to transient price signals. Consumer research indicates that locking in or automating energy efficiency or demand response – through decisions taken at the time of purchase or installation – has a far greater and more persistent impact than relying on consumers to modify their daily behaviour.

Furthermore, only a system which ensures a high probability of automated demand response can provide a credible alternative to the traditional – and increasingly costly – supply-side strategies for accommodating peak demand.

Standard AS/NZS 4755: Demand response capabilities and supporting technologies for electrical products

Australian Standard AS/NZS 4755 is intended to enable the large scale introduction of smart appliances, by ensuring that the appliances will be able to operate reliably with any communications protocol and any metering environment. The standards:

- Define common physical interfaces on a range of electrical products that have a significant impact on electricity network peak demand: air conditioners, pool pumps, electric and electric boosted water heaters and energy storage devices (including electric vehicles).
- Define common operational instructions for effecting demand response in priority appliances.
- Define the requirements for Demand Response Enabling Devices (DREDs), which receive signals from the utility and initiate changes in the appliance operation. DRED functionality may be present in a number of devices including advanced meters, in-home displays, purpose-made devices and home energy management systems. (E3 representatives worked with the NSSC to ensure that the *Smart Meter Infrastructure Functionality Specification* is compatible with AS/NZS 4755).

The suite of standards will ensure interoperability between energy market participant demand response enabling systems (including Advanced Metering Infrastructure), in-home devices and end use electrical appliances. Two parts have been published – the status of the others is indicated in Table 1.

The manufacturer of an appliance complying with AS/NZS 4755 must ensure that it enters one of the following demand response modes (DRMs) when it receives the corresponding signal from the DRED:

- DRM1: shut off, or operate at minimal load, for the duration of the demand response (DR) event. In an air conditioner, this means the compressor must not operate, but

fans and controls may continue to do so. During normal peak load events the utility (or a pre-programmed DRED) would 'cycle' air conditioners to operate for, say, 15 minutes and then shut off for the next 15. In emergencies, a constant DRM1 signal could switch appliances off for the duration of the emergency.
A pool pump controller responding to DRM1 must switch the pump off.
An electric, solar-electric or heat pump water heater must cease the use of electricity for heating water (whether by resistance elements or compressor operation) but water circulation pumps and controllers may continue to operate. This makes DRM1 a technically superior method of control for solar and heat pump water heaters than traditional off-peak, which de-energises the entire unit.

- DRM2: continue operation at not more than 50% load for the duration of DR event.
- DRM3: continue operation at not more than 75% load. This was differentiated from DRM2 at the request of electricity utilities, on the grounds that it will be easier to enrol customers in DR programs if they can be assured of having at least 75% cooling during DR events.
- DRM4: switch on even if timers or user settings would not require operation at that time. This is intended to allow appliances to come on at times when electricity price or CO_2-intensity is low, eg when renewable generation availability is high. It would apply to swimming pool pumps – by bringing forward but not extending daily running hours – and to electric water heaters – allowing additional energy to be stored by temporarily raising thermostat settings. Utilities may also use DRM4 to pre-charge solar-electric water heaters on winter mornings, to prevent their boost elements from operating during the evening peak when space heating, lighting and cooking loads coincide.

For an appliance to be AS4755-compliant, it must be able to respond to only DRM1.

Owners of appliances with these capabilities will be free to obtain and program a DRED to manage their appliances according to their own preferences (eg to minimise their exposure to peak pricing) or to enter a direct load control contract with their electricity distributor or retailer to achieve the same objectives – in which case the utility would supply and connect the DRED (which could be a smart meter). Alternatively, customers can choose to do nothing and operate the product like any other appliance.

Table 1 Part of Demand Response Standard AS/NZS 4755

	Part Title	**Status**
AS4755-2007	Framework for demand response capabilities and supporting technologies for electrical products	Published 2007
AS/NZS 4755.1	Framework for demand response capabilities and supporting technologies for electrical products, and requirements for Demand Response Enabling Devices (DREDs)	Draft at advanced stage.
AS/NZS 4755.3.1	Interaction of demand response enabling devices and electrical products—Operational instructions and connections for air conditioners (published as AS4755.3.1, 2008)	Revision about to be released for public comment.
AS/NZS 4755.3.2	Interaction of demand response enabling devices and electrical products—Operational instructions and connections for swimming pool pump-unit controllers	Draft about to be released for public comment.

AS/NZS 4755.3.3	Interaction of demand response enabling devices and electrical products—Operational instructions and connections for electric and electric-boosted water heaters	Draft at advanced stage.
AS/NZS 4755.3.4	Interaction of demand response enabling devices and electrical products—Operational instructions and connections for charge/discharge controllers for electric vehicles and other energy storage devices	Working Group formed. Publication of final standard expected mid 2012

Focus of this Submission

The main intent of this submission is to bring the significance and the potential of the AS/NZS 4755 product standards to the attention of the AEMC.

Some air conditioners with this demand response capability have been available since 2008, when AS 4755.3.1 was published. Although this demonstrates the technical feasibility of the standard, there has been little market demand in the absence of utility contract offerings that make it attractive for consumers. Appliance manufacturers will not voluntarily offer smart appliances unless the risks are mitigated by adoption of common standards, which apply equally to their competitors.

Connecting smart appliances involves significant fixed costs for establishing communications systems, for marketing and other support. Many electricity utilities are aware of the economic advantages of a smart appliance-based strategy to address peak demand, and confident that consumers would accept it, but are unable to make a business case for it without assurance that the number of appliances connectable at low cost will reach a sufficiently high level.

Neither the electricity distributors nor the appliance industry are able to bring this about on their own, due to commercial and regulatory risk.

While several stakeholder groups – network operators, appliance manufacturers and ultimately consumers – would benefit from the large-scale introduction of smart appliances, no group can be sure of gaining enough of the benefit to warrant the commercial risks of unilateral action.

This situation, where a universally beneficial outcome is foregone because no single agent can capture enough of the benefit to act, is market failure through *positive externality*.

E3 has come to the conclusion that government action is necessary to create the conditions for the appliance market to introduce smart appliances with direct load control capabilities, and to ensure that they are sold in sufficient quantities for the electricity distributors to be able to cost-effectively implement demand response strategies.

E3 has therefore proposed that compliance with AS/NZS 4755 become a mandatory requirement for the products listed in Table 1, for models sold after October 2012, and has prepared a Regulation Impact Statement to this effect. The proposal is projected to be highly cost-effective, even if only a proportion of customers activate the interface to take advantage of energy cost savings or other utility incentives to manage demand. It is of course envisaged that participation in such programs will always be voluntary for consumers, and that they will always be able to withdraw if they find that any inconvenience to them outweighs the benefit. However, utility trials to date indicate that, once enrolled, the great majority of consumers choose to continue to participate.

The remainder of this submission addresses the questions in the Issues Paper that are directly relevant to this proposal.

Consumer participation and DSP opportunities

5. What are considered the drivers behind why consumers may choose to change their electricity consumption patterns? Please provide examples or evidence where appropriate.

Consumers change their electricity consumption patterns in response to a range of factors, including the cost of energy, the cost of the equipment that converts the electricity to the required energy service and their ability to make these changes to their consumption patterns. However, there are differences between short term, easily reversible changes and long term, durable changes in consumption patterns.

In the short term, consumers can only respond by managing their existing stock of appliances, and generally only by curtailing energy services (eg turning thermostats down, taking shorter showers, using fewer lights). Such changes may be a response to a ‘crisis’ (such as a high utility bill, or a public call for restraint in an energy supply crisis), are often inefficient (as most consumers do not know which actions save the most energy) and easily reversed when the crisis passes or the consumer’s attention is diverted to other matters.

However, increasing sensitivity to the price of electricity and price variations over time and awareness of the environmental impacts of its production, will bring about more durable changes in consumption patterns, through the exercise of fuel choice, tariff choice and equipment choice. Consumers will select new appliances that fully or partially substitute gas or solar energy for electricity, appliances that are more energy efficient and products that are able to adjust operation to time-variable prices (eg off-peak water heaters or air conditioners with demand response capability).

Amplifying short term electricity price signals, through in-home displays (IHDs) for example, is not likely to lead to permanent changes in electricity consumption on its own. The direct impact of the IHD on behaviour is minor and falls off in the longer term, as trials have indicated may be the case.[3] However, IHDs provide customers with their real-time energy consumption information, which could indirectly facilitate a transition to purchasing more energy efficient or smart appliances by informing subsequent consumer purchases and the propensity to participate in load control programs.

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[3] NSSC (2009) *National Stakeholder Steering Committee Pilots and Trials 2008 Status Report to the Ministerial Council on Energy*, June 2009

Consumers need information about energy prices and the capabilities and running costs of different appliances, and must be in a position to exercise their preferences, which tenants, for example, may not be. Where lack of reliable information and other market failures prevent consumers from exercising informed choice, there is a case for government intervention to mandate energy labelling, to regulate for minimum standards of energy efficiency or to require other features that could change electricity consumption patterns.

8. Are there other DSP options that are not currently available to consumers, but could be available if currently available technologies, processes or information were employed (or employed more effectively) in the electricity (or a related) market?

Several utilities have undertaken trials of demand response programs which have proven successful both in reducing air conditioner peak demand on extreme hot days and in maintaining customer satisfaction. They have not so far been deployed on a larger scale for a range of factors, including the high cost of establishing communications links with existing air conditioners. Where this can be done at all, the cost per successful connection is high, and furthermore requires the utility to assume the risk of a voided product warranty.

The E3 is currently developing standards on demand response interface specifications for air conditioners, pool pump controllers, hot water heaters and electric vehicle battery rechargers. Introducing these high electricity using appliances with a standard demand response interface, which can be accessed reliably and at low cost, and without voiding the manufacturer's warranty, would radically change the cost profile of demand response programs.

Market Conditions required for efficient DSP Outcomes

9. What are considered the relevant market conditions to facilitate and promote consumer take up of cost effective DSP?

The market conditions are:

- The availability of an open technology platform that ensures that all smart appliances can be used with a range of communications protocols and in all utility areas, with smart meters or without. AS/NZS 4755 provides this open technology platform.
- A steady and reliable rate of growth in the smart appliance stock, that can be accessed for DSP at a low cost, so that utilities can plan DSP programs as they now plan supply-side capital expenditure programs. Making AS/NZS 4755 mandatory would achieve this condition.
- Customers must have an incentive to take up demand response opportunities – either to minimise their exposure to time-variable prices, or to take advantage of bill discounts or cash payments. It is up to the utilities to devise contracts and arrangements that will attract and retain participants (with or without TOU prices).
- The tariffs, contracts or other arrangements must be in place for long enough so that both consumers and utilities gain experience and confidence with them, and the

utilities are able to predict participation and response rates with sufficient accuracy to factor DSP into forecasting and planning.
- A regulatory environment that requires electric distributors to seriously examine the scope for DSP options to moderate or defer capital expenditure, when they are making their case for regulated price determinations.

29. Do current technology, metering and control devices support DSP? If not, why not, and what are considered some of the issues?

Current technology, metering and control devices *can* support DSP through load control. The E3 Committee has worked with the NSSC to ensure that the *Smart Meter Infrastructure Functionality Specification* provide for meters to receive, process and pass on demand response signals to appliances fitted with demand response interfaces (AS/NZS 4755-compliant interfaces). Every smart meter should be able to do this in at least one of two ways:

- Directly, by means of a voltage-free controlled load relay (CLR) designed to connect via cable to an AS/NZS 4755 interface; or
- Indirectly, via a home area network (HAN) interface, which will be able to link wirelessly to receivers connected to AS/NZS 4755 interfaces.

The CLR is at present an optional feature of the smart metering standards. However, its presence on every meter would offer a low-cost demand response activation pathway in every home with a smart meter. It would also increase the number of low-income households that could take advantage of DSP opportunities, and offer a reliable activation pathway where wireless communication is unsuitable or fails.

31. How can pricing signals/tariff arrangements be made complementary with smart grid technologies to facilitate efficient DSP in the NEM?

Time of use pricing, which varies over the cycle of the day, seasonally or at periods of critically high network loads or generation costs, obviously provides an incentive for customers to manage their load. Customers can either control their own electricity load, in which case the utility may not be aware it is happening and not be able to plan for it, or they may authorise the utility to manage certain aspects of usage on their behalf, via a direct load control program. (This is by no means new – it is the basis of traditional off-peak tariffs).

Time of use pricing is necessary to motivate consumers to act on their own (price-driven demand response) but is not the only way to motivate consumers to participate in direct load control programs. Utilities could offer a flat or graduated incentive in return for the authority to load-manage the consumer’s appliances up to a limited number of hours each year. This could be achieved without smart meters – the AS/NZS interface on appliances could be accessed via a separate DRED – making the rate of takeup independent of the rollout of smart meters.

Therefore almost any pricing signal/tariff arrangements could be made complementary with smart grid technologies.

Market and Regulatory Arrangements

35. Are there market failures which mean regulation is needed in some areas to ensure appropriate market conditions are in place?

Yes. While several stakeholder groups – network operators, appliance manufacturers and ultimately consumers – would benefit from the large-scale introduction of smart appliances that respond to direct load control, no group can be sure of gaining enough of the benefit to warrant the commercial risks of unilateral action. This situation, where a universally beneficial outcome is foregone because no single agent can capture enough of the benefit to act, is one of market failure through *positive externality*.

Regulation is needed to

- establish a common standard for the interface between smart appliances and the smart grid, and
- ensure the build-up of a critical mass of smart appliances to the point where the utilities are able to offer demand response programs that are cost-effective for their customers.

Both participants and non-participants would benefit from this: participants through some sort of utility offered incentive; and all customers from lower network and energy prices than would otherwise be the case.

Two types of regulation are needed:

1. Regulation to require the manufacturers of priority appliances to provide AS/NZS 4755 interfaces in products, using the same regulatory framework as for energy labelling and MEPS. After years of involvement in international smart appliance standards work, E3 has come to the conclusion that there is no prospect of adoption of any other comparable standards by the global appliance manufacturers in the foreseeable future.

2. Regulation to require electricity distributors to develop and offer demand response programs to their customers, to fairly evaluate the results and, if they are successful, to incorporate demand response in supply infrastructure planning and in price determination applications.

It should be reiterated that consumers should be free to opt in or out of demand response programs as they choose, subject to whatever contractual arrangements they make with their electricity supplier.

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