DIRECTIONS PAPER
Power of choice - giving consumers options in the way they use electricity

Commissioners
Pierce
Henderson
Spalding
23 March 2012

On 29 March 2011, the former Ministerial Council on Energy (MCE)4 directed the Australian Energy Market Commission (AEMC) to undertake a review of demand side participation (DSP)5 in the National Electricity Market (NEM). The review is entitled Power of choice - giving consumers options in the way they use electricity.

The review is to identify the market and regulatory arrangements needed across the electricity supply chain to facilitate the efficient investment in, operation and use of DSP in the NEM. It has broad focus and considers how the national electricity rules, other national and jurisdictional regulations, commercial arrangements and market behaviours can collectively facilitate economically efficient DSP.

Document (quantity and timing).	**Purpose**	**Date**
Directions paper	Provides an assessment of the potential for DSP in the NEM, confirms the market conditions required to promote efficient DSP, and highlights areas for improving market and regulatory arrangements for further consideration under the review.	Submission close on 4 May 2012
Public forum	**To seek stakeholder input regarding the findings in the directions paper.**	**19 April 2012, Sydney**
Draft report	Seeks to identify the set of feasible reform options based on market conditions that need to be in place across the supply chain.	June 2012
Public forum	To seek stakeholder input regarding the findings in the draft report.	During the consultation phase on the draft report
Final report	Provides our findings and recommendations to the SCER. An implementation plan and timeline for action will also be provided.	September 2012

Making a submission

Stakeholders are encouraged to provide submissions and participate in bilateral and public forum processes to ensure all issues are canvassed and considered. The closing date for submissions to this directions paper is **4 May 2012**. Submissions should quote project number EPR0022 and may be lodged online at www.aemc.gov.au or by mail to:

Australian Energy Market Commission
PO Box A2449
SYDNEY SOUTH NSW 1235

In providing submissions to the review, stakeholders are encouraged to give evidence, data and any other information (for example, case studies) to support any issues raised. We recognise that this material might contain information that is confidential in nature. All information, including confidential information, will be treated in accordance with the AEMC's submissions guidelines which can be viewed at www.aemc.gov.au.

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

Demand Side Energy Efficiency

Demand Side Response (DSR)

DSR refers to actions by energy users to reduce their demand for network supplied energy in response to pricing signals during periods of peak demand or network stress. This may include the use of distributed generation, shifting consumption to off-peak periods or ***simply choosing to consume less*** and foregoing a level of activity.

Hot Water Services

The case is made for review of the demand-side efficiency aspects of hot water service provision in all types of installations by acknowledging that hot water services contribute an average of 23% of household energy consumption, as well as 20% of Green House Gas Emissions – see excerpt/s from ABS below.

Australian Bureau of Statistics - Hot Water Systems[1]

In 2009, as a part of the National Partnership Agreement on Energy Efficiency, COAG committed to phasing out electric resistance hot water systems from 2010. Under the 10 year National Hot Water Strategy, Australian households will transition to low emissions hot water systems. For households with a peak electric water heater or wood fuelled water heater the Victorian government offers a rebate for the installation of a natural gas or LPG water heater that has a high efficiency rating. Both the federal and state governments offer various incentives for solar hot water heaters.

In Australia, ***water heating products are the second largest users of energy out of all household appliances, using 23% of household energy***. Energy consumed for water heating is also the second largest source of household greenhouse emissions in Australia, emitting 24% of greenhouse gasses in the average Australian household. Victoria experiences similar rates as those at a national level (DPI 2010). See Figure 1.

Of the 2,089,900 households in Victoria with hot water systems, most used gas (68%) as a source of energy. In Melbourne, 76% of the 1,503,000 households with hot water systems used gas compared to 47% of the 586,900 households in regional Victoria.

Electricity as a source for heating water in households had a higher proportion in the statistical region of Inner Melbourne (33%), compared to Melbourne overall.

[1] Australian Bureau of Statistics
http://www.abs.gov.au/ausstats/abs@.nsf/Products/9C96AA9AEAA1E416CA25774A0013BE79?opendocument

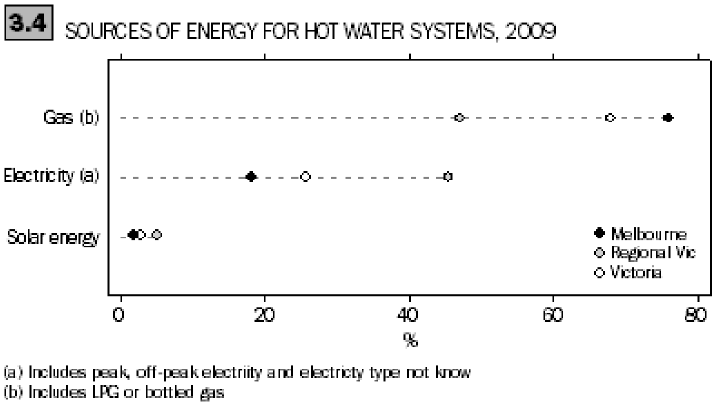

Figure 1 - Hot Water Service Energy Source

In addition, hot water service contribution to Green House Gas Emissions amounts to +/-20%[2].

In 2004, households accounted for just over a third of the greenhouse emissions from Victoria's stationary energy sector. Energy consumption in the residential sector is growing and increased by 33% from 1990 to 2004 (DSE 2006). Appliances, heating and cooling and hot water constitute the majority of the greenhouse gas emissions from Victorian households' energy use, as seen in Figure 2.

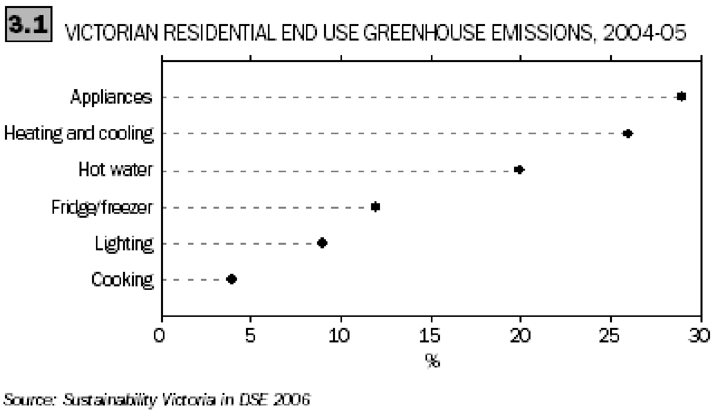

Figure 2 - Residential Green House Gas Emissions

[2] Australian Bureau of Statistics
http://www.abs.gov.au/ausstats/abs@.nsf/Products/292FF7ED881E18B0CA25774A0013BC5E?opendocument

Reducing Water and Energy Consumption

"Simply choosing to use less" of either water and energy, or both requires a change in cultural disposition that may be difficult to achieve. That said, the State of Victoria managed to achieve this shift in cultural disposition during the drought years. The State is internationally renowned for having delivered the 155ltrs/head/day strategy without legislation.

The 155ltrs/head/day did not only deliver water consumption reduction, which was its primary aim, the strategy delivered a significant reduction hot water-based energy consumption as well – the physics of heating water describes this very adequately:

The lower the volume of water to be heated, the less the energy consumed

"Simply choosing to use less" is only one way of reducing water and thus energy consumption in direct relation to hot water, but saving water tends to be culturally counter intuitive – water should be stored, and water consumption should be reduced when there is an abundance of water, ***not*** when there is a scarcity.

In addition, precluding the installation of all electrical hot water service devices, including those electrical devices/appliances that are highly ***energy and water efficient,*** in Class 1 Constructions under the National Partnership Agreement on Energy Efficiency, leaves the Consumer with very little, or no ***choice*** in the selection of type of hot water service.

Hot Water Service Energy Consumption Reduction – An Alternative View

There are however, two very effective, alternative methods that can be used to facilitate a reduction in energy and, necessarily, water consumption. Both methods deliver significant demand side efficiencies:

- Point-of-Use Installation
- Optimised hot water service device/appliance

The distinctive difference between these strategies and *"Simply choosing to use less"* is the fact that the reduction in energy/water consumption delivered by either of the above strategies is independent of usage. Rather, demand side efficiency is delivered ***irrespective*** of usage, thereby significantly enhancing any *"Simply choosing to use less"* water/energy reduction strategy.

Point-of-Use Installation

Water and energy consumption can be reduced through efficient hot water service installation design. A well-known option in this context would be a "Point-of-use" installation. In this relation, hot water reticulation pipes should be kept as short as possible. In new or renovated domestic dwellings, locating wet areas close together will ensure the hot water service will be installed close to all points of hot water use. This includes the kitchen where small, frequent amounts of hot water are used.

The water and energy wastage problem associated with centralised water heating systems (especially those in large homes and commercial buildings), are the result of long reticulation pipe runs. Litres of heated water delivered to the hot water faucet via the pipe run become cold when the hot water is turned off. When a hot water faucet is turned on at a point-of-use cited remotely from the hot water appliance, there is a delay in receiving hot water that results in the cool water in the pipeline being flushed down the drain – technically called “draw off”. Where hot water service pipe runs are very long – in commercial high rise buildings for example, pipe runs are heated in anticipation of use in an effort to reduce water wastage. While saving water is a good outcome, it is at the expense of a significant amount of energy that must be included in the hot water service energy calculation.

As the detailed “Pipework Heat Losses” calculation done by Jemena® Pty Ltd indicates, it can be seen that heat loss through the hot water reticulation infrastructure is substantial. See Table 1.

Piping Heat Loss[3]

For energy efficient centralised hot water design it is essential to minimise heat losses from hot water pipe work by both:

- Minimising hot water pipe diameters to the minimum that good flow design practice will allow; and
- Thermally insulating the hot water piping.

All hot water flow and return lines regardless of the material (i.e. Polymer piping) will need to be insulated. The type and thickness is dependent on achieving the C.F. requirements while satisfying relevant building codes.

Various available insulation materials can be used to insulate hot water supply and return piping. Published heat loss specifications (in both W/m and kJ/H/m) from insulation material suppliers are available and can be used as shown below to determine the level of heat loss for the proposed piping size and configuration. For the table presented below it is assumed the pipes contain water at 60°C and the ambient air temperatures conditions for winter and summer are set at 15°C and 20°C respectively.

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[3] ADG-003 Design Guide for Gas Centralised Hot Water Systems © Jemena Pty Ltd

The inefficiencies related to water and energy wastage due to hot water reticulation piping can be all but eliminated by installing the water heating service device close to the fixture it serves – at the "Point-of-Use". Point-of-use water heating services deliver hot water almost immediately after turning on the faucet, without the requirement to heat pipe runs in anticipation of use.

Ideally, whole house, large commercial, centralised hot water services should be replaced with small, highly efficient, instantaneous point-of-use hot water service.

Additionally, plumbing costs would be reduced by installing point-of-use hot water services, through the reduction in length of hot water reticulation pipe runs. Only cold water piping needs to be reticulated. Where service up-time and hot water delivery is concerned, point-of-use hot water services significantly outperform centralised hot water services.

Table B.1 PIPEWORK HEAT LOSSES						
PIPE SIZE	INSULATION THICKNESS (mm)	" 65 °C HOT WATER / 15 deg.C AMBIENT with Thermotec 4 zero insulation")	" 50 °C TEMPERED WATER System/ 15deg.C AMBIENT with ARMAFLEX insulation")	INPUT LENGTH OF PIPE HERE	UNIT HEAT LOSS FOR COLUMN <F>	UNIT HEAT LOSS FOR COLUMN <G>
(mm OD)	<Nominate insulation type here>	(kJ/H/m)	(kJ/H/m)	(m)	(kJ/H)	(kJ/H)
15	nil	112.3	50.4	0	0.0	0.0
15	20	31.7	19.1	23	729.1	439.3
15	25	25.2	16.9	95	2,394.0	1,605.5
20	nil	144.7	78.5	0	0.0	0.0
20	20	36.6	25.9	0	0.0	0.0
20	25	31.3	22.7	295	9,233.5	6,696.5
25	nil	177.1	97.9	0	0.0	0.0
25	20	40.3	28.4	0	0.0	0.0
25	25	37.4	25.2	98	3,665.2	2,469.6
32	nil	218.2	124.9	0	0.0	0.0
32	20	47.5	32.2	0	0.0	0.0
32	25	41.8	28.1	65	2,717.0	1,826.5
40	nil	258.1	149.0	0	0.0	0.0
40	20	58	36.4	0	0.0	0.0
40	25	50.8	31.1	18	914.4	559.8
50	nil	324.7	200.2	0	0.0	0.0
50	20	64.1	44.6	0	0.0	0.0
50	25	58	38.5	20	1,160.0	770.0
65	nil	372.9	262.6	0	0.0	0.0
65	20	71.6	54.7	0	0.0	0.0
65	25	64.4	46.4	8	515.2	371.2
80	nil	439.6	313.6	0	0.0	0.0
80	20	85.3	63	0	0.0	0.0
80	25	76.3	49.7	0	0.0	0.0
100	nil	590.1	398.2	0	0.0	0.0
100	20	106.2	76.3	0	0.0	0.0
100	25	88.9	59.2	0	0.0	0.0
	Total Central Hot Water Piping Heat Loss (MJ/H) =				21.3	14.7
	Total Central Hot Water Piping Heat Loss (MJ/day) =				511.9	353.7

Table 1 - Piping Heat Loss Table / Jemena Pty Ltd

The energy loss of 511.9MJ per day converts to approximately 142kW-hr per day. This loss occurs by virtue of the hot water reticulation strategy, before a drop of hot water is actually consumed.

Benefits of Point-of-Use Installation

Benefits of point-of-use installations include:

- Reduction in Energy Consumption
  - Virtual elimination of hot water reticulation pipe run results in a significant reduction in energy losses in the pipe run.
  - There are two aspects of reduction in energy loss related to reticulation pipe
    - Loss to the atmosphere
    - Energy to heat and reticulate water in the pipe in anticipation of use.

Optimised Instantaneous/Continuous Flow Water Heating Services[4]

In addition a ***fully optimised*** hot water service device or appliance, will also serve to reduce both water and energy consumption. If improvement in hot water service efficiency is to be taken seriously, then instantaneous/continuous flow hot water heating services should be fully optimised. Optimisation allows only the correct, calculated amount of energy required to heat the water to the desired output temperature to be applied.

Where flow rates are kept low, less energy and water will be used. See Table 2, Table 3 and Table 4. It can be seen that the lower the flow rate, the less energy/water is consumed.

Flow Rate LPM	1.00	ltr/min
Input Temp.	10.00	°C
Output Temp.	45.00	°C
Temp Change	35.00	°C
Power Req.	2438.33	Watts

Table 2 - Energy Consumption at 1ltr/min

Flow Rate LPM	3.00	ltr/min
Input Temp.	10.00	°C
Output Temp.	45.00	°C
Temp Change	35.00	°C
Power Req.	7315.00	Watts

Table 3 - Energy Consumption at 3ltr/min

Flow Rate LPM	4.00	ltr/min
Input Temp.	10.00	°C
Output Temp.	45.00	°C
Temp Change	35.00	°C
Power Req.	9753.33	Watts

Table 4 - Energy Consumption at 4ltr/min

Optimisation also reduces energy required to heat water to the desired output temperature when inbound water temperature is high. See Table 5 and Table 6.

Flow Rate LPM	4.00	ltr/min
Input Temp.	20.00	°C
Output Temp.	45.00	°C
Temp Change	25.00	°C
Power Req.	6966.67	Watts

Table 5 - Energy Consumption with Inbound Water Temperature 20°C

Flow Rate LPM	4.00	ltr/min
Input Temp.	25.00	°C
Output Temp.	45.00	°C
Temp Change	20.00	°C
Power Req.	5573.33	Watts

Table 6 - Energy Consumption with Inbound Water Temperature 25°C

[4] MicroHeat laboratory test data – 2009/2010/2011/2012

Conclusion

It is acknowledged that energy consumption related to hot water services has an impact on Green House Gas Emissions. Thus, if demand side electrical energy efficiency is a requirement to reduce Green House Gas Emissions, Consumers should be given a choice in the selection of hot water service device/appliances that:

- Facilitate Point-of-Use installation, and that are
- Fully optimised

Phasing out Green House-intensive Hot Water Systems[5]

The Australian Government and State and Territory Governments are working together to phase out greenhouse-intensive hot water systems, starting in 2010. The phase-out will apply in all States and Territories except Tasmania.

Conventional residential electric hot water systems produce about four tonnes of carbon dioxide per year — up to three times that of more efficient technologies. By phasing out greenhouse-intensive water heaters, greenhouse gas emissions can be reduced by about 51 million tonnes in the period from 2010 to 2020. This is equivalent to taking 1.4 million cars off the road for 10 years.

This Federal Government Strategy tars all electrical hot water service devices/appliances with the same brush, irrespective of whether the device is energy and water efficient. This severely limits the Consumer's ability to choose a demand side efficient hot water service that facilitates a Point-of-Use installation and that is fully optimised.

This denies the Consumer the option of choosing an efficient way to use electricity in relation to hot water services

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[5] http://www.climatechange.gov.au/en/what-you-need-to-know/appliances-and-equipment/hot-water-systems/phase-out.aspx