



AIR CONDITIONING AND PEAK LOAD WORKSHOP

Draft Agenda

1. Introduction by Steve Anderson of AREMA and Harry Schaap of ESAA (5 mins)
2. Presentation (10 mins) by P Ryan
 - a. Australia – Current Situation
 - b. Strategies & Options – Australia & Overseas
3. General Discussion
 - a. What can work in Australia (15 mins)
 - i. Demand Side Response
 - ii. Correct air conditioner sizing
 - iii. Efficient buildings
 - iv. MEPS
 - v. What else?
 - b. Best Options to Progress in Australia (15 mins)
 - c. Actions and Ways Forward (15 mins)
4. Other Strategies (15 mins)
5. Conference Communiqué (15 mins)
 - a. Potential Items for Inclusion
 - b. Realistic Incentives
 - i. Near term strategies
 - ii. Long term strategies
 - c. “Ideal world” strategies



What More Can be Done in Australia?

A list of possible actions and strategies is shown below:

1. More efficient housing and commercial buildings to reduce the need for air conditioning caused by poor design and building process
2. Undertake correct sizing and installation of air conditioners to minimise excessive demand
3. Achieve cost-effective load control of air conditioners to ensure system wide benefits and/or for particular utility systems:
 - a. Use market signals to manage peak load created by industrial and commercial users
 - b. Use **(DSR)** programs and market signals to manage peak load created by residential customers
 - c. Examine alternatives to banning of climate control in problem localities
4. Examine infrastructure issues for problem localities to plan for improvements and manage load
5. Address power factor correction management of residential air conditioners to decrease power wasted by poor power factor

What Strategies are Available and Tested in Australia?

In managing the peak load contribution of air conditioners, various strategies can be used. Those listed below have various features; some are long term, and some require significant market intervention or changes to the market structure to be fully utilised and match the consumer situations. The strategies described below are complimentary and address both energy/GHG reductions as well as load control.

Demand Side Response

Demand Side Response (DSR) or Demand Response (DR) is used to enable customers to respond to price signals and curtail or shift demand at certain times, with the benefit to both the customer of lower electricity costs; and the utility of reduced electricity network and generation capital investment. Peak load management or demand response occurs when customers reduce or shift electricity use in response signals or to programs specifically designed to induce such actions.



The issues considered important to the success of DSR in Australia are:

- **Price signals** – Residential and small commercial consumers generally purchase electricity on uniform tariffs, hence there is little incentive for customers to reduce or move load at peak times. More cost reflective pricing would allow the customer to be more fully exposed to peak prices and have a sufficient financial or other incentive to reduce load at particular times. In the large commercial and industrial sector, time-of-use (TOU) tariffs are available; however these alone are generally not sufficient to induce response. Market participation on the demand side can reduce both electricity supply costs and – if these are passed on – consumer costs. The fare value for network and generation deferment must be recognised within the wholesale market systems to enable cost reflective pricing. Specific price signals for DSR can then be seen and customers rewarded for curtailing or eliminating peak loads, payments for load reduced and/or the availability to respond at peak times.
- **Metering and signalling** – the technical ability to participate must be present as must the systems to record and pay for response. The wide spread adoption of interval meters and/or signalling equipment for small customers is required but costs and technical concerns have to be addressed. The appropriate choice of signalling method, direct control or manual, needs to address the end-use load type and customer type.
- **Suitable loads** – the control of air conditioning found in residential and small commercial is still a barrier for many customers. Will load control/cycling impact on climate conditions and equipment life? The overseas experience of millions of customers in direct load control programs suggest that these barriers can be overcome [PLMA 2002]
- **Energy/electricity market reform** – the spot market wholesale pricing system currently create incentives to offer capacity as the system pays all generators at the last higher bid price. This issue, combined with network operators being paid on the basis of capital investment does not encourage DSR without a countervailing DSR system.

The issues are complex and are not easily contained to this short document, however studies by the Energy Users Association of Australia, energy utilities (both retailers and distributors) and governments have similar conclusions.

Recent trials in Australia to date include:

Integral Energy with SEDA

Trials in 2000/ 2001 of Interruptible Tariffs, with the objective to manage peak demand to defer capital expenditure and to reduce exposure to high pool prices. The trial tested:

- reliability of the equipment
- response time of the equipment



- impact on the load profile
- market acceptability of interrupting air conditioning load on hot days

The trial concluded:

- Both communication systems effective (pager and frequency control)
- Customer response positive (but were induced to participate)
- Demand reduction is possible
- Administrative effort in management of program very high
- Financial basis a concern.

EUAA Demand Side Response Facility Trial

A DSR Facility Trial was conducted by the Energy Users' Association of Australia (EUAA) in November and December 2002. The trial aimed to demonstrate the feasibility of a prototype DSR facility, encourage participation by its members and identify obstacles to development of an effective DSR capability in the NEM. This trial was a simulation exercise and relied on the voluntary commitments of nine large end-user organisations, three national energy retailers and three distributors from NSW and Victoria. This was a "paper" trial undertaken as an 'off-market' activity. End-users participating in the trial offered 93 items of plant with a total despatch capacity of 119.4 MW, substantially more than anticipated during planning.

The trial effectively demonstrated that the prototype DSR facility worked. If this DSR capacity can be mustered, the trial results suggest that a DSR 'market' could release up to as much as \$2 billion/year in value – or around 10% of retail turnover.

Correct Sizing/Installation

Correct sizing and installation of residential air conditioning systems can ensure the system meets the needs of the customer and encourages efficient operation. These factors help reduce peak load of air conditioners by reducing the likelihood of oversized or undersized systems, which lead to inefficient equipment operation – undersized systems tend to operate longer, while oversized systems create unnecessary peak demand and do not operate at appropriate loads and impact on system power factor.

AIRAH Good Practice Guidelines

The AIRAH Air Conditioning Residential Best Practice Guideline proposes to define a minimum level of service that AIRAH considers should be delivered by a Supplier in order to provide a quality result for a Customer. The guide provides advice on load estimation, sizing, noise and data forms to be left with the customer.



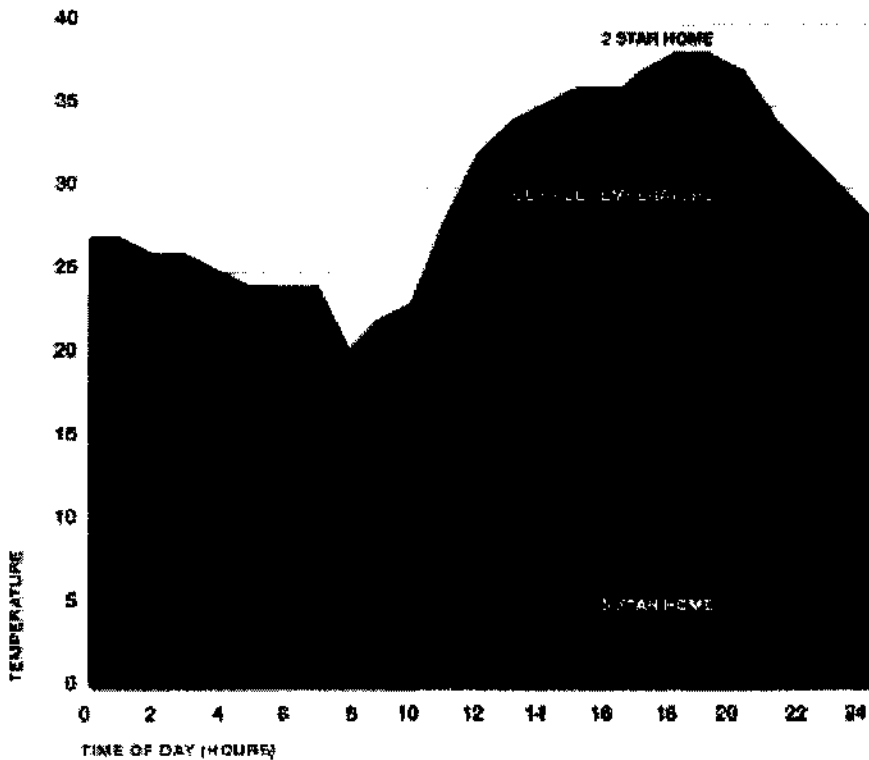
Thermally Efficient Building Construction

Homes and buildings that require less heating and cooling will help reduce pressure on power supplies during high-use summer periods. In Australia, the Building Codes are implemented by the States and coordinated at the national level by Building Codes Australia. On 1 January 2003 energy efficiency measures for houses were introduced into the national Building Code of Australia (BCA). Those measures have been subsequently adopted in the Northern Territory, Queensland, South Australia, Tasmania and Western Australia. Measures already exist in the ACT and Victoria. New South Wales is in the process of finalising its energy efficiency provisions for houses.

Building Codes - Residential

The Victoria government has recently introduced a 5 Star Home Energy Rating (HER) energy efficiency requirement for all new residential buildings from mid 2004. Figure 1 shows the potential impact on indoor temperatures due to the decreased cooling load for a 5 Star house. This will affect the size of the air conditioning system installed in new houses, and potentially reduce the peak demand from air conditioners in new homes.

Figure 1: Reduction in Internal Temperature of 5 Star Homes





Building Codes - Commercial

The Australian Building Codes Board, at its meeting on 27 February 2003, agreed that the energy efficiency measures for commercial buildings be progressively implemented into the BCA. As a result:

- A Regulation Document (RD2003-1) for multi-residential buildings (Class 2, 3, and 4) was released on 15 September 2003 for adoption in the BCA from 1 May 2005.
- A second package of measures for all other building classes is proposed for implementation in the BCA one year later.
- A document outlining the proposed stringency for Class 5 (Office) buildings is to be released in mid 2004.
- The provisions for commercial buildings are being developed on the basis of a single, holistic Performance Clause for the building fabric and services.

Minimum Energy Performance Standards (MEPS) and Energy Labelling

The use of equipment MEPS and energy labelling aims to improve the efficiency of air conditioners used in Australia and have a long history of development and implementation. MEPS aim to remove from the market those least efficient air conditioners and overcome the market failure regarding whole-of-life costs. Energy labelling aims to provide information to consumers on the range of efficiency for the product and running costs, hence encouraging greater market “pull” and supplier “push” for more efficient units. By improving the efficiency of the equipment, peak load contributions will also be reduced. Actions in Australia to date include:

Energy Labelling

- Single Phase Air Conditioners – since 1987, re-rating of the star scale in 2001
- 3 Phase – Voluntary since 2001

MEPS

- Three phase packaged air conditioners with a cooling output up to 65kW
 - Stage 1 MEPS since 2001, Stage 2 MEPS from 2007
- Single phase residential air conditioner
 - Stage 1 MEPS from 2004, Stage 2 MEPS from 2007

Other

There are other factors that impact on the peak load contribution of air conditioners including:

- Power factor correction controls



- Inverter driven air conditioners

What is the Overseas Experiences?

Air Conditioner Sizing

California Energy Commission (CEC 2003) is considering the introduction of sizing rules in the next 2005 Building Energy Efficiency Standards. They claim that most residential air conditioners are oversized and that correct sizing will reduce peak demand and improve customer's comfort, and reduce capital costs.

Some utilities in the USA have implemented maintenance programs that aim to reduce the impact of oversized residential and commercial air conditioners, by reducing the refrigerant charge.

Thermally Efficient Building Construction

Overseas economies have in place building codes which aim to improve the efficiency of new buildings, both in the commercial and residential sectors, including:

- USA & Canada – Residential and Commercial
- UK – Residential and Commercial
- New Zealand – Residential and Commercial

Demand Side Response with Air Conditioning

In the USA, direct load control (DLC) programs target millions of customers with equipment that can be turned off or cycled for relatively short periods of time. The most common applications are, in order of participation rates:

- residential central air conditioners,
- water heaters,
- swimming pool pumps, and
- electric space heaters with storage features.

Receiver systems must be installed on the customer equipment to enable communications from the utility and institute controls. Communications are often by radio signal from the utility. However, the power line carrier is of growing interest, as is the use of public or private wireless communication systems. DLC programs are mandatory typically, once a customer elects to participate. Voluntary participation is now an option for some programs with more intelligent control systems and override capabilities at the customer facility. Typically, the utility is allowed to cycle or shut-off a unit for a limited number of hours for a limited number of occasions. Cycling strategies for air conditioners range widely:

- 25% cycling or 7.5 minutes off out of 30 minutes,



- 33% cycling or 10 minutes off out of 30 minutes,
- 50% cycling or 15 minutes off out of 30 minutes, and
- 100% cycling or off all 30 minutes in each half hour.

Typically the unit is free to operate when not cycled off. Thus the resident is assured of some air conditioning under most schemes. A related issue is whether the fan continues to circulate air and help maintain comfort by being in the “on” position as opposed to the “automatic” position that is tied to the operation of the compressor. Most programs just prevent the compressor from operating thereby allowing the fan to circulate air in the home when the customer has it set in the “on” position. Smarter control systems have built-in memories to recognize how much the equipment has been running and are programmed to cycle at different frequencies so all participants provide similar load reductions. Of course some systems provide no load reduction where the unit is turned off during the curtailment period or the cycling equipment has been disabled by the customer, whether deliberately or not. Most programs factor such “free rider” effects into the calculations of benefits and costs. Incentives to the customer are based on several factors including:

- type of unit under control such as air conditioner or water heater,
- degree of control such as 30% cycling or 100% off,
- the average amount of load reduction net of free rider effects, and
- the value of the load reduction to the utility.

Incentives are typically paid through monthly credits on utility bills. These may be just for the load control season or all year as a reminder of the customer’s value to the utility. Customers typically do not have to pay for the equipment or installation of control systems.

The Current Situation in Australia?

Electricity businesses invest in peak generation capacity and distribution systems to match demand. The growth of air conditioning installation makes it difficult to keep pace with peak demand. Supply investments are expensive and eventually will increase the cost of electricity in Australia, and there are also concerns that supply businesses will struggle to meet demand:

NEMMCo said last week that higher peak-power demand due to the spread of air-conditioning would bring about a deficit in Victoria’s reserve capacity by 2004-05 and across the national electricity market by 2005-06. *The Age, 8 August 2003*

Air conditioning systems are a major end use contributor to peak load growth in both the commercial, but mostly residential sector. Total electricity consumption for HVAC systems in the commercial and residential sectors was estimated in 2001 to be 66 PJ in 1990, 91.7 PJ in 2000 and 119.4 PJ (or some 33 000 GWh) in 2010 [AGO 2000]. The summer peak load increase has been attributed to air conditioners by electricity suppliers and the state



regulators. The contribution to peak load of air conditioning is driving the summer peak load for the eastern States. In Victoria, VENCORP states

"Growth in peak summer load sensitive to temperature is dominated by increased sales and use of refrigerative air conditioning" with a 2,600MW load increase (30%) likely between 2001 and 2011

In this context, the challenge for all involved in the industry – those supplying, designing and installing air conditioning systems; the government that is regulating the industry, and those providing the electricity – is to find an efficient, effective and fair way to meet the needs of the consumers.

The Impact of Air Conditioning

The Australian market for single-phase air conditioners is one of the world's largest markets with estimated current sales of over 600,000 units estimated to be worth over AUD\$500 million despite its small population of 20 million people. 50% of households have air conditioners installed. Some two thirds of the market by volume are mini-split systems. Research completed in January 2002 indicated annual growth in excess of 10% per annum, with residential market penetration set to grow from 50% to 60% within the next 5 years.

Figure 2 shows the sales of air conditioners from 1998 to 2003. Sales are increasing rapidly in the residential market.

Figure 2: Sales of Residential Air Conditioners

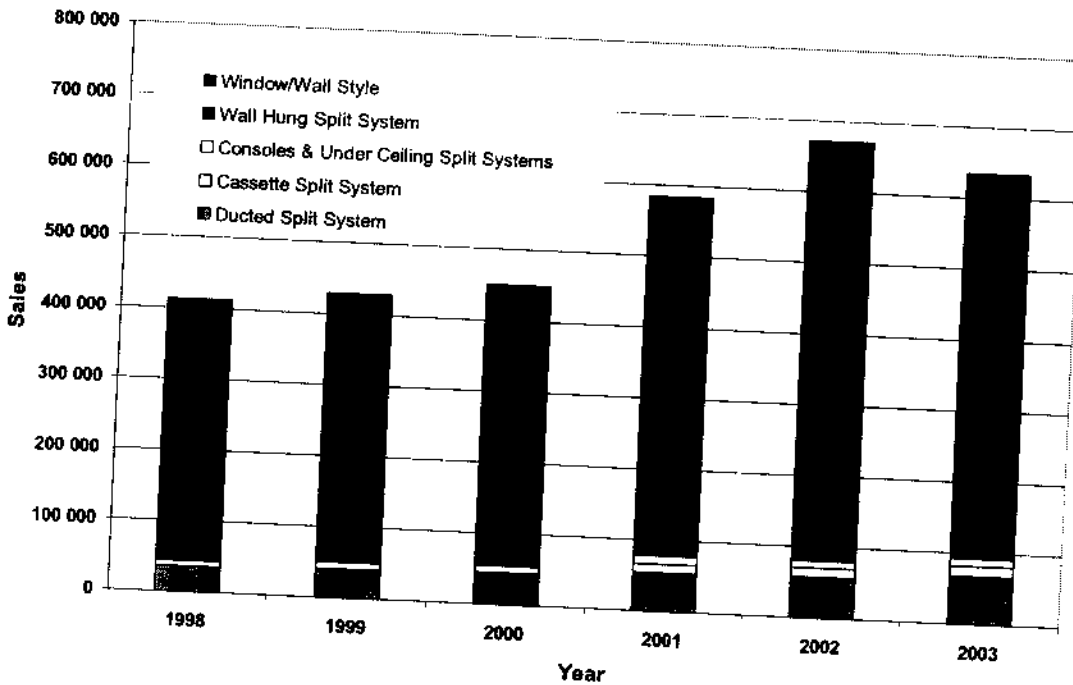
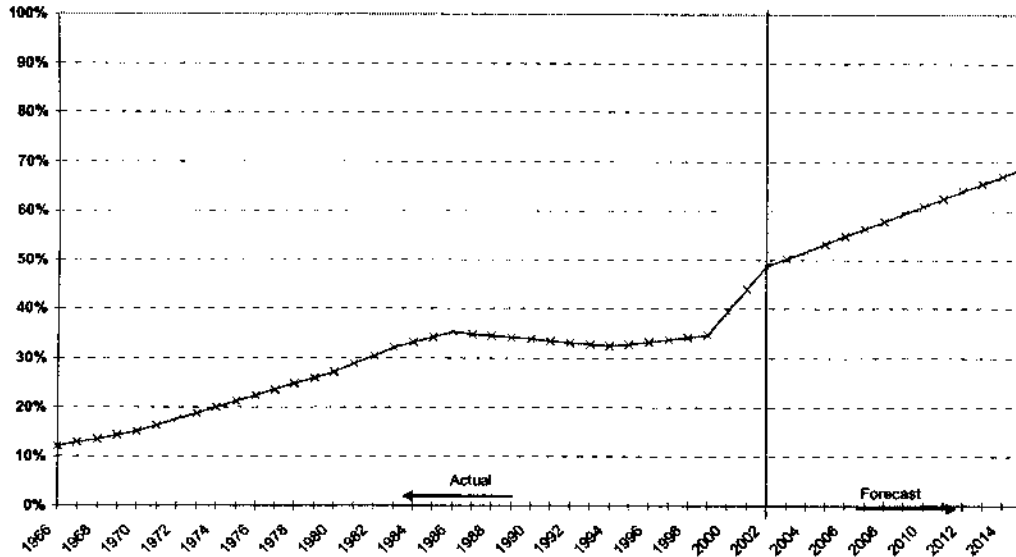


Figure 3 shows the increasing penetration of air conditioners in Australian households.



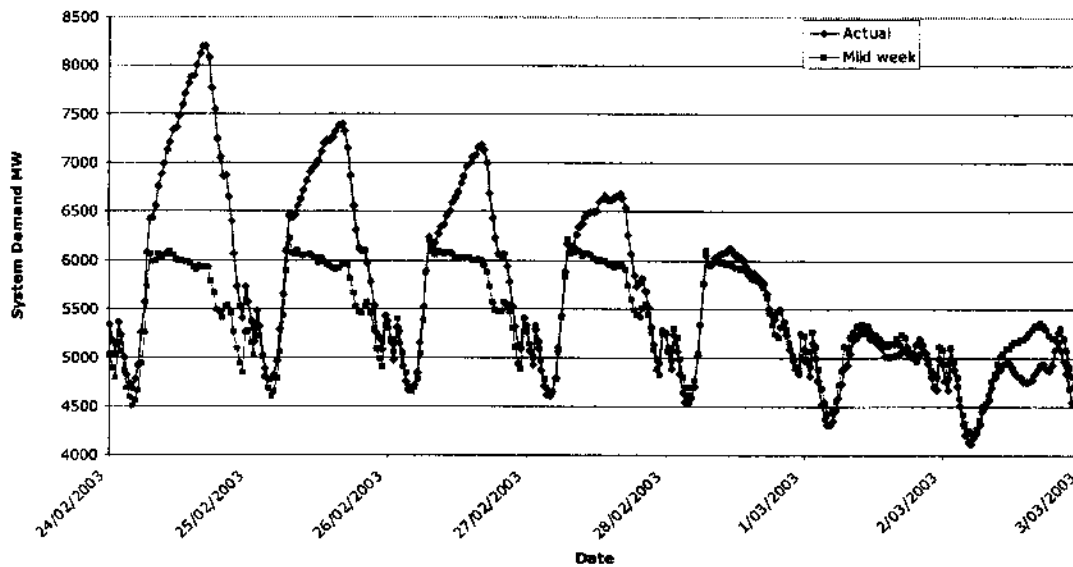
Figure 3: Penetration of Air Conditioners in Households (households with one or more of appliance)



Air conditioning is a major contributor to peak load in many states. Figure 4 shows the impact of high temperatures on the Victorian Peak Demand in February 2003, with over 2,000 MW of additional load required compared to a mild week.

Figure 4: Impact of Summer High Temperatures on System Peak

Victoria State Load - Week of 24 February 2003





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