INFORMATION PAPER

THE IMPACT OF RESIDENTIAL AIR-CONDITIONING ON THE WESTERN AUSTRALIAN ELECTRICITY SYSTEM

OFFICE OF ENERGY
December 2004

Foreword

The Office of Energy has prepared this information paper with the assistance of Western Power. It aims to encourage and provide a basis for public debate about the increasing impact that air-conditioning, and in particular residential air-conditioning, is having on our electricity supply system.

Key Points

- Residential air-conditioning contributes a major and rapidly growing part of peak electricity demand, both in Western Australia and in other Australian states.

- The cost of electricity infrastructure to meet the peak demand from air-conditioners is significant and much larger than the price consumers pay for the air-conditioners themselves.

- The cost of providing electricity infrastructure to provide for air-conditioning growth at peak periods is not recovered in the amounts consumers pay for the electricity used by air-conditioners.

- National mandatory efficiency standards for new air-conditioners were introduced in October 2004 and will be further strengthened over time. This will reduce the greenhouse impact of air-conditioner use and reduce the impact of new air-conditioners on electricity infrastructure at peak times into the future.

- When purchasing an air-conditioner, customers should consider appliance star ratings (or coefficient of performance) to make sure that they choose an energy efficient model. This will save on running costs and reduce the impact on our environment. It will also minimise the consequent need for excessive expenditure on electricity infrastructure.

- Electricity used by air-conditioners can also be minimised by operating them efficiently. Advice on efficient use of air-conditioners is available from the Sustainable Energy Development Office Energy Smart Line and Western Power.

- Studies are continuing in Western Australia and other states to better understand how air-conditioning affects power systems and how the impact can be most efficiently managed.

- Demand management programs to reduce the peak demand are in place and will be further encouraged with the introduction of the new electricity market. This will help to offset some of the rising peak demand resulting from growth in air-conditioner use, but is only a part of the total solution.

- People are not expected to give up their air-conditioners - they have become an important contributor to our lifestyle - but we need to find how we can best accommodate increasing air-conditioning loads while minimising costs and effects on the environment.

How Rapid Growth in Residential Air-conditioning is Affecting Our Electricity System

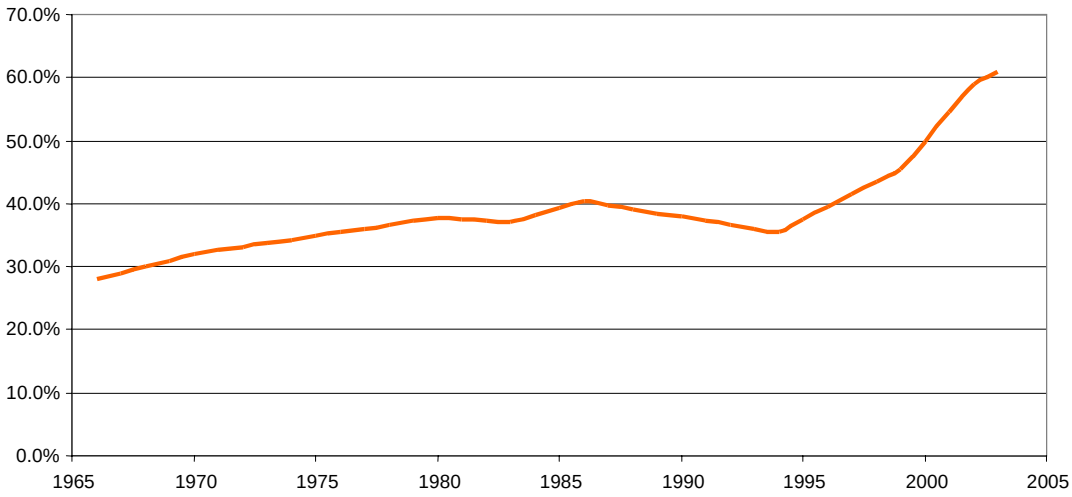
The Growth of Residential Air-conditioning

In our hot summer weather, air-conditioning has become part of our way of life. However, in Western Australia, as in other states, the rapid increase in the use of summer air-conditioning is significantly affecting the cost of maintaining a reliable electricity supply.

Residential air-conditioners are becoming particularly important, because their increased affordability over recent years has meant they are becoming more and more common in our homes. In 1980, about 37% of Western Australian homes had air-conditioners, mostly relatively energy efficient evaporative types. By 2000, this had risen to 45% of homes. Currently, around 60% of Western Australian homes have at least one air-conditioner and most are the more energy hungry refrigerative type. It is expected that this number will continue to rise rapidly for many years to come.

Figure 1 shows the increase in air-conditioner ownership in terms of the percentage of households with one or more air-conditioning appliances.

Figure 1
Percentage of WA Households With One Or More Air-conditioning Appliances

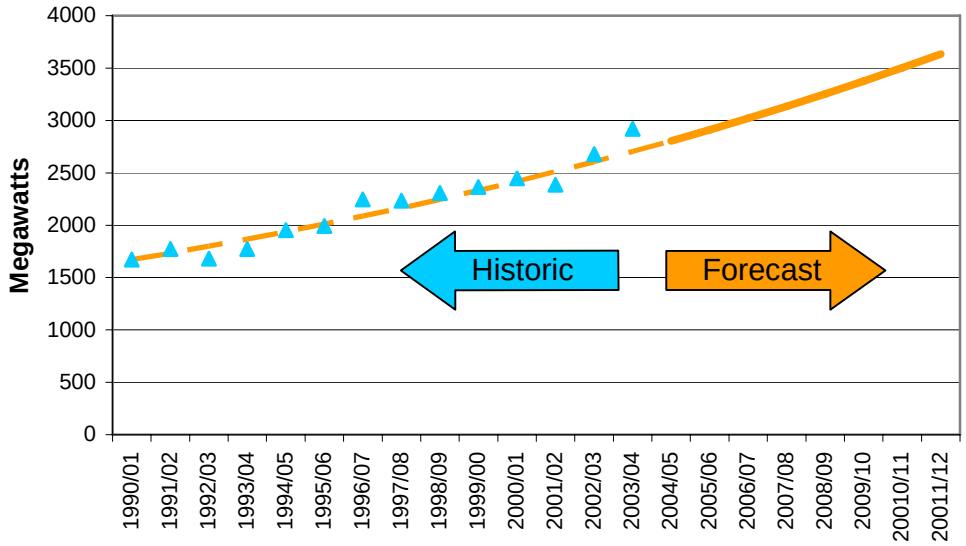


Source EEE estimates based on ABS 4602.0-2002 and EES1990

Air-conditioning and Peak Demand

Western Australia's peak electricity demand occurs in summer and while there are variations from year to year depending on the severity of summer conditions, peak demand is growing steadily along with our economy. Figure 2 shows historic and forecast peak demand for the South West Interconnected System.

Figure 2 - Peak Demand on the South West Interconnected System

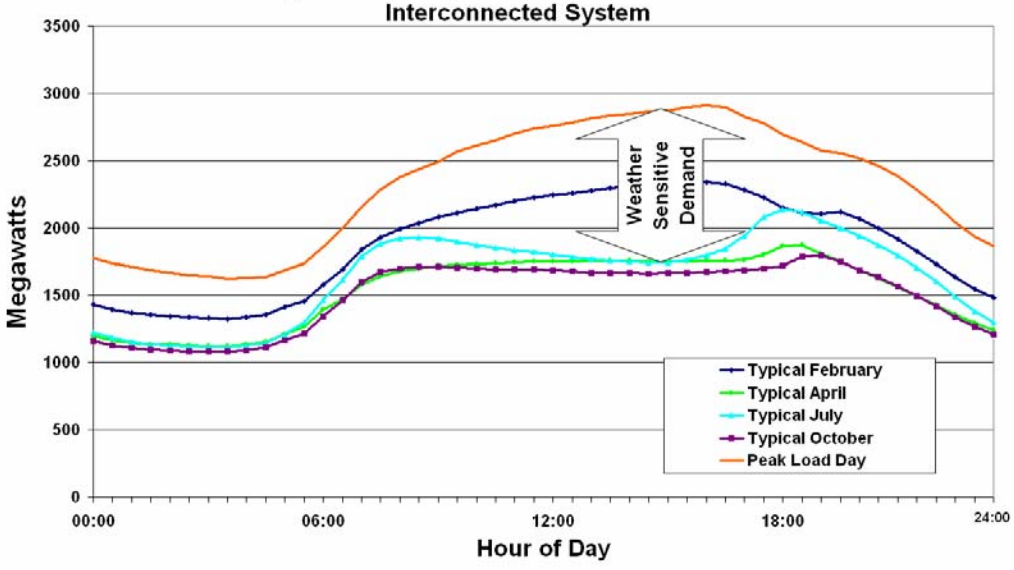


Over the last five years peak demand has grown at an average rate of 5% per year, significantly faster than overall electricity usage which has grown at only 3.5% per year.

Our electricity demand is characterised by an underlying base load overlaid with daily and seasonal variations. Weather is a major contributor to load variations and our peak electricity demand occurs on hot summer days.

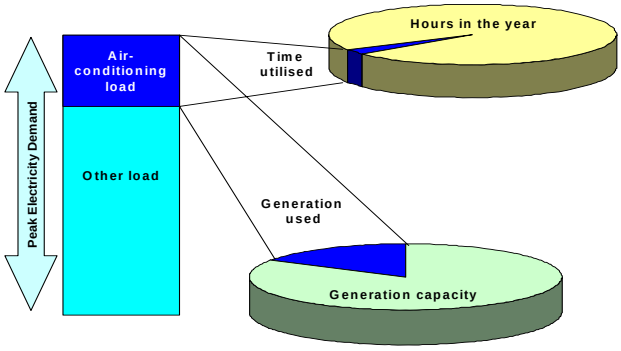
Figure 3 shows average weekday electricity load profiles for each of the four seasons together with a typical annual peak demand day. It can be seen that load on a summer's day is very much higher than in the other seasons. This increase in load is principally a result of hot weather conditions and is often termed "weather sensitive load". Load on days of annual peak demand is typically around 25% higher than the average load expected in February.

Figure 3
Peak and Typical Weekday Demand Profiles for the South West Interconnected System



A significant proportion of our total generation capacity lies idle for most of the year, just so it can be available for those hottest few days of the year when it is needed. For instance the top 20% of demand (600MW) occurs for only 135 hours every year and the top 260MW for only 24 hours. The generating plant that meets demand at these times is unused for the remainder of the year and the network capacity to supply this electricity is only fully utilised for these short periods. 600MW of generation and network capacity represents around $2 billion of infrastructure.

Air-conditioning usage is a major contributor to weather sensitive demand, representing more than 25% of extreme peak demand. Residential air-conditioning is a significant part of this air-conditioning load.



Infrastructure Cost to Meet Air-conditioner Demand

As load grows, additional generation and network infrastructure is needed to keep our electricity supply reliable.

The cost of electricity infrastructure to supply new air-conditioner loads is large compared with the cost of the air-conditioners themselves. The Office of Energy has estimated that an air-conditioner costing around $1000 (around 2 kW input power) could require around $6000 of expenditure on new generation and network infrastructure to enable it to be used whenever required, however rarely that may be.

Tariffs Don't Recover the System Cost of Air-conditioners

All new loads that add to peak demand will contribute to the need for additional infrastructure, but air-conditioning loads have a special significance. Unlike other types of load that remain throughout the year, residential air-conditioners are mostly used for only a small part of the year.

This is important because residential tariffs recover the cost of electricity infrastructure evenly through electricity sales across the year. As a consequence, electricity prices are higher on average because of the high cost of meeting peak demands. This can lead to inequities in that those whose demand contributes little to peak costs, for instance those not operating refrigerative air-conditioners, are effectively supporting large consumers of electricity during the peak.

Responding to the Challenge

People should not be expected to give up their air-conditioners – they have become an important contributor to our lifestyle. However, it is important that we move to minimise the adverse impact of the rapid growth of air-conditioning demand.

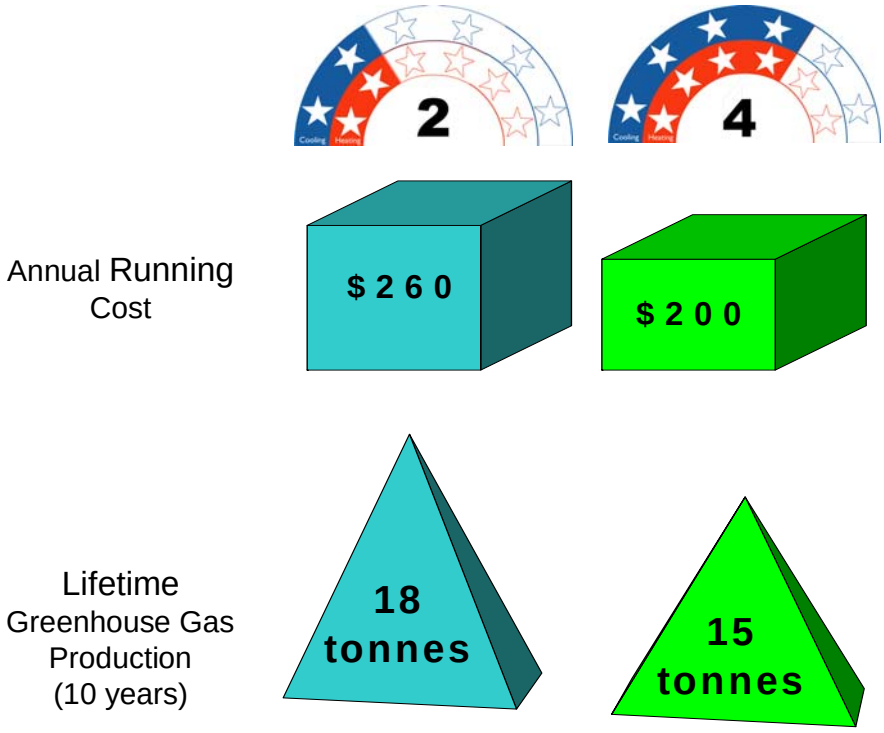
Air-conditioner Efficiency

A key strategy in response to this issue is to ensure that air-conditioners are efficient in their use of electricity. The efficiency of air-conditioners varies greatly and is affected both by their design and by the way they are used.

Less efficient models may be a little cheaper, but they are likely to cost the user more in electricity charges and disproportionately increase the need for extra network and generation capacity. Ultimately this will result in increased costs for all electricity users.

Minimum performance standards for new domestic air-conditioners were introduced in October 2004 as part of the national Minimum Energy Performance Standards. These new requirements are in addition to those already in place for large air-conditioning units. The standards will be further strengthened in April 2006. 75% of the air-conditioners currently on the market will not meet the energy efficiency standards to apply from April 2006 and will no longer be able to be imported or locally manufactured when the standards come into force.

Appliance star ratings provide a guide to consumers in selection of the most efficient air-conditioners and minimising their running costs. It also helps keep the cost of electricity down by minimising their peak demand needs.



Typical Benefits of High Star Ratings (single phase air-conditioner)

Air-conditioner owners can also reduce the power demand of their equipment without reducing the benefits by using them more efficiently. Both the Sustainable Energy Development Office and Western Power provide guidance to consumers on how to

achieve the best cooling effect with minimum energy usage. (See contact information at the end of this paper).

Put simply, keeping the sun out and letting the cool breeze in will mean you won't have to use your air-conditioner as often. When you do turn on your air-conditioner, set the thermostat as high as you feel comfortable. Each 1°C lower on the thermostat can add as much as 10% to your cooling costs. Closing off unoccupied areas also saves power and money.

Energy Efficient House Design

The thermal efficiency of a house is an important factor in overall household energy consumption. In particular, a well-designed house, incorporating passive solar features will help reduce air-conditioner load.

In July 2003, Western Australia adopted new energy efficiency performance standards in the Building Code of Australia. These standards apply to most new housing and include requirements for insulation, glazing and ventilation. It is planned that the standards will increase over time and will be expanded to cover almost all types of buildings**.**

Greenhouse Benefits

Not only will improved air-conditioning efficiency reduce peak demand and electricity bills, but it also has clear energy conservation and environmental benefits. Peak demands are typically met by less efficient generating plant and for extreme peaks, oil rather than gas is used to fuel generation. Improved air-conditioner efficiency, and more efficient use of air conditioners, will mean lower greenhouse gas emissions.

Demand Management

Because the demand caused by residential air-conditioners occurs for only short periods of time there are opportunities to reduce the cost of meeting this peak demand by shifting other electricity loads. Demand management can be cheaper than building new generators and network capacity and can also have significant environmental advantages.

Under demand management schemes, large customers who can rearrange the timing of their electricity needs away from peak periods, or who are prepared to operate standby generators for short periods of time, are contracted to do this for a fee. An example of a new initiative of this type is the Western Power Peak Demand Saver Scheme targeted at medium to large consumers.

Demand freed up in this way can offset to some extent the demand for air-conditioning during these peak periods, which are hot weekday afternoons.

The new electricity market, which will start in 2006, will encourage the expansion of demand management to ensure that maximum use of this valuable flexibility can be achieved.

Domestic customers can also assist in shifting non-temperature-sensitive demand away from the peak periods of summer weekday afternoons. Operating washing machines, dishwashers, driers and pool pumps in the morning rather than afternoon can offset some of the air-conditioning load. However, pool pumps should always be operated when swimmers are using the pool – set the automatic timer to operate the pump early in the morning and turn it on manually if swimming in the afternoon.

Further Studies

Around Australia the growth of air-conditioning load has been much faster than anticipated and its impact on power systems is complex. This is a very new field and studies are being done around the country to gain a better understanding of how air-conditioning affects power systems and how the impact can be most efficiently managed.

Western Power is also investigating the extent and distribution of domestic air-conditioners and their effect on the Western Australian power system. These studies will help point the way on how we can best accommodate increasing air-conditioning loads while minimising costs and effects on the environment into the future.

More Information

Information on demand management is available from the Office of Energy by contacting:

Nathan Johnston, Senior Analyst
Phone: 9420 5637
Email: Demand.Management@energy.wa.gov.au

Information on efficient energy usage in the home and energy efficient house design is available from the Sustainable Energy Development Office:
Website www.sedo.energy.wa.gov.au
Phone: Energy Smart Line 1300 658 158
Email: energysmartline@energy.wa.gov.au

Western Power also provides information on saving energy in the home:
Website: http://www.westernpower.com.au
Phone 131353

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13 December 2004

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