Australian Government

Department of the Environment and Heritage
Australian Greenhouse Office

Dear Stakeholder

PROPOSED MINIMUM ENERGY PERFORMANCE STANDARDS REGULATIONS FOR SINGLE PHASE AIRCONDITIONERS

Australian government agencies responsible for product energy efficiency are currently investigating whether to introduce mandatory minimum energy performance standards (MEPS) for single phase airconditioners.

Your organisation may be interested in commenting upon the proposal to regulate MEPS for single phase airconditioners which is explained in the attached documentation.

The Australian Greenhouse Office (AGO) of the Department of the Environment and Heritage, will be sending this proposal to over 500 stakeholders and will advertise in national newspapers seeking comments from interested persons. It will produce a report on stakeholder views for the Ministerial Council on Energy (MCE), prior to that ministerial body making its decision on the regulatory proposal.

All government agencies responsible for product energy efficiency have had a mandate to explore whether MEPS for any product are in the Australian community's best interest. The AGO is assisting those state and territory agencies that legislate in this field to comply with the process of national rule making. The draft Regulatory Impact Statement (RIS), which includes a cost benefit analysis of a variety of options, and demonstrating their impact on all stakeholders, is attached.

The AGO is managing the process of obtaining stakeholder views on the regulatory proposal, which if endorsed by the MCE, will result in an amendment to state and territory legislation removing from sale products that do not meet these standards. If stakeholders are interested, AGO staff and consultants involved in preparing the RIS will provide a briefing at the following venue:

Date	Time	Location
10 March 2005	9.30am – 12.30pm	Level 17, 227 Elizabeth Street, Sydney

To attend this briefing please contact the project officer listed below.

The AGO will accept written submissions from stakeholders until close of business Thursday, 24 March 2005 on any of the issues raised in the document. The AGO proposes to provide the MCE with a report summarising submissions together with a revision of these documents in late April 2005.

Please address your written submissions to:

Miss Janine Corcoran
Equipment & Appliances Team
Australian Greenhouse Office
Department of the Environment & Heritage
GPO Box 787
CANBERRA ACT 2601

Fax: (02) 6274 1814

Email: Janine.Corcoran@deh.gov.au

Please use this opportunity to comment on the regulatory proposal.

Yours faithfully

Mr Shane Holt
Chair
National Appliance and Equipment
Energy Efficiency Committee
14 February 2005

REPORT NO 2005/04

Proposal to Increase MEPS for Room Air Conditioners

Regulatory Impact Statement

Consultation draft – 10 February 2005

Prepared for

Australian Greenhouse Office

Prepared by

Syneca Consulting

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Abbreviations

AGO	Australian Greenhouse Office
AREMA	Australian Refrigeration Equipment Manufacturers Association
AS/NZS	Australian Standard/New Zealand Standard
BAU	business as usual
COAG	Council of Australian Governments
COP	coefficient of performance
DoE	(US) Department of Energy
DPIE	Department of Primary Industries and Energy
E2G2	Working Group for Energy Efficiency and Greenhouse Gas
EER	energy efficiency ratio
EES	Energy Efficient Strategies Pty Ltd
ESSA	Energy Supply Association of Australia
GWA	George Wilkenfield and Associates
GWh	10^6 kWh
HVAC	heating, ventilation and air conditioning
kW	kilowatts
kWh	kilowatt/hours
LBNL	Lawrence Berkeley National Laboratories
LCC	life cycle cost
MCE	Ministerial Council on Energy
MEPS	minimum energy performance standards
Mt CO_2e	Mega tonnes of greenhouse emissions, measured as equivalent units of carbon dioxide
NAEEEC	National Appliance and Equipment Energy Efficiency Committee
NAEEEP	National Appliance and Equipment Energy Efficiency Program
NATA	National Association of Testing Authorities
NGS	National Greenhouse Strategy
PJ	petajoules
RIS	Regulatory Impact Statement
UNSW	University of New South Wales

Executive summary

This is a regulatory impact statement addressing a two-part proposal to increase the minimum energy performance standards (MEPS) for single-phase non-ducted air conditioners, hereafter referred to as room air conditioners. The proposal relates to refrigerative air conditioners including those that can be configured for reverse cycle operation. A revised Standard, incorporating the proposed changes, would be given legal effect under State and Territory legislation.

The first part of the proposal relates to room air conditioners of less than 10 kW cooling capacity and will increase the MEPS that are currently scheduled for October 2007. The proposal follows a lead set by Korea. New Korean MEPS were implemented in October 2004 and it is proposed that Australia follow Korea with a lag of 3 years.

The second part of the proposal relates to room air conditioners of less than 7.5 kW cooling capacity and will bring forward the existing 2007 MEPS by 18 months – from October 2007 to April 2006. The MEPS for these air conditioners would therefore rise in two steps, first in April 2006 and then in October 2007.

The problem addressed by the regulation

The proposal is an element of the National Appliance and Equipment Energy Efficiency Program (NAEEEP), which is jointly managed and funded by the Commonwealth, State and Territory governments. NAEEEP is part of the National Greenhouse Strategy and targets the energy efficiency of consumer appliances, industrial and commercial equipment.

Electrical cooling and heating equipment contribute significantly to greenhouse gas emissions, accounting for an estimated 4.4% of total emissions in 2000. Earlier projections, which had the emissions share growing 5.6% in 2010, turned out to be conservative. There has been such strong growth in the stock of air conditioners, with household ownership at least doubling over the last 10 years, that the more immediate concern is to accommodate the increased demand for electricity generation and network capacity.

The objective

The objective of the proposed regulation is to further reduce Australia’s greenhouse gas emissions from the use of air conditioners, subject to the following constraints:

- The measures need to be cost-effective for the broad community of users of air conditioners.
- The measures need to be efficiently designed, minimising adverse impacts on manufacturers and suppliers, and minimising adverse impacts on product quality and function.
- The measures need to be clear and comprehensive, minimising potential for confusion or ambiguity for users and suppliers.

Cost-effectiveness is interpreted in terms of the interests of the broad community of users.

In pursuing this objective NAEEEP has followed a policy of adopting ‘world’s best regulatory practice’. This involves setting MEPS at levels broadly comparable with the most demanding MEPS adopted by Australia’s trading partners, but following that lead with a lag of several years. Given Australia’s status as a large net importer of electrical appliances and equipment, it is considered inappropriate to take the lead or to otherwise adopt standards that put Australia significantly at odds with its trading partners. Existing arrangements follow the lead provided by Taiwan and the US for single-phase and three-phase units respectively. The first part of the proposal is to substitute Korea for Taiwan in providing a lead for room air conditioners from October 2007.

The second part of NAEEEC's proposal, bringing certain 2007 MEPS forward, is a response to new evidence that more efficient air conditioners are already available in a number of supplier countries, indicating that there is little impediment to earlier implementation of the existing 2007 MEPS. Specifically, catalogue data from three countries – Malaysia, Thailand and Korea – indicate the product supplied to their domestic markets is significantly more efficient than the product supplied to the Australian market. These three countries collectively supply about 50% of the single-phase models sold in Australia.

Impact of the changes proposed for October 2007

Feasibility of the 2007 proposal

All room air conditioners falling within scope of the regulation are imported and the regulatory obligations fall solely on the importer/wholesalers. Some of these suppliers have questioned the feasibility of the new 2007 proposals, citing differences between the Korean and Australian markets. For example, the Korean market is mainly for cooling only units that also dehumidify the conditioned air, whereas the Australian market is now mainly for reverse cycle units. Where heating is not required, the refrigeration circuit can be optimised for higher 'cooling only' performance.

This and similar issues will be tested with suppliers in consultations about this document. With that in mind, the RIS provides a range of evidence arguing the case for feasibility. Important considerations are that:

- There is a broad-based world-wide effort to increase efficiency, providing good coverage of all market segments. While the Australian proposal mimics the 2004 Korean MEPS, it does not follow that Korea will be the sole source of high efficiency products.
- There is a three year lag between the Korean MEPS and their implementation in Australia, with the further likelihood that suppliers will be able to stock-up with enough non-complying product to substantially carry them through the peak summer sales season of 2007/08. The regulation would not take full effect till 2009.
- Australia's supply structure is not unusual. It is dominated by the supplier brands and manufacturing countries that provide high efficiency products to markets throughout the world.

Impact on energy efficiency and greenhouse emissions

About 96% of the room air conditioners that are currently registered do not comply with the new proposal and would need to be replaced. However most would also need to be replaced to meet the existing 2007 MEPS. The additional efficiency increases are in the range 3-9%, with the greatest increase required from split units of less than 4 kW cooling capacity. The minimum EER for these units rises from 3.05 to 3.33 under the new proposal.

The reductions in energy use and greenhouse emissions amount to about 2% of BAU energy use and emissions in 2010, which is the mid-point of the first commitment period under international arrangements to reduce emissions. This builds to 5.9 % in 2016.

Business compliance costs

It is estimated that, from a user perspective, the proposal will raise the cost of air conditioners by $172 million but deliver energy savings worth $333 million. The net benefit is $161 million and the overall benefit/cost ratio is 1.9. Most of these benefits are from split units configured for reverse cycle operation, reflecting their large market share. The cost benefit analysis remains positive under reasonable variations in the underlying assumptions.

Impact on suppliers
Consistent with the assessment that the proposal is quite feasible, the additional adjustment costs that may be borne by suppliers is put at only $3 million. However, previous attempts to engage suppliers in the process of estimating these costs have been almost completely unsuccessful. Further supplier input would be welcome.

Net national benefit
The overall national perspective is not very different from the user perspective. The main reason is that, because a large share of energy savings occur in peak periods, the electricity tariff is a reasonable approximation of the avoidable cost of electricity. Also, the additional adjustment costs incurred by suppliers are small relative to user benefits, and the impact on taxpayers is small enough to be ignored.

The benefits are large compared to previous estimates, reflecting more realistic assumptions for the continued growth of air conditioner ownership and for the associated sales.

Impact analysis of the changes proposed for April 2006

Feasibility of the 2006 proposals
Suppliers are concerned about the 18 month interval between the April 2006 and October 2007 MEPS for the room airconditioners affected by this part of the proposal. The interval may be too short to allow those additional adjustment costs to be recouped. At worst, suppliers may look ahead to the new 2007 proposals and decide to bring those plans forward rather than revise their product range twice in 18 months.

The April 2006 proposal is being put in the expectation that, for the most part, it is not a *de facto* imposition of the October 2007 proposals from April 2006. Given the availability of more efficient product in overseas markets, it is considered feasible to make the complete transition in two steps over the 3 years to October 2007, and that the October 2007 MEPS will be brought forward only where the MEPS difference is minor.

Impact on energy efficiency and greenhouse emissions
Compliance with the existing 2007 MEPS would require significant increases in energy efficiency from about 87% of currently registered models, delivering an average 6.9% reduction in the energy used by non-complying models. On this basis, the proposal would reduce energy savings and emissions by 0.6% in 2006, increasing to 1.3% in 2010.

However there is more than usual uncertainty about this estimate; the regulation has a short life of 18 months and sales could depart significantly from trend over that period.

Impact on users
It is estimated that the proposal will raise the cost of air conditioners by $36 million but deliver energy savings worth $88 million. The net benefit is $52 million and the overall benefit/cost ratio is 2.5. The result is robust under varying assumptions but remains sensitive to cyclical variations in sales over this period.

Business compliance costs
The additional adjustment costs have been put at $9 million for the purposes of this RIS, which is a sizeable figure in comparison to the energy savings and greenhouse emissions that are delivered. In this respect, the second part of the proposal is quite different to the first. One difference is the short life of the regulation, generating relatively few sales and energy savings to put against the adjustment costs. However the more important difference is that, for room air conditioners, the effect is to introduce another full round of adjustments rather than simply bring forward the adjustments that were otherwise scheduled to occur in October 2007.

Further supplier input on this issue is welcome.

Net national benefit – room air conditioners
The net national benefit is put at $43 million, being the user benefits of $52 million minus the adjustment costs of $9 million. This assumes that adjustment costs are fully accepted as 'national' costs. Arguably, a discount should be applied to allow for the large share of these costs borne by foreign companies.

Regardless of that consideration, there are a number of reasons why the estimate is less robust than it might be.

- There is uncertainty about how suppliers will respond to the short life of the April 2006 regulation. They may use all possible means to delay their response to the April 2006 requirements. Or they may bring elements of the 2007 proposals forward.
- There is unavoidable uncertainty about cyclical effects on sales during the short life of the regulation.
- The costs associated with a second full round of product adjustments are uncertain.
- Some suppliers have already started to prepare for April 2006, in which case some of the expected costs are sunk and can be put aside.

Recommendation
Despite the uncertainties, the proposal is consistent with the National Greenhouse Strategy. It meets the requirements of the Prime Minister's statement of November 20, 1997, delivering *. . . realistic, cost-effective reductions in key sectors where emissions are high or growing strongly, while also fairly spreading the burden of action across the economy.* He also stated that the Government is *. . . prepared to ask industry to do more than they would otherwise be prepared to do, that is, go beyond a "no regrets", minimum cost approach where this is sensible in order to achieve effective and meaningful outcomes.*

It is recommended that States and Territories implement the proposed mandatory minimum energy performance standards. This will require States and Territories to amend existing regulations governing appliance energy labelling and MEPS.

1 The context for regulation

This document addresses a two part proposal to increase the minimum energy performance standards (MEPS) applying to non-ducted single-phase air conditioners, hereafter referred to as 'room air conditioners'. These are refrigerative air conditioners configured for either cooling only or reverse cycle[1] operation, and exclude evaporative coolers.

The first part relates to room air conditioners of less than 10 kW cooling capacity and will increase the MEPS that are currently scheduled for October 2007. The existing 2007 MEPS for these units are based on Taiwanese MEPS that have now been bettered by Korean MEPS. The Korean MEPS were implemented in October 2004 and it is proposed that Australia follow the Korean lead from October 2007.

The second part relates to room air conditioners of less than 7.5 kW cooling capacity and will bring forward the existing 2007 MEPS by 18 months – from October 2007 to April 2006. The MEPS for these air conditioners would therefore rise in two stages, first in April 2006 and subsequently in October 2007.

The proposals addressed in this document are NAEEEC's response to a number of developments.

- There is new evidence that more efficient air conditioners are already available is a number of supplier countries, indicating that there is little impediment to earlier implementation of the 2007 MEPS.
- The mainstream adoption of air conditioning over recent years, particularly in new houses, has created a sense of urgency that any opportunity to increase the penetration of more efficient air conditioners should not be missed. A related concern is the growth in peak loads that air conditioners are putting on electricity networks.
- Korea's recent adoption of more stringent MEPS for room air conditioners provides an opportunity to replace Australia's existing 2007 MEPS while still providing industry with reasonable lead time.

More generally, the proposal is part of the National Appliance and Equipment Energy Efficiency Program (NAEEEP), which is an element of the National Greenhouse Strategy (NGS). The remainder of this section explains the broader policy context.

1.1 National Greenhouse Strategy

The Australian Government's response to concerns about the environmental, economic and social impacts of global warming was enunciated in the Prime Minister's statement of November 20, 1997, *Safeguarding the Future: Australia's Response to Climate Change*. The Prime Minister noted that the Government was seeking . . . *realistic, cost-effective reductions in key sectors where emissions are high or growing strongly, while also fairly spreading the burden of action across the economy.* He also stated that the Government is . . . *prepared to ask industry to do more than they would otherwise be prepared to do, that is, go beyond a "no*

[1] The air conditioners that will be subject to the proposed MEPS are of the vapour compression or refrigerative type. They can be designed as 'cooling only' devices that pump heat out of a building, or they can be configured for a 'reverse cycle' that allows the equipment to be used for either cooling or heating. The latter are often referred to as 'heat pumps', distinguishing the reverse cycle equipment from the cooling-only air conditioners. We refer to both as air conditioners.

regrets"[2], minimum cost approach where this is sensible in order to achieve effective and meaningful outcomes.

The NGS was subsequently endorsed by the Commonwealth, States and Territories as a commitment by governments to an effective national greenhouse response.

> *The Strategy maintains a comprehensive approach to tackling greenhouse issues. The range of actions it encompasses reflects the wide-ranging causes of the enhanced greenhouse effect and the pervasive nature of its potential impacts on all aspects of Australian life and the economy. (NGS 1998)*

The NGS is also the mechanism through which Australia will meet its international commitments as a party to the *United Nations Framework Convention on Climate Change*. The Australian government has announced its intention to meet an overall target by 2008-2012 of 108% of its 1990 emissions which is, in effect, a 30% reduction on the projected "business as usual" (BAU) outcomes in the absence of interventions.

1.2 Nationally consistent energy efficiency program

The proposed regulation is an element of the National Appliance and Equipment Energy Efficiency Program (NAEEEP). NAEEEP is part of the National Greenhouse Strategy and targets the energy efficiency of consumer appliances, industrial and commercial equipment. The main tools of the Program are mandatory energy efficiency labelling and minimum energy performance standards, and voluntary measures including endorsement labelling, training and support to promote the best available products.

NAEEEP's governance structure is as follows:

- The Program is the direct responsibility of the National Appliance and Equipment Energy Efficiency Committee (NAEEEC). It is comprised of officials from the Commonwealth, State and Territory government agencies, plus representatives from New Zealand, responsible for implementing product energy efficiency initiatives in those jurisdictions.
- NAEEEC reports through the Working Group for Energy Efficiency and Greenhouse Gas (E2G2) to the Ministerial Council on Energy (MCE), which is made up of the Ministers with portfolio responsibility for implementation of the National Greenhouse Strategy in this field.
- MCE has charged E2G2 to manage the overall policy and budget of the national program.

NAEEEP relies on State and Territory legislation for legal effect. This involves the use of state and territory legislation to enforce relevant Australian Standards for the specific product type.

1.3 NAEEEP's policy framework

The broad policy directions of NAEEEP were reviewed in 1998-99 and again in 2000-01, with recommendations brought together in two 'Future Directions' documents (NAEEEC 1999 and NAEEEC 2001). The MCE subsequently endorsed certain changes, with the result that NAEEEP operates with the authority of the MCE with respect to broad policy objectives.

[2] The Productivity Commission has defined 'No regrets' policy options as measures that … *have net benefits (or at least no net cost) in addition to addressing the enhanced greenhouse effect. A more intuitive interpretation of 'no regrets' measures could be that they are actions which would still be considered worthwhile even in the absence of concerns about the potential adverse impact of global warming.* (PC 1997: page vii). This may involve imposing additional business costs on suppliers if the resulting more efficient products deliver a net benefit to the wider community.

These relate to product coverage, communication, and procedures and timetable for products proposed for regulation.

Product coverage
Any type of consumer appliance, industrial or commercial equipment is eligible for inclusion in NAEEEP, provided it is identified as a likely contributor to growth in energy demand or greenhouse gas emissions. The selection criteria include potential for greenhouse or energy savings, environmental impact of the fuel type, opportunity to influence purchase, market barriers, access to testing facilities, and administrative complexity. The measures adopted by NAEEEP are subject to a community cost benefit analysis and consideration of whether the measures are generally acceptable to the community.

Communication
NAEEEC develops its product strategies through a transparent planning process, including by providing stakeholders with formal opportunities for providing comment and feedback.

Procedures and timetable
In respect of any proposal to implement MEPS, a significant initiative in recent years has been the decision by MCE to match the best MEPS level of Australia's trading partners, after taking account of differences in test methods and other relevant differences such as climate or consumer preferences. The explicit adoption of 'world's best regulatory practice' focuses attention on specific options, provides stakeholders with confidence that proposed MEPS are technically feasible, and thereby avoids the long and many-sided debates about technical options that have characterised the development process in the past.

Related to that, NAEEEP uses the standards machinery that is familiar to industry. Labelling and MEPS requirements are set out in Australian and New Zealand Standards and developed within the consultative machinery of Standards Australia. On occasion, this has required the development of a new standard, for example, to harmonise Australian testing standards with testing procedures commonly used by trading partners. In the present case, the new MEPS would be set out in a revision of Australian and New Zealand Standard AS/NZS 3823.2, *Performance of household electrical appliances – air conditioners and heat pumps*. These arrangements are explained in chapter 8, dealing with implementation of the proposals.

NAEEEP has adopted a standard legislative timetable, designed to implement any proposed MEPS within 3 to 5 years, giving industry some certainty about the process while also providing industry with adequate notice of new MEPS.

1.4 Industry and trade structure, including the Trans Tasman Mutual Recognition Agreement

All room air conditioners falling within scope of the proposals are imported to Australia. The supplier structure in Australia has two main levels. Several thousand businesses are engaged in the retailing, installation and maintenance of air conditions. (A search of the yellow pages produces a list of 5,000 businesses but there is a certain amount of duplication in business names.) These range in size from national discount stores to small and medium-sized businesses operating locally. The wholesale/importer level is more concentrated. BIS Shrapnel (2002) report that 8 major brands account for about 75% of total sales. Another 120 brands are registered with the AGO, indicating that the market also accommodates a significant number of other importers and wholesalers. Allowing for the fact that some businesses have multiple brands, it seems that the about 100 separate business entities are engaged in importing. A proportion of these would be on a very small scale. Anecdotally, the industry is aware that some small suppliers would take one container load from time to time as a suitable distribution opportunity arises. 60 of the registered brands have 5 or fewer models against their name.

The formal requirements of the MEPS fall on importers. For the purposes of the regulation they are regarded as the suppliers of air conditioners to the Australian market.

Air conditioners are subject to the provisions of the Trans Tasman Mutual Recognition Agreement, which provides that a good that is legally sold in New Zealand can also be legally sold in Australia. Accordingly, Australia and New Zealand[3] work together to try to keep MEPS levels the same, using joint standards and processes to develop and implement proposals. At worst, there has been some variation in the regulatory dates, with actual dates announced by gazette notice. All air conditioning standards are joint standards with New Zealand.

The regulatory authorities in both countries are concerned with broadly the same issues, although with somewhat different emphasis. In particular, New Zealand is more concerned about the heating performance of reverse cycle air conditioners at the lower temperatures experienced in New Zealand. Certain labelling changes are now proposed to ensure that New Zealand consumers are adequately informed about heating performance. These will benefit Australian consumers who experience similar conditions.

However the consultative processes proceed independently in Australia and New Zealand, and are based on separate consultative documents. In New Zealand the consultative document does not have the formal status of a draft RIS. Consultation is currently being undertaken through a study to analyse the potential New Zealand impacts of the 2006 and 2007 MEPS proposals for air conditioners. Each country may be regarded as addressing the issues from its own national perspective at this stage. Any differences are subsequently addressed by negotiation and agreement between governments in accordance with the TTMRA strategic objectives and principles.

1.5 Contribution of air conditioners to greenhouse emissions

Estimates of the greenhouse contribution of electrical heating, ventilation and airconditioning (HVAC) equipment can be obtained from two studies commissioned by the Australian Greenhouse Office (AGO), *Australian Residential Building Sector Greenhouse Gas Emissions 1990 – 2010* (EES 1999) and *Baseline Study of Greenhouse Gas Emissions from the Commercial Buildings Sector with Projections to Year 2010* (EMET & Solarch, 1999). The estimates include the effects of energy efficiency programs in place by 1999.

GWA (2000) summarised the key findings of the two studies – see table 1.1.

- Electrical HVAC equipment accounted for 4.5% of total emissions in 2000, increasing from 3.7% in 1990 and projected to increase to 5.4% in 2010.
- Residential sector emissions are small relative to the commercial sector; the split is roughly 10% residential and 90% commercial.
- The residential contribution was expected to increase by 14% in the 20 years to 2010, whereas the commercial contribution is projected to increase by 66% over the same period. This reflects projected strong growth of the services sector of the economy and has been addressed by associated measures that first increased MEPS for commercial-sized units in October 2001, with a further increase scheduled for October 2007.
- There are significant omissions from the electrical HVAC estimates provided in table 1.1. Specifically, the commercial building sector has been defined to exclude airconditioned space in non-service sectors – that is, excluding agriculture, mining, manufacturing, electricity generation, transport and construction.

Room air conditioners of less than 10 kW probably accounted for about 15% of the 2000 energy use and emissions reported in table 1.1. Important considerations are that, firstly, room air conditioners are a subset of all air conditioners and, secondly, other types of conditioning equipment are also included in the broad definition of ‘electrical HVAC’ equipment. In the

[3] The coordinating agencies are the Australian Greenhouse Office and New Zealand’s Energy Efficiency and Conservation Authority.

residential sector, for example, table 1.1 includes contributions from electric resistance heaters and evaporative coolers. In the commercial sector, table 1.1 includes contributions from the purpose built installations that serve larger buildings, generally incorporating central cooling towers.

That said, the original AGO studies did not anticipate the dramatic growth of air conditioner use that has occurred in recent years. Revised emissions projections for electrical HVAC equipment would show that more widespread and intensive use of room air conditioners has been an important driver of emissions growth.

TABLE 1.1: PROJECTED ENERGY USE AND GREENHOUSE EMISSIONS DUE TO ELECTRICAL HVAC EQUIPMENT: 1990, 2000 AND 2008-2012

	Residential	*Commercial*	*Total*
Energy use (PJ)			
1990	7.1	59.4	66.5
2000	8.4	83.3	91.7
2010	9.1	110.3	119.4
Greenhouse emissions (Mt CO2-e)			
1990	2.1	17.6	19.7
2000	2.3	22.8	25.1
2010	2.4	29.1	31.5
Greenhouse emissions (% of total emissions)			
1990	0.4%	3.3%	3.7%
2000	0.4%	4.1%	4.5%
2010	0.4%	5.0%	5.4%
Greenhouse emissions (% of 1990 level)			
1990	100.0%	100.0%	100.0%
2000	109.5%	129.8%	127.7%
2010	114.3%	165.6%	160.1%

Source: GWA 2000 (drawing on EES 1999 and EMET *et al*, 1999)

1.6 Market failure

There is certainly technical scope to increase the efficiency of air conditioners. Efficiency variations of 20-30% are readily observed in the Australian market, even putting aside the extremes of high and low efficiency. More energy efficient product is available overseas. However it is conceivable that the purchase of less efficient product is rational, for example, where consumers have low energy costs or use the appliance infrequently. Is there any reason to believe that consumers systematically fail to minimise the ‘whole of life’ cost of air conditioners, creating scope for welfare-improving government intervention?

First, consumers may not pay the full cost of energy; they can’t make rational choices if the prices that they pay for goods and services are not cost-reflective. The major failure in the present context is that the adverse environmental impacts of energy consumption, particularly climate change, are not factored into energy charges. Secondary failures arise from the complex nature of electricity production and distribution, with the cost of supply varying significantly from hour to hour and from place to place, and little of that variation reflected in residential electricity charges.

A further difficulty is that, to give an appropriate weight to the price signals that they do receive, consumers need to calculate energy costs over the life of the appliance. This requires a considerable amount of information – about the life of the appliance, how long the consumer will stay in the current residence, future energy charges, usage patterns and the relationship between usage patterns and energy consumption, and how their preferences for air conditioning will be altered by the experience of air conditioning. It would be unreasonable to expect more than a small proportion of users to pursue the issue to this level of detail.

Even long-time users may be quite uncertain about the running cost of air conditioners. Because they are charged only for the total amount of electricity used, with no separate monitoring of individual appliances, they are in a poor position to assess investments in the energy efficiency of any appliance.

Often, the selection of an air conditioner is a relatively minor element of a more complex purchasing decision. For example, the air conditioner may be offered to new home buyers as part of a home and land package, or as part of a rental property offered to tenants. It is understandable that the consumer gives little consideration to the efficiency of the air conditioner in these situations; other long term and costly decisions are being made at the same time. The selection is effectively delegated to the property developer, builder or landlord, who does not pay the energy bills.

Finally, even if full information about life cycle costs were readily available there is room to doubt that the consumer response would always be fully rational. Air conditioners are often purchased during extreme weather, with a pronounced sales peak during summer, suggesting that consumers are focused on an immediate need to relieve discomfort and may not pay much attention to the longer term costs.

Suppliers accept that there is market failure. They say that energy efficiency is not a primary or even a significant consideration in consumer purchases. The apparent lack of concern is at odds with the fact that energy costs contribute significantly to the ‘whole of life’ or ‘lifecycle’ costs of using an appliance. There is expert evidence that the energy efficiency of many air conditioners could be considerably improved at little or no cost to suppliers and hence consumers.

2 The objective

This chapter explains the objectives of the regulation, firstly in terms of completing NAEEEC's strategy for air conditioners (section 2.1), much of which has already been implemented, and secondly, in terms of the formal objectives against which the proposal is assessed in this RIS (section 2.2).

2.1 NAEEEC's air conditioner strategy

Existing measures

The proposed regulations will complete NAEEEP's package of air conditioner measures. The following elements of the strategy have already been implemented through successive amendments to Australian and New Zealand Standard AS/NZS 3823:

- NAEEEC's energy efficiency labelling scheme (the 'Star' scheme) is mandatory for residential air conditioners taking single-phase power. It has been in place nationally for 10 years (in some states for much longer) and remains the cornerstone of the national program.
- Suppliers of three-phase units have had the option of labelling since October 2001. However all of the conditions apply if that option is taken, including the requirement for product testing. Marketing laws cover instances where suppliers inadvertently or intentionally label inaccurately.
- The regulation of performance standards for air conditioners commenced in October 2001 on a national scale, starting with air conditioners taking three-phase power and used primarily in commercial applications. This work was completed under the previous policy regime, that is, prior to the MCE decision to accelerate the development process by focusing on world's best regulatory practice. These air conditioners account for about 75% of the energy consumed by the targeted air conditioners.
- MEPS coverage was extended to single-phase air conditioners in October 2004 These units are used primarily in the residential sector.
- The most recent changes to air conditioner MEPS also increased the stringency for both single-phase and three-phase air conditioners from October 2007, increasing efficiency requirements across both the commercial and residential sectors.
- The registration testing requirements have been reduced, cutting business costs.
- AS/NZS 3823 also requires:
  - all statements about cooling and heating capacity, energy consumption and energy efficiency to be consistent;
  - the values to be determined under the test conditions specified in Part 1;
  - products to meet requirements of the maximum cooling test in Part 1;
  - products to be registered with a State or Territory energy agency;
  - statements about cooling and heating capacity, energy consumption and energy efficiency to be subject to check testing, using the procedure specified in Part 2.
- Australian test standards have been aligned with overseas testing procedures – specifically, ISO5151:1994 and ISO1325.3:1995. This will avoid the costs of duplicate tests, since many supplier countries also have testing requirements as part of their MEPS arrangements.
- The Standard now includes the definition of 'high efficiency' air conditioners.

How the existing 2007 MEPS were developed

In developing the existing 2007 MEPS proposals, NAEEEC followed the MCE policy directive to explore levels that are commensurate with MEPS adopted by Australia's trading partners. Given Australia's status as a large net importer of electrical appliances and equipment, NAEEEC considers that it could be excessively costly to adopt standards that put Australia significantly at odds with major trading partners.

Accordingly, NAEEEC described the development of the existing 2007 MEPS as follows.

> *NAEEEC commissioned consultants to examine international developments. …The results were tested with key representatives from industry and other stakeholder groups and the outcome of this process is reported in this public profile.*
>
> *In general, USA MEPS being implemented in 2003/4 were considered the basis for MEPS proposed for Australia for three-phase air conditioners while the Taiwanese MEPS levels implemented in 2001 were considered the basis for MEPS proposed for Australia for single-phase air conditioners. These were chosen after detailed comparison of testing methods and comparison with Australian products showed they were the most stringent currently or proposed by the major trading partners. Although Japan has proposed more stringent levels for certain sizes of single-phase air conditioners, they are based on a sales weighted average efficiency and not directly translatable to Australian conditions. They do, however, establish that more efficient product will be readily available. (NAEEEC 2002)*

Given an appropriate lead from a trading partner, the strategy has been to match international best practice within a few years of the leading country. Note the meaning of 'best practice' in this context. It is best practice in terms of regulation, eliminating the least efficient models, not best practice in terms of leading the process of technological development.

The selection of a leading country for three-phase air conditioners was straightforward, since the USA is the only one of Australia's major trading partners to adopt MEPS for the larger (commercial) air conditioners. In broad terms, the existing 2007 MEPS are set at levels that applied in the USA from October 2003 for smaller commercial units and from October 2004 for larger commercial units. Consequently about 75% of models on the Australian market in 2004 would not be eligible for registration in 2007.

A number of Australia's trading partners have adopted MEPS or MEPS-like arrangements for single-phase air conditioners. NAEEEC's consultants (EnergyConsult 2002) provided comparisons for existing MEPS in the USA, Chinese Taipei, Japan, Korea and China. The most stringent of these, Chinese Taipei (Taiwan), provided the lead for the existing 2007 MEPS. Consequently, about 90% of models on the market in 2004 would not be eligible for registration in 2007.

A further element of the 2007 MEPS arrangement is to require three-phase appliances designated as *high efficiency* to comply with specific efficiency requirements that are set higher than the mandatory requirements that apply to all appliances. This is a form of energy labelling, designed to ensure that the designation of *high efficiency* retains a well-defined meaning for users and is not diluted to the point where any unit that is marginally better than the MEPS can be marketed as highly efficient.

The high efficiency category also has a role in signalling NAEEEC's intentions beyond 2007, which it does in two ways:

- First, NAEEEC has indicated to industry that, after 2007, there would be no further increases in MEPS until at least 2012, allowing time to recoup costs.
- Second, NAEEEC commits to industry that any future MEPS commencing not earlier than 2012 would not exceed the standard for high efficiency appliances applicable

from 2007. Industry has a clear view of the regulatory timetable for developments well into the next decade.

Harmonisation of Australian and New Zealand MEPS
As noted already, Australia and New Zealand work together to try to keep MEPS levels the same, using joint standards and processes to develop and implement proposals.

Proposal to follow Korean increase in MEPS for room air conditioners
In October 2004 Korea adopted new MEPS for room air conditioners of less than 10 kW cooling capacity. These are shown in the final column of table 2.1. It is now proposed that Australia adopt the 2004 Korean MEPS from October 2007. The existing and newly proposed MEPS for 2007 are also shown in table 2.1.

TABLE 2.1: AUSTRALIAN MEPS AND EQUIVALENT KOREAN MEPS FOR ROOM AIR CONDITIONERS OF LESS THAN 10 KW COOLING CAPAPCITY

Cooling capacity (kW)	*2007 Australian MEPS*		*2004 Korean MEPS, equivalent to the proposed 2007 Australian MEPS*
	Currently scheduled for October 2007	*Now proposed for October 2007*	
Unitary			
All	2.75	2.84	2.88
Split			
0 - 4	3.05	3.33	3.37
4 - 10	2.75	2.93	2.97

There are some differences between the 2004 Korean MEPS and the proposed 2007 Australian MEPS, as follows:

- There is a small difference in the test conditions. The outdoor wet bulb is set at 19oC and 19.5oC for Australian and Korean tests respectively, with the result that the measured EER is slightly lower in Australia. The adjustment reported in table 2.1, which is to reduce MEPS by 0.04, is based on advice from Graham Morrison at the University of NSW.
- The Australian proposal relates solely to single-phase models, whereas Korea does not discriminate between single and three-phase models.
- Whereas the Korean regulation distinguishes between ‘Window types’ and ‘Split types’ of air conditioner, the Australian regulation distinguishes between ‘Unitary’ and ‘Split’ types. However it has been confirmed that the Korean regulation embraces all unitary types of room air conditioners, regardless of how they are mounted.
- The 2004 Korean regulation extends also to units with cooling capacity in the range 10-17.5 kW, for which the minimum EER is 2.76. This is equivalent to an Australian MEPS of 2.72, which is less than the Australian MEPS of 2.75 that will apply to models in this range. The existing Australian arrangements for the larger units will be retained.

This element of the current proposal is consistent with the MCE policy directive to match the best MEPS level of Australia’s trading partners. The timing is a little tight, in that it will leave suppliers with something less than 3 years to make the adjustment. However it avoids the need for a further round of amendments within a year or two.

Proposal to bring the existing October 2007 MEPS forward to April 2006
The second part of the new proposal relates to room air conditioners of less than 7.5 kW and will bring the 2007 MEPS forward by 18 months. This is a response to new evidence that

more efficient air conditioners are already available in a number of supplier countries, indicating that there is little impediment to earlier implementation of the 2007 MEPS.

The investigation was undertaken by consultants to NAEEEC, Danish Energy Management, and included adjustments for differences in testing methods. Catalogue data was examined for 5 APEC countries – Australia, China, Malaysia, Thailand and Korea – encompassing both split and window/wall units up to 16 kW of cooling capacity. Three groups of countries were identified:

- *Thailand* and *Korea* returned average energy efficiency ratios (EERs) of 3.16 and 3.22 respectively. Such product would easily comply with the 2007 MEPS.
- *Malaysia's* average EER was somewhat lower at 2.93.
- *Australia* and *China* returned average EERs of 2.68 and 2.66 respectively, approximately 15% lower than for Thailand and Korea.

This review of market trends in supplier countries was prompted by concerns about the impact of air conditioners on electricity networks and generating capacity in Australia. The results of the study were presented to Australian industry representatives and other stakeholders in April 2004.

2.2 Objectives against which the new proposals are to be assessed

The objective of the proposed regulation is to further reduce Australia's greenhouse gas emissions from the use of air conditioners, subject to the following constraints:

- The measures need to be cost-effective for the broad community of users of air conditioners.
- The measures need to be efficiently designed, minimising adverse impacts on manufacturers and suppliers, and minimising adverse impacts on product quality and function.
- The measures need to be clear and comprehensive, minimising potential for confusion or ambiguity for users and suppliers.

Cost-effectiveness is interpreted in terms of the interests of the broad community of users.

3 Options

The purpose of this chapter is to identify feasible options for detailed consideration. There is also a brief explanation why other possible options have been put aside without further detailed consideration. The material is organised under the following headings.

- The BAU option
- Stringency options
- Timing options
- Alternative policy approaches

Stringency is taken to be the primary issue. Appropriate timing is then determined in the light of that decision.

3.1 The BAU option

NAEEEC has the option of preserving the existing regulatory arrangements, which provide for increased MEPS from October 2007. This is called the BAU option. A RIS for the existing regulation was completed in December 2003 (Syneca 2003). Appendix 1 provides a summary of the MEPS imposed by this regulation.

The existing regulation is expected to have a significant impact on the market. About 89% of the currently registered single-phase models would not comply with the 2007 MEPS. In general, the smaller units (<4kW) return higher rates of non-compliance.

The BAU option is necessarily included in the detailed impact analysis; it is the base case against which other options are compared.

3.2 Stringency options

The existing regulation implements the best regulatory practice that was identified at the time. Korea has since introduced more stringent MEPS for room air conditioners, applying from October 2004. The proposal is an obvious alternative to the BAU option, implementing the MCE's policy directive to follow world's best regulatory practice.

Feasibility of following the Korean lead
Some suppliers have questioned the feasibility of following the Korean lead. They say that, due to certain differences between the Australian and Korean markets, high efficiency products may not be available for the Australian market.

- First, the domestic Korean market is mainly for cooling only units that also dehumidify the conditioned air, whereas there has been strong trend in Australia to reverse cycle air conditioners. Where heating is not required, the refrigeration circuit can be optimised for higher cooling only performance. In particular the heat exchanger in the outdoor unit does not need to be optimised to limit the build up of frost that occurs in reverse cycle models.
- A second impediment to product availability is that Korea's electricity supply has a frequency of 60 Hz, whereas Australia is on 50 Hz. Modifications would be required to supply the Australian market.
- Third, these differences are exacerbated by the relatively small size of the Australian market, limiting the ability of manufacturers to cost-effectively modify products that will be sold only in Australia.

These issues will be further tested in consulting with suppliers about this document. With that in mind, the feasibility of the new proposal is argued on the grounds set out below.

Technological issues
There is no secret about how to increase the efficiency of air conditioners to the required levels. It is largely a matter of increasing the size of the heat exchangers, installing more efficient fans and compressors, and taking advantage of inverter technology. The more efficient units are somewhat bigger than otherwise but very much the close relatives of models already sold in Australia. Moreover, while the most advanced models are developed in Japan, Korea and Europe, the new designs are usually manufactured in the lower-wage countries (Thailand, China and Malaysia) within a year or two.

Regarding differences in the frequency of the mains power supplies, it is necessary to distinguish between inverter and non-inverter products. The frequency difference is irrelevant for inverter product, because inverters convert the power supply to the required frequency in any case. For non-inverter product the effect of replacing the 60 Hz motor with a 50 Hz motor, and making no other changes to an otherwise 60 Hz product, would be to reduce cooling and heating capacity with little adverse impact on energy efficiency[4].

It is standard practice for 60 Hz manufacturers, like the Koreans, to modify components and designs to satisfy the MEPS requirements of their 50 Hz customers. However it is recognised that implementation of even minor design changes can be costly and time-consuming. Manufacturers subject all changes to rigorous and multi-staged review before committing to large scale production. This suggests that there is a minimum fixed cost to making modifications, regardless of how minor that modification might appear to be.

Availability of high efficiency products in other countries
Appendix 2 provides a review of product availability in Europe, Asia and the US, including compliance with the proposed Australian MEPS. These data provide support for the following propositions regarding *unitary air conditioners*:

- With the exception of the US and possibly India, unitary models have a small share of the market for room air conditioners. The same is true of Australia, and industry sources say that they expect further significant declines.
- The compliance rate is high in the US – 98% for 0-4 kW models and 61% for 4-10 kW models. The US is on 60 Hz.
- 33% of the European models comply, but with marked differences between market segments. None of the 0-4 kW cooling units comply; all of the complying units are either reverse cycle or greater than 4 kW. Two manufacturers – Airwell and LG – account for 16 of the 19 complying models. Europe is on 50 Hz.
- The compliance rates for Indian and Thai models are 50% and 56% respectively. 80-90% of the models are within 10% of the 2004 Korean MEPS. Both countries are on 50 Hz.
- It is not possible to make direct assessments of the Japanese situation because Japanese targets are set in terms of sales-weighted average efficiencies, not minimum efficiencies. However these targets are such that only a minority of Japanese models would need to comply with the Korean MEPS. Japan has a mixed power supply, with eastern and western Japan on 50 Hz and 60 Hz respectively.
- None of the Chinese (50 Hz) and Taiwanese (60 Hz) models comply.

[4] Based on a personal communication with Professor Graham Morrison, MECHLAB@UNSW.

The data on *split air conditioners* can be summarised as follows:

- 14% of European models already comply with the proposed 2007 MEPS, with the rate of compliance systematically higher for larger models and for reverse cycle models. Seven of the 48 manufacturers on the Eurovent database account for 75% of the complying models – LG, Daikin, Hitachi, Mitsubishi, Toshiba, Panasonic and Fujitsu. Airwell is the next largest.
- There are significant sectoral differences in the Japanese market. The targets for smaller (<3.2 kW) reverse cycle units are most demanding; virtually all such units would exceed the Korean MEPS by October 2004, and by a significant margin. A majority of the smaller cooling only models would also comply by October 2007. The targets for larger splits (>3.2 kW) are less demanding again, but even there a sizeable minority would comply by October 2007. (Note the different timing, with the smaller reverse cycle units required to meet their targets 3 years earlier than all other models.)
- Of the other Asian countries, only Korea (89%) and Thailand (66%) return high rates of compliance. The compliance rate is less than 10% in China, India and Taiwan. However, a large proportion of the models in all countries are within 10% of the Korean MEPS.

Trade in air conditioners
The following findings are based on analysis of UN trade data[5].

- Four countries – Korea, China, Thailand and Malaysia – account for three quarters of the trade in room air conditioners. Korea and China have about 30% each, with Thailand and Malaysia on 11% and 7% respectively.
- Total trade is split 60:40 between exporters with mains power supplies of 50 Hz and 60 Hz respectively.
- There is considerable cross-trade between countries on 50 Hz and 60 Hz – see table 3.1. In particular, 65% of exports from 60 Hz exporters are to 50 Hz importers.
- The pattern of Australian imports broadly reflects the global pattern. In particular, about 60% comes from 50 Hz countries and 40% from 60 Hz countries. Very little now comes directly from Japan. Within the 60 Hz group, Korea has steadily increased its position at the expense of Taiwan, to the point where 90% of the 60 Hz supplies come from Korea. Within the 50 Hz group, the trend in market share was first from Malaysia to Thailand, and subsequently from Thailand to China. The market shares within the 50 Hz group of exporters are roughly 20%, 40% and 40% to Malaysia, Thailand and China respectively.

TABLE 3.1: MEASURES OF CROSS TRADE IN ROOM AIR CONDITIONERS BETWEEN 50 HZ AND 60 HZ COUNTRIES, 2002

Exporter group	*Share of exports, by Importer group*			
	50 Hz	*60 Hz*	*50/60 Hz (Japan)*	*Total*
50 Hz	65%	26%	10%	100%
60 Hz	54%	45%	1%	100%
50/60 Hz (Japan)	82%	18%	0%	100%
Total	60%	35%	6%	100%

Conclusion on feasibility of following the Korean lead
The general impression is that different countries are on different development paths. High efficiencies are delivered according to the core requirements of the various regional markets – for example, unitary models in the US, smaller reverse cycle splits in Japan, larger reverse

[5] Available at http://unstats.un.org/unsd/comtrade/default.aspx

cycle splits in Europe, and cooling only splits in Korea. High efficiency targets are not peculiar to cooling only models in Korea. Nor does Korea have the most demanding requirements across the board. Japan sets much higher targets for the smaller reverse cycle splits. And Europe's Class A labelling requirements for unitary models and the larger splits are more demanding than the corresponding Korean requirements.

With different countries pursuing high efficiency strategies for different types and sizes of air conditioners, it is conceivable that Australian needs are not addressed. One possibility is that the Australian market is so different that products suited to the Australian market are not available at reasonable cost, despite all of the effort to increase efficiency. Another possibility is that suitable product is generally available but not through the existing supplier structure; it would then require a significant upheaval of the supplier structure and their relationships with manufacturers.

For the purposes of this consultation RIS it is assumed the Australian market is not unusual and that supply arrangements do not need to be fundamentally restructured. With reasonable effort a suitable range of product can be provided to the Australian market. Important considerations are that:

- There is a broad-based world-wide effort to increase efficiency, providing good coverage of all market segments. While the Australian proposal mimics the 2004 Korean MEPS, it does not follow that Korea will be the sole source of high efficiency product.
- There is a three year lag between the Korean MEPS and their implementation in Australia, with the further likelihood that suppliers will be able to stock-up with enough non-complying product to substantially carry them through the peak summer sales season of 2007/08. The regulation would not take full effect till 2009.
- Australia's supply structure is not unusual. It is dominated by the supplier brands and manufacturing countries that provide high efficiency products to markets throughout the world.

Option of adopting the next best European benchmark

Recognising that the feasibility of adopting the Korean benchmarks is an issue, the possibility of adopting the 'next best' or 'approximately equal' European benchmarks has also been identified as an option for more detailed analysis in chapter 4. These benchmarks are reported in table 3.2. Note that:

- The European efficiency classes vary according to the type of air conditioner and the mode of operation, with higher efficiency required from spilt systems and in the heating mode. But there is no variation by size, except that there is no labelling requirement for air conditioners with cooling capacity greater than 12 kW.

TABLE 3.2: EUROPEAN SCHEME FOR ENERGY LABELLING, INTRODUCED JANUARY 2004, APPLYING TO AIR CONDITIONERS WITH COOLING CAPACITY UP TO 12 KW

Efficiency class	*Unitary*		*Splits & multi-splits*	
	EER – cooling mode	*COP – heating mode*	*EER – cooling mode*	*COP – heating mode*
Class A	>3.0	>3.4	>3.2	>3.6
Class B	>2.8 – 3.0	>3.2 – 3.4	>3.0 – 3.2	>3.4 – 3.6
Class C	>2.6 – 2.8	>3.0 – 3.2	>2.8 – 3.0	>3.2 – 3.4
Class D	>2.4 – 2.6	>2.6 – 3.0	>2.6 – 2.8	>2.8 – 3.2
Class E	>2.2 – 2.4	>2.4 – 2.6	>2.4 – 2.6	>2.6 – 2.8
Class F	>2.0 – 2.2	>2.2 – 2.4	>2.2 – 2.4	>2.4 – 2.6
Class G	0.0 – 2.0	0.0 – 2.2	0.0 – 2.2	0.0 – 2.4

- The new Australian proposal puts the minimum EER for unitary air conditioners at 2.84, which falls into European class B and is about 1.5% higher than the minimum required for class B (2.8).
- The proposed minimum EER for the smaller split units (0-4 kW) is 3.33 and falls into European class A. This is about 4.1% higher than the minimum EER required for class A (3.2).
- The proposed minimum EER for the larger split units (4-10 kW) is 2.93 and falls into the European class C. This is about 4.6% higher than the minimum EER required for class C (2.8).

The adoption of the next best European benchmarks would clearly dilute the proposal. The minimum EER required of both unitary air conditioners and the larger splits would be 2.80, which is a relatively small advance on the BAU requirement of 2.75. And the minimum EER for the smaller splits would be reduced from 3.33 to 3.20, compared with a BAU requirement of 3.05.

However there are certain similarities between the European and Australian markets, not shared with Korea, that may ease the transition. First, Korea's electricity supply has a frequency of 60 Hz, whereas both Australia and Europe are on 50 Hz. Second, the domestic Korean market has been characterised as a 'cooling only' market whereas there has been strong trend in Australia to reverse cycle air conditioners. The Australian market may be more like the European market in that and other respects. Arguably, therefore, the European alternative would provide access to a wider range of product that can be more readily or cheaply adapted for the Australian market.

3.3 Timing options

Under existing arrangements there is an interval of 3-6 years between successive increases in MEPS. The longer interval of 6 years applies to three phase units, with MEPS first imposed in October 2001 and scheduled to increase from October 2007. The shorter interval of 3 years applies to single phase units, with MEPS introduced in October 2004 and scheduled to increase from October 2007. The new proposal alters the timing for room air conditioners less than 7.5 kW, with the previous interval of 3 years being replaced with two intervals of 18 months each. MEPS were first imposed in October 2004 and would be scheduled for increases in April 2006 and October 2007.

The question is whether an interval of 18 months is too short, particularly where two such intervals are strung together, as in the second case above. Industry would be concerned that the adjustment costs cannot be recouped over 18 months. 'Adjustment costs' are the costs of upgrading and replacing products to comply with the regulation, which can be significant. There is a related concern that more notice needs to be provided; otherwise, the costs of adjustment are increased unnecessarily.

There are a number of alternatives to the proposed timing for room air conditioners less than 7.5 kW, for example:

- A single 3 year interval could be restored by abandoning the interim step at April 2006 and making a single step to the higher levels in October 2007.
- The two intervals could be retained but made more generous. Several combinations are possible, such as:
  - October 2004/April 2006/April 2009 – providing intervals of 18 months and 3 years respectively
  - October 2004/October 2007/April 2009 – providing intervals of 3 years and 18 months respectively
  - October 2004/October 2007/ October 2010 – providing 2 intervals of 3 years each

We focus on the first alternative in the detailed analysis. It is the simplest alternative to the proposal, involving a single increase in October 2007 and no changes to the current timing. The question posed is … *Given the proposal to introduce significantly more stringent MEPS for room air conditioners in October 2007, does it make sense to have an interim step in April 2006, only 18 months beforehand?*

3.4 Alternative policy approaches

The proposal is that the minimum energy efficiency of airconditioners be subject to explicit government regulation. That is one form of regulation. ORR (1998) identifies a spectrum of regulatory approaches with explicit government regulation at one end of the spectrum and self-regulation at the other. Intermediate forms of regulation (quasi-regulation and co-regulation) are also identified. The differences can be summarised as follows:

- Self-regulation requires that the industry has a viable industry association with broad coverage and that members are sufficiently ‘of like mind’ that they will voluntarily adhere to a code of conduct devised by the members. Minimal sanctions such as loss of membership or peer disapproval are all that is required to ensure broad compliance. The government role is reduced to facilitation and advice.
- Self-regulation merges into quasi-regulation, the latter distinguished by a stronger role for government in endorsing industry codes, providing technical guidance, or entering into government-industry agreements.
- Co-regulation describes the further stage where government provides some form of legislative underpinning for industry codes and standards. This may involve delegating regulatory powers to industry, enforcement of undertakings to comply with codes, or providing a fall-back position of explicit regulation in the event that industry fails to self-regulate.

These options have been addressed in the previous RIS (GWA 2000) under the heading of ‘Voluntary MEPS’, referring mainly to the option of self-regulation. Various difficulties were identified. The key difficulty is that the industry association (AREMA) represents the larger and medium suppliers only and is not broadly representative of the industry. The preconditions in terms of trust and confidence simply do not exist in the industry. It was determined from an early stage (mid 1990s) that AREMA was not a suitable vehicle for developing an energy efficiency code and that it would need to be developed as a government rather than an AREMA program. This consideration is fatal to options for quasi-regulation and co-regulation as well, both of which would promote AREMA as the *de facto* industry regulator. GWA further identified the following considerations:

- Users are too numerous and diverse to provide the institutional structure that would be required to impose standards on suppliers.
- Governments could adopt efficiency standards for their own purposes but comprise too small a market to provide effective leadership to the market as a whole.
- All APEC countries other than Japan have used explicit regulation to impose MEPS. Japan is recognised as a special case in terms of the close relationships between government and industry, industry’s willingness to provide governments with confidential information, and the effectiveness of informal sanctions.

In terms of ORR’s checklist for assessing regulatory options (ORR 1998: Box D.2), it is also apparent that government is the active party. Government is responding to a significant public issue; it is convinced of the need for action; and it needs to ensure that there are specific achievements against the criteria of cost-effectiveness set out in the National Greenhouse Strategy. Overall, therefore, suppliers are neither strongly motivated nor well structured to take the initiative.

The earlier RIS applies specifically to three-phase airconditioners. If anything, however, self-regulation and the intermediate forms of regulation would prove even more problematic in the case of single-phase airconditioners. The main issue is that AREMA would be even less representative of the suppliers of smaller airconditioners, who are more numerous than the suppliers of three-phase units. And consumers are even more fragmented and naïve.

Accordingly, this RIS gives no further consideration to options for reducing the government role in the regulation of the energy efficiency of airconditioners.

Option of using alternative instruments
ORR also identifies a number of alternative instruments that might be used instead of regulation. These include information and education campaigns; labelling requirements; taxes, subsidies and user charges; and tradable property rights.

The information, education and labelling options are not given further consideration in this RIS. As discussed in chapter 2, the airconditioner strategy already includes initiatives of this kind, organized around the energy labelling (star-rating) scheme. Airconditioners of less than 7.5 kW have been included in this scheme for 10 years[6]. Nevertheless, NAEEEC considers that significant opportunities for cost-effective increases in energy efficiency remain. This basic proposition is assessed in chapter 4.

The previous RIS also briefly considered the options for market based instruments – specifically, levies on the use of energy or on the use of inefficient equipment. However, these are major policy issues for the highest level of governments. They would not be decided by NAEEEC or even necessarily by MCE. Nor would they be decided in relation to specific items of equipment such as airconditioners, since such schemes would apply to inefficient equipment generally or to the use of energy generally. They were rejected in the previous RIS and no longer represent realistic alternatives that could be considered by MCE. Accordingly, these options are not further considered in this RIS.

3.5 Conclusion

Given the feasible options described above, the impact analysis has been organised in two chapters.

- *Changes proposed for October 2007:* Chapter 4 deals with the level of the 2007 MEPS for room air conditioners less than 10 kW. Two feasible alternatives to the BAU option have been identified, following either the Korean or the European lead.
- *Changes proposed for April 2006:* Chapter 5 deals with the proposal to bring existing 2007 MEPS from October 2007 to April 2006, for room air conditioners less than 7.5 kW.

[6] The criterion for labelling has recently been altered from a capacity-based rule (<7.5 kW) to a rule based on the type of power supply. Specifically, labelling now is required only of single-phase models. These dominate the range of smaller models.

4 Impact analysis of the changes proposed for October 2007

This chapter is concerned with the proposed increase in the 2007 MEPS for room air conditioners of less than 10 kW cooling capacity. It provides assessments of the regulatory impact on energy use and greenhouse emissions, users, suppliers and government. These are brought together as an assessment of national costs and benefits in section 4.5. Appendices 3 and 4 explain modelling assumptions that are not otherwise detailed in this chapter.

4.1 Impact on energy efficiency, energy use and greenhouse emissions

The proposed regulation relates to about 1,750 of the airconditioner models that were registered with the AGO in August 2004. About 96% of these would not comply with the proposed new MEPS; the proportion falls to 92% if the alternate European standard is adopted.

Table 4.1 provides some further detail. Note that the analysis is in terms of 10 categories of air conditioner, distinguished by configuration (split or unitary), type (cooling only or reverse cycle) and size group. (Two categories that fall within scope of the regulation have been excluded. These are unitary air conditioners of 7.5-10 kW, both cooling only and reverse

TABLE 4.1: AVERAGE CHARACTERISTICS OF NON-COMPLYING MODELS

Category of airconditioner	*Non-complying models (%)*	*Average cooling capacity (kW)*	*BAU energy use (kWh/yr)*	*Reduction in energy use (kWh/yr)*	*Reduction in energy use (%)*
Proposed MEPS, equivalent to the 2004 Korean MEPS					
Split, cooling only, 0-4kW	100.0%	3.0	650	52	8.0%
4-7.5 kW	92.8%	6.0	1,778	104	5.9%
7.5-10 kW	90.5%	8.3	2,458	147	6.0%
Split, reverse cycle, 0-4kW	96.7%	3.0	676	48	7.1%
4-7.5 kW	94.6%	5.9	1,764	89	5.1%
7.5-10 kW	98.8%	8.3	2,478	126	5.1%
Unitary, cooling only, 0-4kW	97.2%	2.4	593	17	2.9%
4-7.5 kW	96.2%	5.2	1,547	49	3.2%
Unitary, reverse cycle, 0-4kW	97.3%	2.8	660	17	2.6%
4-7.5 kW	97.7%	5.3	1,526	41	2.7%
Alternate MEPS, based on next best European benchmark					
Split, cooling only, 0-4kW	95.8%	3.0	657	29	4.5%
4-7.5 kW	86.5%	6.1	1,793	31	1.7%
7.5-10 kW	85.7%	8.3	2,454	44	1.8%
Split, reverse cycle, 0-4kW	95.5%	3.0	676	27	3.9%
4-7.5 kW	89.2%	5.9	1,771	27	1.5%
7.5-10 kW	95.0%	8.3	2,482	37	1.5%
Unitary, cooling only, 0-4kW	88.7%	2.5	596	10	1.7%
4-7.5 kW	96.2%	5.2	1,547	28	1.8%
Unitary, reverse cycle, 0-4kW	94.5%	2.8	661	10	1.5%
4-7.5 kW	96.6%	5.3	1,523	23	1.5%

cycle, for which no models are recorded on the AGO register and/or few sales are recorded.) Large proportions of all 10 categories would need to be replaced, delivering energy savings in the range 2.5-8%. The larger gains are from the smaller splits that face the more demanding increase in minimum EER. Most of these models will be replaced to comply with the existing 2007 MEPS, which define the BAU scenario. However, the reductions in energy use reported in table 4.1 are additional to the energy savings expected from the existing 2007 MEPS; savings have not been double counted.

See figures 4.1 and 4.2 for projections of energy use and greenhouse emissions under alternative MEPS arrangements. The overall shape of the projections – with large increases through to 2005, followed by continued but slower growth – reflects the large increases in the stock of air conditioners that have occurred since 1995. Our projection is for the residential ownership ratio, which is the average number of air conditioners per household (including households without air conditioners), to increase by 127% from 0.32 in 1995 to

FIGURE 4.1: SCENARIOS FOR ENERGY USE BY ROOM AIR CONDITIONERS, <10KW

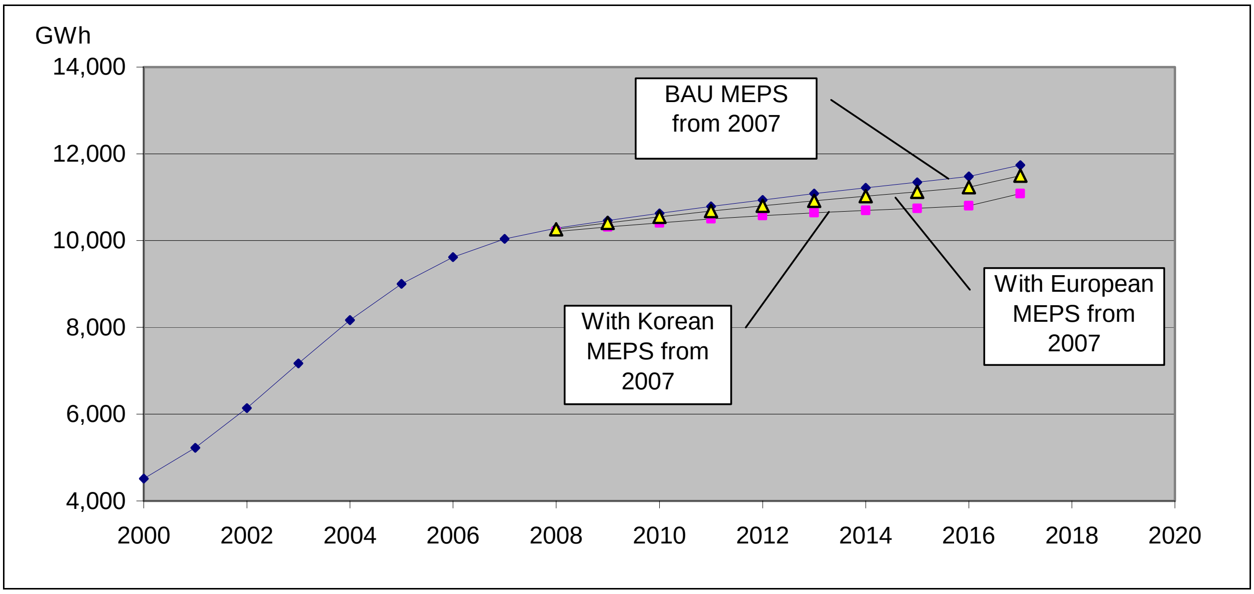
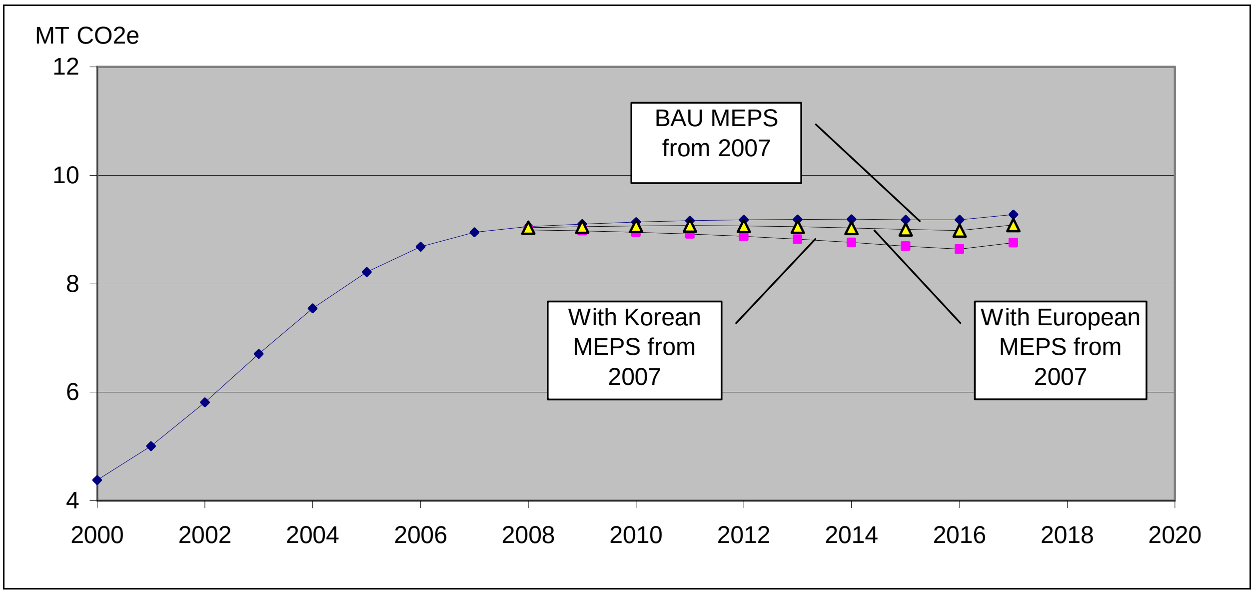


FIGURE 4.2: SCENARIOS FOR GHG EMISSIONS FROM ROOM AIR CONDITIONERS, <10KW



0.73/household in 2005. We estimate that the ownership ratio has increased by 87% to 2003 (0.6/household), and allow for a relatively modest further increase before returning to more normal rates of growth. The ownership ratio would reach 0.82/household by 2010, consistent with 60% of households using air conditioners, each with 1.35 air conditioners. A commensurate increase in non-residential ownership is also assumed.

Regarding the impact of energy efficiency on this underlying projection, note that:

- The projection for emissions is somewhat flatter than that for energy use. This reflects a projected reduction in the emissions intensity of electricity as generators become more efficient and switch from coal to fuels like gas and renewables that have lower emissions.
- The 2007 MEPS are assumed to be fully effective in 2009, recognising that suppliers have 12 months to clear stock acquired before October 2007 and would be able to stock up with non-complying models that would substantially carry them through the peak summer period of 2007-08. It is assumed that 67% implementation is achieved in 2008.
- The proposed regulation is assumed to have a life of 10 years, terminating in 2016. It is unreasonable to suppose that the efficiency of air conditioners purchased after 2016 would still be influenced by the 2007 MEPS. However the units purchased in the period to 2016 would deliver energy savings for the remainder of their lives, which would extend to about 2030.
- Suppliers anticipate the new MEPS by starting to introduce the more efficient units from 2006.

On these assumptions, the proposed regulation affects energy use and greenhouse emissions as follows:

- The reductions in energy use and emissions build to about 5.9% of the BAU scenario in 2016.
- Annual energy savings in 2016 are about 678 GWh per year and emissions are down by about 0.54 Mt CO2e per year.
- The savings account for about 2.0% of BAU energy use and emissions in 2010, which is the mid-point of the first commitment period (2008-12) under international arrangements to reduce greenhouse emissions.
- Over the life of the air conditioners affected by the regulation, total energy use and greenhouse emissions are reduced by about 6,882 GWh and 5.5 Mt CO2e respectively.

The second alternative, which is to adopt the next best European benchmarks, delivers about 37% of these benefits. Energy use and emissions are down by about 2.2% in 2016 and by 0.7% in 2010.

4.2 Impact on users

Table 4.2 presents estimates of costs and benefits to users. Both costs and benefits are presented as impacts on the lifecycle costs of an air conditioner. Specifically, estimated increases in the installed cost of air conditioners are presented as a positive impact on the lifecycle cost – more efficient air conditioners are assumed to be more expensive. Benefits are presented as reductions in the present value of energy costs over the lifecycle, that is, as negative impacts on the total lifecycle costs of air conditioners. The net effect is a reduction in total lifecycle costs, also presented as a negative number. In all other respects the estimates in table have been derived from standard cost-benefit analysis, with future values bought to account by discounting.

TABLE 4.2: BENEFITS AND COSTS FROM A USER PERSPECTIVE

Category of airconditioner	Percentage increases in…		Impact on lifecycle costs						Benefit/ cost ratio
			Change in unit costs ($/kW)			Change in aggregate costs , 2007-2016 (present values, $M)			
	Effic-iency	Install cost	En'gy costs	Install costs	Net effect	En'gy costs	Install costs	Net effect	
Proposed MEPS, equivalent to the 2004 Korean MEPS									
Split, CO, 0-4kW	8.7%	2.6%	-14.8	+8.8	-6.0	-16.4	+9.7	-6.6	1.7
4-7.5 kW	6.2%	1.9%	-14.3	+4.4	-9.9	-21.6	+6.6	-15.0	3.3
7.5-10 kW	6.4%	1.9%	-14.6	+6.2	-8.4	-9.0	+3.8	-5.2	2.4
Split, RC, 0-4kW	9.0%	2.7%	-13.6	+11.6	-2.0	-49.4	+42.2	-7.2	1.2
4-7.5 kW	6.3%	1.9%	-12.5	+5.8	-6.8	-150.0	+69.0	-81.0	2.2
7.5-10 kW	6.4%	1.9%	-12.5	+8.0	-4.5	-41.9	+26.7	-15.1	1.6
Unitary, CO, 0-4kW	3.0%	0.9%	-6.0	+2.0	-4.0	-14.9	+5.0	-9.9	3.0
4-7.5 kW	3.3%	1.0%	-7.8	+1.7	-6.0	-11.2	+2.5	-8.7	4.5
Unitary, RC, 0-4kW	3.2%	1.0%	-5.3	+2.3	-3.1	-7.9	+3.4	-4.5	2.3
4-7.5 kW	3.2%	1.0%	-6.3	+1.9	-4.4	-10.9	+3.3	-7.5	3.3
Total						**-332.9**	**172.2**	**-160.7**	**1.9**
Alternate MEPS, based on next best European benchmark									
Split, CO, 0-4kW	4.7%	1.4%	-8.3	+4.0	-4.3	-8.9	+4.2	-4.6	2.1
4-7.5 kW	1.7%	0.5%	-4.2	+1.0	-3.2	-5.9	+1.4	-4.5	4.1
7.5-10 kW	1.8%	0.5%	-4.4	+1.5	-2.9	-2.5	+0.9	-1.7	3.0
Split, RC, 0-4kW	4.9%	1.5%	-7.6	+5.2	-2.4	-27.1	+18.7	-8.5	1.5
4-7.5 kW	1.8%	0.5%	-3.7	+1.4	-2.3	-41.9	+15.4	-26.5	2.7
7.5-10 kW	1.8%	0.5%	-3.7	+1.9	-1.8	-11.8	+6.0	-5.8	2.0
Unitary, CO, 0-4kW	1.8%	0.5%	-3.6	+1.0	-2.6	-8.1	+2.2	-5.9	3.6
4-7.5 kW	1.8%	0.5%	-4.4	+0.8	-3.6	-6.3	+1.1	-5.2	5.5
Unitary, RC, 0-4kW	1.8%	0.5%	-3.0	+1.1	-2.0	-4.4	+1.5	-2.8	2.8
4-7.5 kW	1.8%	0.5%	-3.6	+0.9	-2.7	-6.0	+1.5	-4.5	4.0
Total						**-122.9**	**53.0**	**-69.9**	**2.3**

The underlying assumptions are briefly stated here; appendices 3 and 4 provide a full account.

- It is assumed that the increase in efficiency is the minimum required to achieve borderline compliance with the proposed MEPS.
- For reverse cycle units, the increase in COP is set at 75% of the increase in EER. (COP is a measure of efficiency in the heating cycle and is not directly regulated.)
- The impact on the installed cost of air conditioners has been assessed in terms of an assumed relationship between the percentage increase in efficiency and the percentage increase in installed cost. It is a two-stage process:
  - For the alternative MEPS based on European benchmarks, the percentage increase in installed costs has been put at 25% of the increase in efficiency. That is, a 10% increase in efficiency is accompanied by a 2.5% increase in installed cost.
  - For the further increase from the European benchmarks to the proposed MEPS, the percentage increase in cost has been put at 33% of the percentage increase in efficiency. This makes an allowance for increasing marginal costs of delivering further increases in efficiency.
- Estimates of the increase in installed cost were obtained by applying the percentage increase to baseline estimates of installed cost. The latter have been derived from the *Rawlinsons Australian Construction Handbook* (Rawlinsons 2004).

- Estimates of the reduction in lifecycle energy cost have been obtained by applying the increase in efficiency to baseline estimates of lifecycle energy costs. The latter were based on the following assumptions:
  - uniform asset life of 10 years;
  - discount rate of 6.3% in real terms;
  - residential and commercial energy charges of 12cents/kWh and 10cents/kWh respectively.
  - residential and commercial operating hours or 500 and 1,500 hours per year respectively;
  - 50:50 mix of cooling and heating hours for reverse cycle units.
- All cost and price estimates exclude GST.

On these assumptions, the proposal would cost $172 million and return benefits of about $333 million. The net benefit is $161 million and the overall benefit/cost ratio is 1.9. Most of these benefits are from split units of 4-7.5 kW, reflecting their large market share. The benefit/cost ratio varies considerably by type of air conditioner. For example, smaller splits return lower benefit/cost ratios reflecting shorter operating hours and higher baseline estimates of the installed cost per kW of cooling capacity. From the user perspective the European option is clearly second best.

Sensitivity analysis
There is considerable uncertainty about some of the parameters that determine the balance of costs and benefits. Sensitivity analysis of the benefit cost assessment is reported in table 4.3, indicating the nature and quantitative significance of the uncertainties.

Relationship between COP and EER
In the base case the increase in COP has been set at 75% of the increase in EER. A much weaker relationship, with COP increasing by only 50% of the increase in COP, would reduce the benefits by about 10%.

Relationship between increase in installed cost and increase in efficiency
There is little information to inform an assessment of cost increases, and most of that is from the US. Table 4.3 reports a sensitivity test for a large (50%) increase in the cost estimate. This reduces the net benefits by about half and leaves the benefit/cost ratio much closer to 1.0.

Asset lives
The available evidence on the life of air conditioners, all from overseas, indicates that our baseline setting of 10 years may be unreasonably short. However it is difficult to make sense of the reported sales of air conditioners, relative to stocks, without assuming a relatively short life. Testing on the upside, at 12 years, indicates that this is a significant parameter, increasing the estimate of benefits by about 14%.

Discount rate
The discount rate has been set at 6.3%, which is the rate adopted by the Australian Building Codes Board for its analysis of energy efficiency measures. This is a relatively low rate, reflecting a judgement that investments in energy efficiency will be somewhat insulated from cyclical fluctuations in economic activity, and are therefore relatively low risk[7]. Increasing the rate to 7.3%, which is a significant change, has a moderate impact but leaves the benefit/cost ratio comfortably above 1.0.

Trend in the cost of energy and appliances
Like many manufactured products, the cost of air conditioners has fallen significantly over the last 10-20 years. A price series extracted from *Rawlinsons Construction Cost Guide* indicates

[7] This issue is discussed in some detail in Atech's report to the Board – see Atech (2003), *A Financial Analysis Procedure for Energy Efficiency in Buildings*

TABLE 4.3: SENSITIVITY ANALYSIS OF IMPACT ON AGGREGATE ENERGY AND INSTALLATION COSTS, 2007-2016

	Change in energy costs (present values, $M)	*Change in installation costs (present values, $M)*	*Change in aggregate lifecycle costs (present values, $M)*	*Benefit/ cost ratio*
Base case				
	-332.9	+172.2	-160.7	1.9
Relationship between COP and EER				
COP increases by 50% of increase in EER	-297.4	+172.2	-125.2	1.7
COP increases by 100% of increase in EER	-367.3	+172.2	-195.2	2.1
Relationship between increase in installed cost and increase in efficiency				
-25%	-332.9	+129.1	-203.7	2.6
+50%	-332.9	+258.2	-74.6	1.3
Asset lives				
Increased from 10 to 12 years	-378.3	+172.2	-206.2	2.2
Discount rate				
Discount rate = 7.30%	-293.2	+158.9	-134.3	1.8
Discount rate = 5.30%	-378.9	+186.8	-192.0	2.0
Trends in the cost of appliances and electricity				
Appliance costs falling by 1% per year	-332.9	+164.3	-168.5	2.0
Electricity costs rising by 1% per year	-366.1	+172.2	-194.0	2.1

that the real (inflation adjusted) cost of ducted systems fell by 42% between 1995 and 2004, and by 48% and 57% for split and wall/window types of room air conditioners. Analysis of Australia's trade data shows that average price of imported units (in $US) has been falling at a trend rate of 3.7% per year. While this is crude figuring, and may be affected by changes in the composition of imports, it is consistent with trends in US prices for household appliances. These are reported by Meyer *et al* (2002) and indicate that the real cost of room air conditioners fell at a trend rate of 4.7% per year over the period 1985-1998.

Accordingly, the assumption for future appliance costs was tested on the downside. As noted in table 4.3, a 1% trend reduction in appliance costs adds about $8M to the value of the proposed regulation. A downwards trend of 2-3% per year would add $16-24M.

It is also reasonable to test on the upside for future trends in the cost of electricity. As noted in table 4.3, a 1% trend increase in electricity costs adds about $33M to the value of the proposed regulation.

Ownership ratio

The issue not addressed in table 4.3 is the ownership ratio. As discussed in appendix 3, it has been assumed that the large increases observed in the last few years will continue to 2005 before slowing to more moderate growth. However, there is a credible view that larger increases should be factored in. The net benefits from the proposal would increase accordingly.

Equity considerations

Expected increases in the market price of residential airconditioners would not have significant adverse equity implications. Based on the assessments provided in table 4.2, the increase in price would be or the order of $40-$80 for split units, up to $15 for unitary appliances, and would not be a significant impediment to the purchase of a long-lived asset such as an air conditioner. The increase in price is such that any adverse effect on sales, which are currently at very high levels, can be safely ignored. Most likely, cash-constrained buyers would purchase an air conditioner of marginally smaller capacity than otherwise, with costs substantially borne as some reduction in the functional value of the air conditioner in operation.

It should also be kept in mind that, while total net benefits of the proposal may be positive, the benefits will be distributed unevenly between users, depending on the type of air conditioner used, the cost of energy and, most importantly, the intensity of use. Based on US assessments, a minority of low-intensity users will be worse off, at least in certain stages of the life cycle when dwellings are unoccupied for a large portion of the day, or where energy is particularly cheap. Lack of data on ownership patterns and user behaviour prevent more detailed quantitative assessment of these impacts.

4.3 Business compliance costs

The structure of the air conditioner industry is briefly explained in section 1.4. It can be summarised as follows:

- all room air conditioners are imported;
- the importation and wholesaling of room air conditioners is dominated by 8 major brands that account for 75% of sales;
- a total of about 100 separate business entities may be involved in importing, with about half of these operating on a small scale, importing a ‘container load’ at irregular intervals;
- several thousand businesses are engaged in the retailing, installation and maintenance of air conditioners.

The regulatory obligations fall entirely on the importer/wholesalers, who are regarded as the suppliers of air conditioners to the Australian market. In round figures, 50 of these may be small or medium-sized businesses.

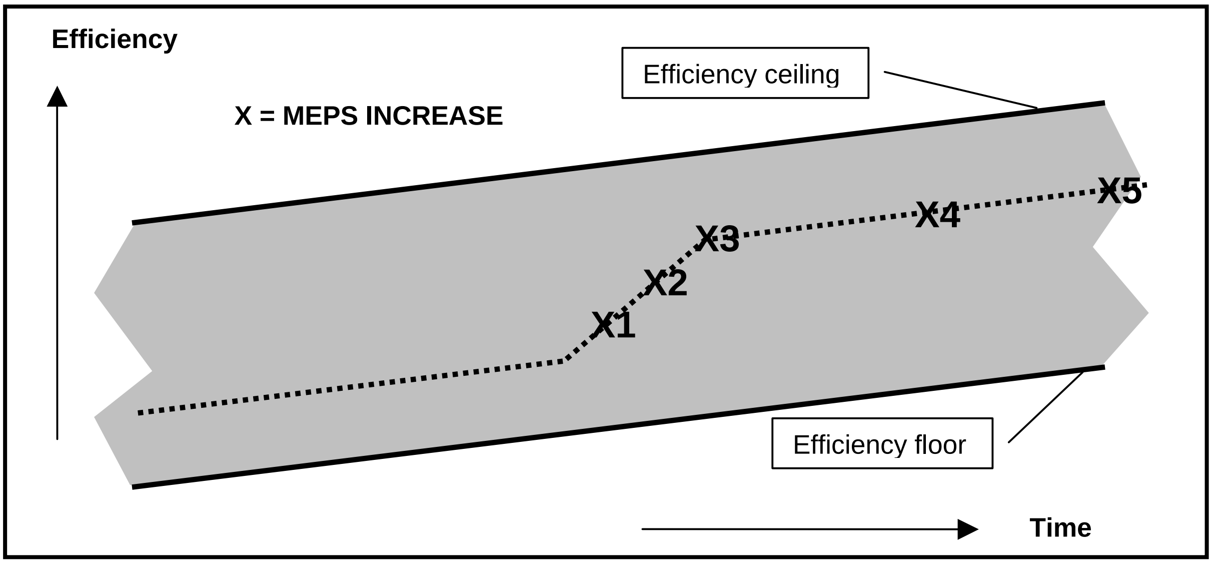
No change in the administrative arrangements
No costs will be incurred on account of changes to the administrative arrangements. The requirements for product registration, including any associated testing, are unchanged, and would be required for the purposes of product labelling in any case, regardless of MEPS arrangements. However, there may be more paperwork during the adjustment phase, associated with the higher turnover of models. These are allowed for here as part of the adjustment costs.

Adjustment costs – what are they?
It is normal practice for suppliers of air conditioners to periodically upgrade the range of product that they offer to the market. Some models may be replaced quite regularly – say, every 2 years if not annually – although such changes are often only cosmetic. The cost of such alterations is a normal cost of doing business and would ultimately be recovered in the prices charged to customers. It is reasonable to expect some increase in these costs during the transition from an unregulated to a regulated regime. Any such additional costs may be regarded as ‘adjustment costs’. It is convenient to treat them here as ‘impacts on suppliers’ because it is not clear that abnormal adjustment costs can be fully passed onto customers in highly competitive market[8].

[8] This begs the question of how to distinguish between normal and abnormal costs. Arguably, suppliers understand that air conditioners are energy-intensive and that energy use has significant environmental consequences. The energy star labelling scheme has been in place for over a decade and MEPS have been discussed for almost as long. There should be a reasonable expectation that air conditioners will continue to attract the interest of regulators, with compliance costs built into the price structure.

Figure 4.3 puts this issue in the context. It shows an unregulated industry offering products with a broad range of energy efficiencies, initially weighted to the bottom of the range, but improving incrementally over time in line with background productivity improvements. The industry then shifts to a higher level in response the introduction of MEPS in one or more stages (X1, X2 & X3) but resumes the normal rate of change thereafter, supported by periodic upward revision of MEPS (X4 & X5) to capture background improvements.

FIGURE 4.3: SCHEMATIC PRESENTATION OF TRANSITION TO HIGH EFFICIENCY PATH



Two factors drive the costs of adjustment associated with X1, X2 and X3. Firstly, the normal cycle of product renewal is interrupted during the transition period, shortening the life of products. The abnormal rate of product replacement will be associated with additional costs of reorganising the existing supply chain, for example:

- additional marketing costs, such as the printing of brochures, adjustment of marketing programs and communication with retailers;
- additional costs of regulatory compliance, including not only tests for energy efficiency but also tests for safety and compatibility;
- additional cost of providing repairers with training and information materials, or reorganising arrangements for parts and maintenance;
- additional cost of negotiating product specifications with manufacturers, including any redesign or repackaging that may be required.

The costs associated with a faster pace of change are reduced by the combination of advance notice of new MEPS and provisions allowing one year for pre-MEPS stock to be cleared. This provides suppliers with options for integrating the required upgrades with their normal processes of product renewal. The impacts would be quite modest for the smaller products used in residential applications; their short lives create opportunities for a smooth transition.

However, it may not be just a matter of accelerating the pace of change within a framework of familiar commercial relationships and technologies. The second cost factor is the possible need to abandon old relationships and to create new ones. For example, some suppliers may find that their existing manufacturers cannot supply complying product, requiring them to abandon those relationships and to forge new relationships with more capable manufacturers. Or they need to undertake research and development or otherwise redesign their product range. These costs can be contained by reducing the number of steps in the transition phase.

As a final general observation, note that the adjustment costs associated with the transition phase deliver benefits over the long term stretching beyond the life of the MEPS introduced during the transition phase. Referring again to figure 4,3, it is a once-only investment the transformation of the industry that extends beyond the life of X3.

Additional adjustment costs due to the proposal
Suppliers are already committed to the adjustment costs associated with the existing 2007 MEPS. Our concern here is the amount of any additional adjustment costs associated with the more demanding proposal that is now put.

Previous attempts to engage suppliers in the process of estimating these costs have been almost completely unsuccessful. The estimate provided in the RIS for the existing regulation was little more than guesswork. The component for single phase units was only $3 million but attracted no adverse comment from stakeholders. It was more than offset by the value of AGO concessions on the number of models that needed to be tested for registration purposes. The low estimate is due to the following assumptions:

- A significant proportion of the non-complying models on the AGO register were identified as duplicates of other models or likely to have been replaced by more recent models. There is considerable scope for outdated models to accumulate in the register.
- It was assumed that a further proportion of the required replacements would be integrated with normal processes of model replacement, reflecting the high turnover of single phase models under BAU conditions.
- Finally, it was assumed that a proportion of the replacement models could be introduced to the Australian market without incurring any additional costs of redesign or testing, and that some of the redesign costs would have been incurred in future years under the BAU scenario.

On these assumptions the average cost of renewing the product menu to comply with the existing 2007 MEPS was put at about $2,000 per non-complying model, of which there were about 1,500. The notion that tens of thousands of dollars needed to be spent for every such model was rejected.

For the purposes of this consultation RIS, the additional adjustment costs associated with the new proposal has also been put at $3 million. This is a somewhat arbitrary figure, inviting industry comment. It recognises the extra degree of difficulty presented by the new proposals, but consistent with the view that the proposals are entirely feasible and would not require an ‘order of magnitude’ increase in the estimate of adjustment costs.

Impacts on employment and profitability
The proposal is not expected to significantly affect the level of demand, which is expected to continue its strong growth over recent years. Similarly, there is no expectation that the proposals are any general threat to employment in the supplier industry.

However there may be significant adverse effects on smaller importer/wholesalers. Their adjustment costs would be spread over fewer sales in the first instance, although that would be relatively temporary effect. The damage to their business would be greater over the longer term if they cannot establish suitable commercial relationships with suppliers of more efficient product.

4.4 Impact on government

The impact of the proposals on the taxpayer will be minimal. Not only is NAEEEP a relatively inexpensive program from the viewpoint of taxpayers, the majority of these costs would be incurred under BAU conditions. Once the proposed measures have been developed and implemented, there are few additional costs that can be attributed to the proposal.

On the first point the ongoing costs of administering the MEPS initiative are of the order of $2 million per year at most. This allows for the equivalent of two full-time staff member in each of the regulatory authorities of the larger states, a somewhat smaller resource commitment from the smaller states, and ongoing work by AGO staff at the national level.

On the second point, the ongoing program of registration, monitoring and check testing would be required for the purposes of the labelling program for single-phase units and the existing MEPS for three-phase airconditioners. The more demanding nature of the MEPS may justify some increase in the tempo of check-testing, at least for a period. However the additional costs would be less than $100,000 and can be safely ignored for the purposes of the RIS.

4.5 National costs and benefits

National costs and benefits are generally calculated as the sum of the costs and benefits falling on all parties – that is, users, suppliers and taxpayers. However there are two complications in this case. One is that some of the adjustment costs fall on the foreign owners of the multinational corporations that supply the Australian market; these do not strictly qualify as 'national' costs. This possibility is given no further consideration, if only because the adjustment costs have been assessed as relatively minor. The more difficult issue is the avoidable cost of electricity.

Avoidable cost of electricity
The cost of electricity consists of the cost of electricity generation (including the energy lost as heat in transmission and distribution), the cost of network services (poles, wires and substations for transmission and distribution of electricity) and the market costs associated with functions such as metering, billing and advertising. These costs are recovered in the tariffs charged to users and users rightly look to the tariff schedules to determine the value of energy savings. However some of these costs are not avoidable. That is, they cannot be reduced by energy saving measures. Market costs are the obvious but relatively minor example, since market costs generally account for less than 5% of average costs.

Less obviously, the large fixed costs of providing network services means that the marginal cost of providing additional network capacity is considerably less than the average costs. Based on a recent report to the Australian Building Codes Board[9] (ABCB), the marginal network cost of a general increase in energy use might be reasonably put at about 30% of average network costs, although considerable uncertainty attaches to any such estimate. This is a more serious consideration since network costs account for about 70% of the average residential and small to medium commercial tariffs. If 70% of those costs are unavoidable, it follows that about half of the average cost of electricity is unavoidable (70% * 70% = 49%).

However a further adjustment is required. Because network capacity is designed to cope with peak loads, the avoided network costs associated with any particular measure depends on the extent to which the measures reduce the peak load on the network. Some measures would have little or no impact on peak loads and would generate no such savings. Airconditioners are at the opposite extreme. In terms of the proportion of its energy that an appliance uses when the network is under peak load, airconditioners have a peak load factor that is 3-4 times greater than the average load profile that networks must accommodate[10].

It follows that, whereas the network savings associated with proportional reductions in all loads would be equal to about 30% of average costs, the network savings associated with more

[9] Atech (2003), *A Financial Analysis Procedure for Energy Efficiency in Buildings*, Report to the Australian Building Codes Board
[10]This estimate reflects parameters developed by the Lawrence Berkeley National Laboratories (LBNL) and presented in a report to the US Department of Energy - LBNL (1997). The discussion there is in terms of the Conservation Load Factors of different appliances, and variations in the amount of energy that must be saved to reduce peak loads by 1 kW.

efficient airconditioners would be in the range 90-120% – that is, 3 to 4 times 30%. Note the possibility that reduction in network costs associated with more efficient airconditioners may actually *exceed* the average cost of network services.

Given these particular circumstances arising from the peak load demands of air conditioners, it is reasonable to regard the marginal tariff as a conservative estimate of the avoided cost of electricity. This is particularly so given that generation costs also increase under peak loads, which means that airconditioners incur higher-than-average generation costs as well. Accordingly, the average electricity tariff as has been retained as a reasonable estimate of the avoided costs of supplying the energy used by airconditioners.

Findings

Table 4.4 presents the cost benefit analysis from a national perspective. It is not very different from the user perspective. The main reason is that the electricity tariff is a reasonable approximation of the avoidable cost of electricity. This is not generally the case in industries with large fixed costs; it reflects the large share of energy savings that occur in peak periods. Also, the additional adjustment costs incurred by suppliers are small relative to user benefits.

Table 4.4 also presents two additional sets of sensitivity tests. The first shows the impact of alternative estimates of the avoidable cost of electricity networks. We consider that the load profile of room air conditioners is such that, at a minimum, the avoidable cost can be set equal to the average cost of networks (ie, 100% of average cost). The final panel shows the effect of a range of discount rates that are customarily used by AGO, showing that estimates of net benefits are much reduced when the future is heavily discounted.

TABLE 4.4: BENEFITS AND COSTS FROM A NATIONAL PERSPECTIVE ($M, 2007-2016)

	Impact on lifecycle costs of air conditioners acquired in the period 2007-2016 (present values, $M)				*Benefit/ cost ratio*
	Avoidable energy costs	*Installed cost of air conditioners*	*Supplier adjustment costs*	*Net change*	
New proposal, based on 2004 Korean MEPS	-332.9	+172.2	+3.0	-157.7	1.9
Alternative proposal, based on next best European benchmarks	-122.9	+53.0	+3.0	-66.9	2.2
Sensitivity test for estimate of avoidable network costs					
0% of average cost	-109.1	+172.2	+3.0	+66.1	0.6
50% of average cost	-221.0	+172.2	+3.0	-45.8	1.3
100% of average cost	-332.9	+172.2	+3.0	-157.7	1.9
150% of average cost	-444.8	+172.2	+3.0	-269.6	2.5
Sensitivity test for alternative discount rates					
0.0%	-787.7	+295.6	+3.0	-489.0	2.6
5.0%	-394.1	+191.5	+3.0	-199.5	2.0
10.0%	-210.8	+128.8	+3.0	-79.0	1.6

5 Impact analysis of the changes proposed for April 2006

This chapter is concerned with the further proposal for room air conditioners of less than 7.5 kW, which is to bring their 2007 MEPS forward by 18 months, from October 2007 to April 2006. It provides assessments of the impact on energy use and greenhouse emissions, on users, and on suppliers and government. These are brought together as an assessment of national costs and benefits in section 5.5. Appendices 3 and 4 document modelling assumptions that are not otherwise detailed in this chapter.

5.1 Impact on energy efficiency, energy use and greenhouse emissions

Our estimates of the physical impacts of the proposal are described in table 5.1. A key estimate is the additional number of room air conditioners (<7.5 kW) that would be required to comply with the existing 2007 MEPS, put at 1.5 million. This is slightly more than our estimate of ‘on-trend’ sales of these air conditioners over 18 months in 2006 and 2007, despite the fact that only 87% of the currently registered models do not comply and would need to be upgraded. The explanation lies in the interaction between the highly seasonal nature of air conditioner sales and the actual timing of the relevant MEPS.

To explain, recall the assumption that the new 2007 MEPS will not take full effect until 2009, because suppliers will pre-stock with enough non-complying product before October 2007 to carry them through the sales peak in the summer of 2007/08. Some of that slippage will be recouped by the proposal for April 2006, on the assumption that it will not be feasible to pre-stock with non-complying product to quite the same extent. It has been assumed that there is 50% compliance with the 2006 MEPS in 2006 plus the capture of any sales from 2007 and 2008 that will escape the 2007 MEPS.

There is also uncertainty about the underlying volume of sales that will be affected by the proposal. The economic cycle is one consideration. Cyclical variation over the life of a 5-10 year regulation can usually be ignored. In this case, however, the impacts are concentrated in 2006 and 2007, and sales may diverge considerably from the trend in the short term. Also, suppliers may look ahead to the new 2007 proposals and decide to bring those plans forward rather than revise their product range twice in 18 months.

Accepting the baseline estimate, the improved appliances use 7% less energy and generate lifecycle energy savings of 1,317 GWh. Greenhouse emissions would be reduced by about 1.1 Mt CO_2e. The 2006 savings equal 0.6% of the BAU energy use and greenhouse emissions from these categories of air conditioners – increasing to 1.3% in 2010.

5.2 Impact on users

Table 5.2 presents estimates of costs and benefits to users, mostly using the same cost benefit parameters (asset life, discount rate, energy tariffs, etc.) as for the new 2007 proposals. There is one difference; the percentage increase in installed cost has been put at 25% of the percentage increase in efficiency, which is the cost/efficiency relationship assumed for the European benchmarks. This is slightly weaker than the cost/efficiency relationship assumed for the more demanding Korean MEPS, for which the increase in installed cost was put at 33% of the percentage increase in efficiency.

TABLE 5.1: IMPACT ON ENERGY EFFICIENCY AND GREENHOUSE EMISSIONS

Category of airconditioner	*Additional air conditioners that comply with the existing 2007 MEPS*			*Additional energy savings*		*Additional greenhouse reductions (tonnes CO_2e/yr)*
	Number of units	*Total cooling capacity (MW)*	*BAU energy use (MWh/yr)*	*% of BAU*	*MWh/yr*	
Split, CO, 0-4kW	86,149	261	63,166	9.4%	5,950	5,059
4-7.5 kW	60,644	368	113,684	4.1%	4,669	3,970
Split, RC, 0-4kW	322,256	965	247,077	11.0%	27,117	23,056
4-7.5 kW	500,858	2,966	963,176	6.4%	61,359	52,170
Unitary, CO, 0-4kW	244,318	592	150,870	4.5%	6,820	5,799
4-7.5 kW	75,054	393	124,319	6.4%	7,939	6,750
Unitary, RC, 0-4kW	136,343	377	98,117	7.5%	7,329	6,231
4-7.5 kW	83,717	444	137,055	7.6%	10,469	8,901
Total	**1,509,339**	**6,366**	**1,897,465**	**6.9%**	**131,653**	**111,936**

TABLE 5.2: BENEFITS AND COSTS FROM A USER PERSPECTIVE

Category of airconditioner	*Percentage increases in…*		*Impact on lifecycle costs*						*Benefit cost ratio*
			Change in unit costs (present values, $/kW)			*Change in aggregate costs , 2006-2007 (present values, $M)*			
	Effic-iency	*Install cost*	*En'gy costs*	*Install costs*	*Net effect*	*En'gy costs*	*Install costs*	*Net effect*	
Split, CO, 0-4kW	10.4%	2.6%	-19.3	+8.8	-10.5	-4.0	+1.9	-2.2	2.2
4-7.5 kW	4.3%	1.1%	-10.5	+2.5	-8.0	-3.1	+0.8	-2.3	4.1
Split, RC, 0-4kW	14.8%	3.7%	-23.8	+15.7	-8.0	-18.3	+12.4	-5.9	1.5
4-7.5 kW	8.0%	2.0%	-17.1	+6.1	-11.0	-40.4	+14.8	-25.6	2.7
Unitary, CO, 0-4kW	4.7%	1.2%	-9.7	+2.6	-7.1	-4.6	+1.3	-3.3	3.6
4-7.5 kW	6.8%	1.7%	-16.7	+3.0	-13.7	-5.2	+1.0	-4.3	5.5
Unitary, RC, 0-4kW	9.6%	2.4%	-16.4	+5.7	-10.7	-5.0	+1.8	-3.2	2.8
4-7.5 kW	9.7%	2.4%	-19.5	+4.9	-14.6	-6.9	+1.8	-5.1	3.9
Total						**-87.6**	**35.6**	**-52.0**	**2.5**

On these assumptions, earlier application of the 2007 MEPS would return energy savings worth $88M, at the expense of an additional $36M for the installed cost of air conditioners. The net benefit is $52M and the overall benefit/cost ratio is 2.5. The benefit/cost ratio increases with the size of the unit, reflecting more intensive use and lower unit cost of these units ($/kW).

Sensitivity analysis

Sensitivity analysis indicates that the cost benefit analysis is robust – see table 5.3. The most significant threats are that the increase in installation costs has been underestimated or that the additional sales affected by the measure have been overestimated.

Our assessment of these uncertainties is expressed in the table. Specifically, a large (50%) increase in the estimate of the additional installation costs reduces the net benefit to $34M and the benefit cost ratio to 1.6. A significant reduction in the sales estimate (-30%) reduces the net benefit to $36M but leaves the benefit cost ratio unchanged.

TABLE 5.3: SENSITIVITY ANALYSIS OF IMPACT ON AGGREGATE ENERGY AND INSTALLATION COSTS, 2007-2016

Alternative setting of benefit cost parameter	*Change in energy costs (present value, $M)*	*Change in installation costs (present value, $M)*	*Change in aggregate lifecycle costs (present value, $M)*	*Benefit cost ratio*
Base case				
	-87.6	+35.6	-52.0	2.5
Relationship between COP and EER				
COP increases by 50% of increase in EER	-78.1	+35.7	-42.4	2.2
COP increases by 100% of increase in EER	-96.6	+35.5	-61.1	2.7
Relationship between increase in installed cost and increase in efficiency				
-25%	-87.6	+26.7	-60.9	3.3
+50%	-87.6	+53.4	-34.2	1.6
Asset lives				
Increased from 10 to 15 years	-114.9	+35.6	-79.3	3.2
Discount rate				
Discount rate = 7.30%	-80.8	+34.4	-46.4	2.3
Discount rate = 5.30%	-95.0	+36.8	-58.2	2.6
Trends in the cost of appliances and electricity				
Electricity costs increase by 1% per year	-95.0	+36.8	-58.2	2.6
Additional sales falling within scope of the existing 2007 MEPS				
+15%	-100.7	+40.9	-59.8	2.5
-30%	-61.3	+24.9	-36.4	2.5

5.3 Business compliance costs

As discussed in section 4.3, the impact on suppliers is equated with costs of adjustment that may be incurred by suppliers as they respond to MEPS. They need not only change more rapidly than is usual but also make more demanding changes than is usual. However previous attempts to engage suppliers in estimating these costs have not been successful. The estimates presented here are guesstimates.

The additional complication for suppliers in this case is that their April 2006 adjustments would be effective for only 18 months before being overtaken by the October 2007 adjustments. They necessarily choose between two broad strategies. One is to implement the proposed 2007 MEPS from April 2006, eliminating the adjustment costs associated with the intermediate step but perhaps increasing the adjustment costs associated with an earlier move to the more demanding 2007 MEPS. Or they can make the changes in two stages as envisaged by the proposal. Probably, some combination of strategies will be employed, depending on which is the cheapest option in a particular situation.

The April 2006 proposal is being put on the assumption that, for the most part, it is not a *de facto* imposition of the October 2007 proposals from April 2006. It is considered feasible to make the complete transition in two steps over the 3 years to October 2007, and assumes that the October 2007 MEPS will be brought forward only where the difference is minor. For example, there is only a 3% difference between the MEPS for unitary room air conditioners. They must achieve EERs of 2.75 and 2.84 by April 2006 and October 2007 respectively and it may be sensible to move directly to 2.84. Elsewhere, suppliers are assumed to respond in two stages. Split units require further significant efficiency increases (6-9%) beyond April 2006 and it not obviously attractive to make the move in one step.

The additional adjustment costs associated with the two-step process have been put at $9 million. This is large relative to the $3 million estimate already assigned to the new 2007 MEPS, for two reasons. First, the crowded schedule will eliminate many of the opportunities to integrate the renewal process with normal processes of model renewal. The cost of these lost opportunities is properly assigned to the April 2006 proposal. Second, the $3 million estimate is additional to the adjustment costs associated with the existing 2007 proposals, but assuming a one-step transition. A two-step process delivering the same result by October 2007 will be inherently more costly.

To repeat, these estimates have been developed with minimal input from suppliers.

5.4 Impact on government

The impact of the proposals on the taxpayer will be minimal, for the reasons already discussed in section 4.4.

5.5 National costs and benefits

Table 5.4 presents the cost benefit analysis from a national perspective. As discussed in section 4.5, electricity tariffs are taken to be reasonable approximation for the avoidable cost of electricity. In this case, however, the national perspective differs somewhat from the user perspective that is presented in table 5.2. The reason is that supplier adjustment costs are significant relative to net user benefits. Nevertheless the net benefits are still large, at $43 M, and the benefit cost ratio is comfortably above 1.0.

Table 5.4 also presents two additional sets of sensitivity tests. The first shows the impact of alternative estimates of the avoidable cost of electricity networks. We consider that the load profile of room air conditioners is such that, at a minimum, the avoidable cost can be set equal to the average cost of networks (ie, 100% of average cost). The final panel shows the effect of a range of discount rates that are customarily used by AGO, showing that estimates of net benefits are much reduced when the future is heavily discounted.

TABLE 5.4: BENEFITS AND COSTS FROM A NATIONAL PERSPECTIVE

	Impact on lifecycle costs of air conditioners acquired in the period 2007-2016 (present values, $M)				*Benefit/ cost ratio*
	Avoidable energy costs	*Installed cost of air conditioners*	*Supplier adjustment costs*	*Net change*	
Base case					
National costs & benefits	-87.6	+35.6	+9.0	-43.0	2.0
Sensitivity test for estimate of avoidable network costs					
0% of average cost	-109.1	+172.2	+9.0	72.1	0.6
50% of average cost	-221.0	+172.2	+9.0	-39.8	1.2
100% of average cost	-332.9	+172.2	+9.0	-151.7	1.8
150% of average cost	-444.8	+172.2	+9.0	-263.6	2.5
Sensitivity test for alternative AGO discount rates					
0.0%	-150.9	+44.5	+9.0	-97.4	2.8
5.0%	-97.4	+37.2	+9.0	-51.2	2.1
10.0%	-65.5	+31.5	+9.0	-25.1	1.6

Finally, it is useful to reiterate the various factors affecting the April 2006 proposal for room air conditioners.

- There is uncertainty about how suppliers will respond to the compressed schedule. They may use all possible means to delay their response to the April 2006 requirements. Or they may effectively bring the 2007 proposals forward.
- There is unavoidable uncertainty about the impact of cyclical variations on sales of more efficient air conditioners.
- Assuming a two-stage response, the increase in adjustment costs is uncertain.
- Supplier preparations for April 2006 have already started and some of the adjustment costs for April 2006 have already been incurred and are not reversible.
- A final rather hard-nosed consideration is that the adjustment costs may fall largely on foreign owned corporations and is not strictly a national cost to Australians.

Further supplier input is required to assess the balance of upside and downside risks.

6 Consultation

The issues related to energy efficiency programs for air conditioners generally, and MEPS in particular, have received considerable exposure over the last 10 years. This section provides a chronology of previous reports and consultations.

October 2001 MEPS
The following table provides the history of the consultative process leading up to the introduction of the preliminary MEPS for three-phase air conditioners in October 2001.

April 1994	Packaged air conditioners identified as one of the products potentially suitable for MEPS and/or labelling, in Energetics 1994.
March 1995	DPIE holds meeting in Sydney to discuss issues related to air conditioners. Attended by representatives of AREMA, 4 suppliers electricity utilities, professional and standards associations and governments.
February 1996	Unisearch organises meeting in Sydney to discuss proposed MEPS program. Principles of "low-level" MEPS discussed, but actual levels not yet determined. Attended by representatives of AREMA, 19 suppliers (out of 65 invited).
March 1996	Unisearch reports to DPIE on changes affecting the air conditioner market since 1994, and on feedback from industry meetings.
June 1998	Unisearch reports to DPIE on energy efficiency program for air conditioners, including recommended MEPS levels and information disclosure provisions.
November 1999	Mechlab reports to AGO on proposals for revision of AS3823 Part 2 and a new Part 3 to give effect to recommended MEPS levels and option of computer simulation testing.
March 2000	Standards Australia issues drafts of new AS/NZS 3823 Part 1.2, revised AS/NZS 3823 Part 2, new AS/NZS 3823 Part 3. Comment period closed 30 April 2000.
March 2000	Before preparing the draft RIS, GWA presents issues paper (GWA 2000) to a steering group comprising members of AREMA.
August 2000	Preliminary draft RIS circulated to AREMA members. GWA presents preliminary findings at AREMA meeting

MEPS for October 2004 and October 2007
NAEEEC then commenced work on the proposals for new single-phase MEPS for 2004 and revised MEPS for 2007. A review of overseas MEPS was released in May 2002 (EnergyConsult 2002), followed by the industry meetings listed below. A consultation document (NAEEEC 2002) was also released, asking for comments by 1 November 2002.

27 March, 2002	Seminar on MEPS, *Air Conditioning, Refrigeration and Building Services Exhibition,* Sydney Convention and Exhibition Centre
30 May 2002	Presentation to AREMA general meeting, Sydney
5 June 2002	Air Conditioner MEPS Steering Committee Meeting, Sydney
16 August 2002	Three phase air conditioners – Potential MEPS 2007 *Being Part Of*

	The Solution, Conference, Sydney
31 October 2002	MEPS Training Future Directions, Sydney
25 March 2003	NAEEEC Forum, Melbourne

Regarding development of the relevant standard, Standards Australia issued a draft of a revised Part 2 of AS/NZS 3823 on 6 March 2003, asking for comment by 8 May 2003. Following some minor amendments (to accommodate changes in certain tests and to include water-cooled air conditioners), the new standard was formally adopted in November 2003.

A number of consultative activities in connection with the drafting of the RIS for the 2007 MEPS, as follows:

June 2003	Phone interviews with a sample of 11 suppliers
September 2003	Draft RIS released, with comments received to the end of October.
18 September 2003	Presentation of draft RIS to the Air conditioner MEPS Steering Committee
6 October 2003	Request for information issued to industry, to address issues raised by the Air conditioner MEPS Steering Committee

No formal submissions were received in response to the draft RIS for the 2007 MEPS.

New proposals for April 2006 and October 2007
The proposals addressed in this document are NAEEEC's response to new evidence that more efficient air conditioners are already available, at a time when mainstream adoption of air conditioning has created a sense of urgency that any opportunity to increase the penetration of more efficient air conditioners should not be missed. Korea's recent adoption of more stringent MEPS provides an opportunity to replace Australia's existing 2007 MEPS while still providing industry with reasonable lead time.

The evidence that more efficient air conditioners are already available overseas was presented to industry representatives and other stakeholders in April 2004. Industry subsequently endorsed the change. The key industry associations have been notified of the further proposal to follow the Korean lead on room air conditioners. Otherwise, however, this consultation RIS has been developed with the benefit of only informal consultation with industry.

7 Conclusion and recommended option

7.1 Assessment against objectives

Tables 7.1 and 7.2 summarise our assessments of the options against the objectives of the proposed regulation, for the 2007 and 2006 proposals respectively. Only the first and second best options are listed in each case.

The options relating to stringency (table 7.1) are given primacy over the options relating to timing (table 7.2). Regarding stringency, the practical choices are to follow the lead provided by either Korea or Europe. Once the recommended option for stringency is accepted the practical choices for timing are to accept the 2006 proposal or to abandon it altogether.

7.2 Recommendations

It is recommended that States and Territories implement the proposal to bring the 2007 MEPS forward by 18 months and to implement the more stringent MEPS now proposed for 2007. This will require State and Territories to adopt amended regulations governing appliance energy labelling and MEPS.

TABLE 7.1: ASSESSMENT SUMMARY – PROPOSALS FOR OCTOBER 2007

Objective	*RECOMMENDED OPTION Implement new MEPS for room air conditioners based on most recent Korean MEPS*	*SECOND BEST OPTION Implement new MEPS for room air conditioners based on next best European benchmarks*
Reduction in greenhouse emissions	Greenhouse emissions from the targeted categories of air conditioner will be reduced by about 2% in 2010.	Greenhouse emissions from the targeted air conditioners will be reduced by about 0.7 % in 2010.
Cost effective for users	Total benefits exceed total costs by a significant margin - $161 million. But there would be some losers amongst those with low energy costs or who use air conditioners sparingly.	Total benefits exceed total costs by a lesser margin - $70 million. There would be fewer losers amongst those with low energy costs or who use air conditioners sparingly.
Minimise adverse effects on manufacturers and suppliers	The additional adjustment cost to suppliers has been estimated at $3 million. It is additional because suppliers are already committed to the adjustment costs associated with introducing the existing 2007 MEPS.	The additional adjustment cost to suppliers has been estimated at $3 million. It is additional because suppliers are already committed to the adjustment costs associated with introducing the existing 2007 MEPS.
Minimise potential for confusion or ambiguity	There is some potential for confusion because the proposal is to replace a MEPS arrangement for 2007 that had been settled. The larger suppliers, accounting for the bulk of the industry, are already aware of the proposals. The remaining communications issues need to be identified and addressed by AGO.	There is some potential for confusion because the proposal is to replace a MEPS arrangement for 2007 that had been settled. The larger suppliers, accounting for the bulk of the industry, are already aware of the proposals. The remaining communications issues need to be identified and addressed by AGO.

TABLE 7.2: ASSESSMENT SUMMARY – PROPOSALS FOR APRIL 2006

Objective	*RECOMMENDED OPTION Implement April 2006 proposals for room air conditioners*	*SECOND BEST OPTION (BAU) Abandon April 2006 proposals for room air conditioners*
Reduction in greenhouse emissions	Greenhouse emissions from the targeted air conditioners will be reduced by about 1.3% in 2010, relative to the BAU scenario.	Greenhouse emissions from the targeted air conditioners may have stabilised by 2010, with the growth of air conditioner ownership roughly offset by the falling emissions intensity of electricity generation. However there is significant upside risk; ownership may continue to grow strongly.
Cost effective for users	Total benefits exceed total costs by a comfortable margin - $52 million. However there is some uncertainty about the estimate. The regulation has a short life (18 months) and its impact may be affected by the economic cycle.	The very worst air conditioners will have been removed by the 2004 MEPS, delivering some benefits to users.
Minimise adverse effects on manufacturers and suppliers	The adjustment costs are sizeable in comparison to the net benefits to users - $9 million. This is because this part of the proposal introduces a full second round of adjustments. Much of the cost will be met by foreign owned companies and may be discounted for that reason. Even so, there is also uncertainty about this cost. Additional supplier input is welcome.	The BAU scenario for suppliers is for continued strong demand for airconditioners.
Minimise potential for confusion or ambiguity	Suppliers are generally aware of the proposals but some may find it difficult to fully commit to the changes until the regulatory decision is finalised.	Some suppliers have already responded to the announced changes and may be disadvantaged by a decision not to proceed.

8 Implementation and review

The national legislative scheme for mandatory energy labeling and performance standards relies on State and Territory legislation to give it legal effect. This creates some potential for inconsistencies in the operations of the various regulatory agencies, creating additional costs and inconvenience to industry. NAEEEC published a set of administrative guidelines to minimize those risks (NAEEEC 2000). The Guidelines are not legally binding but they are intended as a guide for State and Territory regulatory agencies to facilitate uniform and consistent practice among the States and Territories, delivering consistent outcomes for all affected products irrespective of the product or jurisdiction.

Key elements of the scheme are as follows:

- The technical details of the MEPS are contained in Australian and New Zealand Standards that are incorporated by reference into the State and Territory legislation. These standards do not vary between States. The format and content of the standards are also familiar to industry, as are the operations of Standards Australia.
- Changes to the technical detail in Standards are subject to transition periods that are negotiated between industry and government.
- To minimize trade barriers, State and Territory regulatory agencies support a policy of adopting international standards wherever appropriate.
- Grandfathering arrangements are adopted, allowing reasonable time for the phase out of non-complying stock.
- All States and Territories accept the registration of an appliance undertaken in another State.
- State and Territory regulatory agencies have set target time periods within which they aim to process applications.
- Proposed changes in administrative and operating practice are subject to consultation between states.
- It is proposed that after October 2004, appliance registration testing must be conducted by a laboratory accredited by the National Analytical Testing Authority (NATA).
- Compliance monitoring takes the form of a program of check testing by accredited laboratories.
- Equipment is selected for check testing on the basis of risk factors rather than randomly. The risk factors are as follows:
  - history of success and failure in check tests;
  - age of models, with newer models given greater attention, reflecting the prospect of longer life in the market;
  - high volume sales;
  - claims of high efficiency;
  - complaints from third parties.
- There are several sanctions. There is a ‘shaming’ option involving publication of failed brands or models in the AGO annual report. The second option is deregistration by the state authorities, subject to show cause procedures. Subsequent sale of deregistered appliances would be a criminal offence. Re-registration of models that are subject to MEPS is subject to new registration tests. The third option involves legal action by the ACCC but is highly unlikely.

- Standard statistical criteria are applied to deal with normal variation in the performance of equipment selected for check testing. (A sample of only one is selected initially, with a further sample of 3 selected if the first fails.)
- Laboratories that produce misleading tests results may also be denied further registration business.
- In due course the introduction of more stringent MEPS will also be handled nationally. That is likely to be in 2012. Further increases in the stringency level at that time will be subject to the same processes of industry consultation and a RIS.
- NAEEEC holds a consultation forum each year, providing an opportunity for stakeholders to raise concerns about the operation of the Standards or the Guidelines.

The check-testing and sanctions regime is obviously critical. Currently, check-testing expenditure (on all products) is running at about $350,000 per year, and accounts for about 25% of NAEEEC's budget. The 2002 program included 160 laboratory tests, 126 tests as part of the standards development program and 34 as part of the enforcement program. There were 12 instances where the claimed energy efficiency was not supported by testing conducted at NATA accredited laboratories. State regulators subsequently deregistered six products, negotiated acceptable outcomes including re-labelling of another four products. Several three-phase air conditioners were found to be non-compliant with MEPS.

Discussions with industry indicate that the check-testing and sanctions regime is adequate, provided it is adequately resourced. The commercial consequences of loss of reputation are considered to be serious. More generally, industry had no adverse comment on the regime for implementation and review of the MEPS.

The review functions are not centralised. Each State and Territory has its own arrangements for review, in some cases triggered by 5 year sunset provisions. However NAEEEP anticipates this cycle somewhat, with a general commitment to provide a minimal interval of 4 years between increases in the stringency of MEPS.

Finally, it is important to note that NAEEEP monitors market developments continuously, using the AGO's product register. Given the concerns about possible adverse effects on the heating efficiency of reverse cycle units, arising because only the cooling efficiency is directly regulated, there will be a particular focus on trends in the heating efficiency of newly registered models.

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APPENDIX 1: TECHNICAL BACKGROUND & TABULATION OF MEPS PROPOSALS

Technical background

The *capacity* of an air conditioner is measured as the number of kilowatts (kW) of *output power* in the cooling cycle, which is the rate of cooling achieved in the conditioned space under certain standard conditions. The efficiency of an air conditioner is measured as a ratio of output power to *input power,* which is the rate at which energy is used by the compressor and fans that drive the air conditioner. This ratio is measured in the cooling mode under certain standard conditions and is known as the *energy efficiency ratio* (EER). EERs are typically greater than 2; they can range up to 4 or more.

Air conditioners can also be configured for reverse cycle operation, which means that in cold weather they can be used as heaters, transferring heat from outside the building into the conditioned space. Such units are often referred to as heat pumps, and the ratio of power output to power input in the reverse cycle is referred to as the *coefficient of performance* (COP). Air conditioners are more efficient in the reverse cycle mode than in the cooling mode.

Note that the power output is a multiple of the input power, which means that air conditioners and heat pumps move more energy than they use. This reflects the fact that heat pumps *move* energy in or out of the conditioned space, using a refrigeration cycle; they do not *generate* heat in the same manner as a gas or electric resistance heater.

MEPS for air-cooled air conditioners

Table A1.1 shows the MEPS introduced in October 2001 and October 2004, the further changes that are currently scheduled for October 2007 but are now proposed for implementation in April 2006, and the new proposals for October 2007. The schedule is fairly complex. Note the following:

- The schedule distinguishes between air conditioners taking single-phase and three-phase power. Smaller units are single-phase and larger units are three-phase, but with a considerable overlap in the intermediate sized units. For single phase units there is a further distinction between ducted and non-ducted units.
- MEPS are being applied to three phase units in 2 stages. The initial MEPS for three-phase units were introduced in 2001. The second round is scheduled for 2007 and no changes are proposed.
- MEPS are being applied in 2 stages to the ducted units and the larger non-ducted units with cooling capacity of 10 kW or more. The initial MEPS for these units were introduced in 2004. The second round is scheduled for 2007 and no changes are proposed.
- MEPS are being applied in 2 stages to single-phase non-ducted units with cooling capacity of 7.5 to 10 kW. The initial MEPS for these units were introduced in 2004. The second round is scheduled for 2007 but it is proposed to increase the minimum EER that will apply from 2007. A relatively small increase is proposed for unitary types – from 2.75 to 2.84 (+3.3%). A more significant is proposed for split types – from 2.75 to 2.93 (+6.5%). This follows the lead from more stringent MEPS that Korea has applyed from October 2004.
- Under the proposal, MEPS will applied in 3 stages to the remaining types of air-cooled air conditioners, comprising single phase non-ducted units of less 7.5 kW.
    - The first stage commenced in October 2004.
    - The second stage is currently scheduled for October 2007 but is now proposed for April 2006.
    - A third stage is proposed for October 2007, taking a lead from more stringent MEPS that Korea has applied from October 2004, and replacing the MEPS that would be brought forward to April 2006.

TABLE A1.1 MEPS FOR AIR-COOLED AIR CONDITIONERS: 2001, 2004, 2006 & 2007

Type	*Cooling capacity (kW)*	*Existing MEPS arrangements (minimum EERs)*			*Proposed changes to MEPS arrangements (minimum EERs)*	
		October 2001	*October 2004*	*October 2007*	*Currently scheduled for October 2007, now proposed for April 2006*	*New proposals for October 2007*
			Non-ducted single-phase			
Split	<=4	None	2.45 for cooling only, 2.30 for reverse cycle	3.05	3.05	3.33
Split	4-7.5	None		2.75	2.75	2.93
Split	7.5-10	None		2.75	No change	2.93
Split	>10	None		2.75	No change	No change
Unitary	0-7.5	None		2.75	2.75	2.84
Unitary	7.5-10	None		2.75	No change	2.84
Unitary	10+	None		2.75	No change	No change
			Ducted single-phase			
All types	all	None	No change	2.50	No change	No change
			Three-phase power supply			
All types	7.6-10.0	2.25	No change	2.75	No changes	
	10.1-12.5	2.30		2.75		
	12.6-15.5	2.35		2.75		
	15.6-18.0	2.40		2.75		
	18.1-19.0	2.45		2.75		
	19.1-25.0	2.45		3.05		
	25.1-30.0	2.50		3.05		
	30.1-37.5	2.55		3.05		
	37.6-39.0	2.60		3.05		
	39.1-45.0	2.60		2.75		
	45.1-65.0	2.65		2.75		

MEPS for water-cooled air conditioners

There is a single round of MEPS for water-cooled air conditioners, originally scheduled for October 2007 and now proposed for April 2006. This is of little practical significance, given the small number of units that are affected and the relative ease of achieving the minimum EER (3.50). Water-cooling is inherently more efficient than air cooling, reflecting the more rapid exchange of heat with water.

APPENDIX 2: AVAILABILITY OF HIGH EFFICIENCY ROOM AIR CONDITIONERS IN OTHER COUNTRIES

Europe – 50 Hz

The European information provided here has been obtained from the website of the *Eurovent Certification Company* – see http://www.eurovent-certification.com. Eurovent (European Committee of Air Handling and Refrigerating Equipment Manufacturers) is an industry association representing the European air conditioning, heating, ventilating and refrigeration manufacturers with national trade associations. It deals with international and European issues on behalf of industry.

Eurovent's certification program for air conditioners applies to factory-made units up 100 kW cooling capacity. There is exclusion for multi-split systems with more than two indoor units. Participating companies must certify all production models within the scope of the program. Ratings are verified by tests conducted in Eurovent's independent laboratory. Participating companies account for 90% of European sales.

Since June 2004 all air conditioners with a cooling capacity under 12 kW must be labelled, using the classification scheme shown in table A2.1. Otherwise Eurovent's program is voluntary and seems to have been adopted after the failure of an EU proposal to set the efficiency standards at somewhat higher levels. The original proposal would also have required that certification be provided on condition that manufacturers completely withdrew models falling in classes F or G.

Table A2.1 shows how the various efficiency classes (A to G) are defined and how currently registered models are distributed between the various efficiency classes. Models that would fail the 2004 Australian MEPS have been excluded from the analysis, maintaining comparability with the current Australian situation. The table also reports the proportion of models that comply with the proposed 2007 MEPS.

Regarding the unitary models:

- The Europeans refer to all unitary models as 'packaged', including Window/wall types.
- Very few unitary models are registered – only 58.
- The proposed 2007 MEPS (EER>=2.84) fall in the range of Europe's class B.
- Overall, 33% of these models comply with the proposed 2007 MEPS. Another 30% of the models have efficiencies that are no more than 10% lower than the proposed 2007 MEPS.
- Reverse cycle models are better represented at the higher levels of efficiency than are the cooling only models. The low ratings of the smaller cooling only models are particularly notable.
- Two manufacturers – Airwell (France) and LG (Korea) – account for 16 of the 19 complying models.
- Eurovent also classifies models according to the type of mounting. Models designed for 'High wall' and 'Floor' mountings account for most of the complying product. None of the 'Window' models comply. Possibly, the latter are subject to constraints of size, shape or weight that make it more difficult to achieve higher efficiencies. It is something of a puzzle, however, since Eurovent staff informally advise that they see no difference between Window and High wall models.

TABLE A2.1 EFFICIENCY OF MODELS CERTIFIED FOR THE EUROPEAN MARKET: SINGLE PHASE, 0-10 KW, OCTOBER 2004

	EER range	00-04 kW		04-10 kW		Grand total
		CO	RC	CO	RC	
Unitary type (includes floor, window, wall and cassette mounts)						
No. registered models		22	30	6	0	58
Complies 2007 MEPS?		0%	43%	100%	-	33%
Class A	EER>3.0	0%	30%	100%	-	26%
Class B	>2.8 – 3.0	0%	47%	0%	-	24%
Class C	>2.6 – 2.8	59%	13%	0%	-	29%
Class D	>2.4 – 2.6	41%	10%	0%	-	21%
Splits (includes floor, wall and cassette mounts)						
No. registered models		241	511	248	474	1474
Complies 2007 MEPS?		5%	11%	16%	22%	14%
Class A	EER>3.2	24%	41%	4%	9%	22%
Class B	>3.0 – 3.2	10%	15%	12%	9%	12%
Class C	>2.8 – 3.0	22%	12%	15%	17%	16%
Class D	>2.6 – 2.8	30%	16%	36%	26%	25%
Class E	>2.4 – 2.6	15%	12%	32%	32%	22%
Class F	>2.2 – 2.4	0%	3%	0%	6%	3%

Regarding the split units:

- The proposed 2007 MEPS fall in the range of class A and class C for the 0-4 kW and 4-10 kW models respectively.
- Overall, 1 in 7 models (14%) already comply with the 2007 MEPS, with the rate of compliance systematically higher for larger models and for reverse cycle models.
- Significant proportions of the smaller models (0-4 kW) have an EER that exceeds 3.0 and is within 10% of the Korean MEPS.
- Similarly for the larger models (4-10 kW), a significant proportion of the models return efficiencies that are not much less than the Korean MEPS. For example, consider the significant proportion in class D.
- There are 48 certified manufacturers on the Eurovent database. Of these, the following 7 account for 75% of the complying models – LG, Daikin, Hitachi, Mitsubishi, Toshiba, Panasonic and Fujitsu. Airwell is the next largest.

Japan – 50 Hz for Eastern Japan, 60 Hz for Western Japan
The minimum energy performance of air conditioners is not directly regulated in Japan. Instead, suppliers are required to achieve a sales-weighed average efficiency across their product range. These targets are set out in table A2.2, including comparisons with the 2004 Korean MEPS. Note these further particulars about the operation of the system:

- With some exceptions that Top Runner targets must be achieved from October 2007. The exceptions are reverse cycle units of less than 4 kW, which must achieve their target from October 2004.
- The Top Runner target for reverse cycle units is defined in terms of the average of EER and COP. For the purposes of comparison with the Korean MEPS, the equivalent EER has been estimated at 90% of the combined target, which allows the targeted COP to be about 20% higher than the targeted EER.

TABLE A2.2 JAPANESE 'TOP RUNNER' TARGETS COMPARED WITH THE 2004 KOREAN MEPS

Cooling capacity range (kW)	2007 Korean MEPS (EER)	Cooling only models		Reverse cycle models			Difference between reverse cycle and cooling only EER (%)
		2007 Japanese targets (EER)	Japan/ Korea diff (%)	2004/7* Japanese targets (av. EER & COP)	Estimate of equiv. EER**	Japan/ Korea diff (%)	
Unitary							
All	2.84	2.67	-6%	2.85	2.57	-10%	-4%
Splits							
0-2.5	3.33	3.64	9%	5.27	4.74	42%	30%
2.5-3.2	3.33	3.64	9%	4.90	4.41	32%	21%
3.2-4.0	3.33	3.08	-8%	3.65	3.29	-1%	7%
4.0-7.1	2.93	2.91	-1%	3.17	2.85	-3%	-2%
7.1-10.0	2.93	2.81	-4%	3.10	2.79	-5%	-1%

Notes
* With some exceptions that Top Runner targets must be achieved from October 2007. The exceptions are reverse cycle units of less than 4 kW, which must achieve the target from October 2004.
** The equivalent EER has been estimated at 90% of the combined target for reverse cycle units, which is defined as the average of the EER and the COP. This allows for COP to be about 20% higher than the EER.

The main points and inferences to take from table A2.2 are as follows:

- Look first at the final column of the table, which shows the percentage difference between the Japanese targets for cooling only and reverse cycle units. This comparison suggests that the targets are very similar, but with the exception of the smaller split reverse cycle units, where the target is set 20-30% higher.
- The Japanese targets for unitary models are somewhat weaker than the Korean MEPS. However the logic of sales-weighting, which rewards sales that significantly exceed the target, suggests that at least a minority of the Japanese units would comply with the Korean MEPS.
- A similar comment applies to split units with greater than 3.2 kW cooling capacity, except that the gap is smaller and it is reasonable to suppose that at sizeable minority of the Japanese units would comply with the Korean MEPS.
- That leaves the smaller splits (<3.2 kW), where there is a significant difference between the cooling only and reverse cycle units. It seems reasonable to infer that a sizeable majority of the cooling only units must comply by October 2007. And virtually all of the reverse cycle units must comply from October 2004; the sales-weighted target seems to be 30-40% higher than the Korean MEPS.

Asian countries other than Japan – mix of 50 Hz and 60 Hz

Table A2.3 presents estimates of compliance rates for models supplied to the domestic markets of a number of Asian countries. The Korean data is of high quality, generated from the register that is maintained for regulatory purposes. The other data is of lesser quality, having been extracted from a sample of product catalogues for major suppliers. Catalogues do not provide comprehensive market coverage[11], and some of the efficiency claims seem to be overstated.

[11] 15-20 suppliers were identified in Taiwan and Thailand, and somewhat fewer in China and India, with 5 and 7 respectively.

TABLE A2.3 EFFICIENCY OF MODELS CATALOGUED FOR CERTAIN ASIAN MARKETS: SINGLE PHASE, 0-10 KW, MID-2004

Cooling cap. kW	*00-04*	*04-10*	*Total*	*00-04*	*04-10*	*Total*	*00-04*	*04-10*	*Total*
	Number of registered or catalogued models			*Complies with 2007 MEPS (%)*			*EER no more than 10% less than 2007 MEPS (%)*		
Unitary									
China	23	1	24	0%	0%	0%	13%	0%	13%
India	6	24	30	50%	50%	50%	50%	88%	80%
Korea	26	12	38	69%	67%	68%	92%	100%	95%
Taiwan	2	2	4	0%	0%	0%	0%	0%	0%
Thailand	10	6	16	50%	67%	56%	100%	83%	94%
Splits									
China	136	260	396	4%	0%	2%	98%	59%	72%
India	3	17	20	0%	6%	5%	67%	82%	80%
Korea	122	514	636	89%	89%	89%	100%	100%	100%
Taiwan	96	84	180	5%	7%	6%	100%	73%	87%
Thailand	101	210	311	35%	81%	66%	100%	98%	99%

Source: EES & DEM

The available data does not distinguish between cooling only and reverse cycle models. To provide a degree of comparability with the Australian situation, all models with an EER less than 2.38 have been excluded. This is the mid-point between Australia's 2004 MEPS for Cooling only and Reverse cycle models, which require EERs of 2.45 an 2.30 respectively.

Korea and Taiwan are on 60 Hz. The remainder are like Australia, on 50 Hz.

The main points are that:

- Generally there are relatively few unitary models. India is an exception, returning more unitary than split models.
- Korea returns the highest compliance rate.
- China and Taiwan return low rates of compliance, with zero compliance for all unitary models.
- Thailand returns healthy rates of compliance, all at 50% or more with the exception of the smaller split units. Importantly, Thailand's mains power is on 50 Hz, which suggests that the achievement of Korean levels of efficiency is not significantly impeded by the frequency difference.
- India's unitary models also perform well.
- With the exception of unitary models in China and Taiwan, large proportions of the catalogued models are within 10% of the proposed 2007 MEPS.

USA – 60 Hz

High-quality data is also available for window/wall models in the US market, comprising lists of all certified brands and models provided by the US Association of Home Appliance Manufacturers. These lists returned very high rates of compliance against the proposed 2007 MEPS. Overall, 90% of the models would comply – 98% of the 0-4 kW models and 61% of the 4-10 kW models. For all but a few of 17 brands, compliance was better than 50% in all categories.

APPENDIX 3: PROJECTED SALES OF REFRIGERATIVE AIR CONDITIONERS

The available data indicates that the market for refrigerative air conditioners has been transformed over the last 10 years, with annual sales rising from about 0.4 million/year in the mid 1990s to 1.25 million/year in 2003. See figure A3.1 for estimates of total sales to 2003. These are based on a series published by BIS Shrapnel for 1991 to 2001, and extrapolated by Syneca to 2003 to reflect the increase in imports. Currently, imports provide at least 90% of the air conditioners sold in Australia.

The immediate cause is a large fall in the real cost of air conditioners. *Rawlinsons Construction Cost Guide* contains a consistent series of unit prices for domestic air conditioners from 1995 to the present. This series indicates that the real cost has fallen by 42% for ducted systems, and by 48% and 57% for split and wall/window types of room air conditioners.

Residential sales

There are no direct estimates for sales to residential users. However we have made rough calculations on the basis of ABS estimates of the proportion of households with air conditioners, and the number and type of air conditioners. These are shown in figure A3.1 as a back-projection or ‘backcast’ from 2003, with the gap between the residential and total sales indicating the level of non-residential sales.

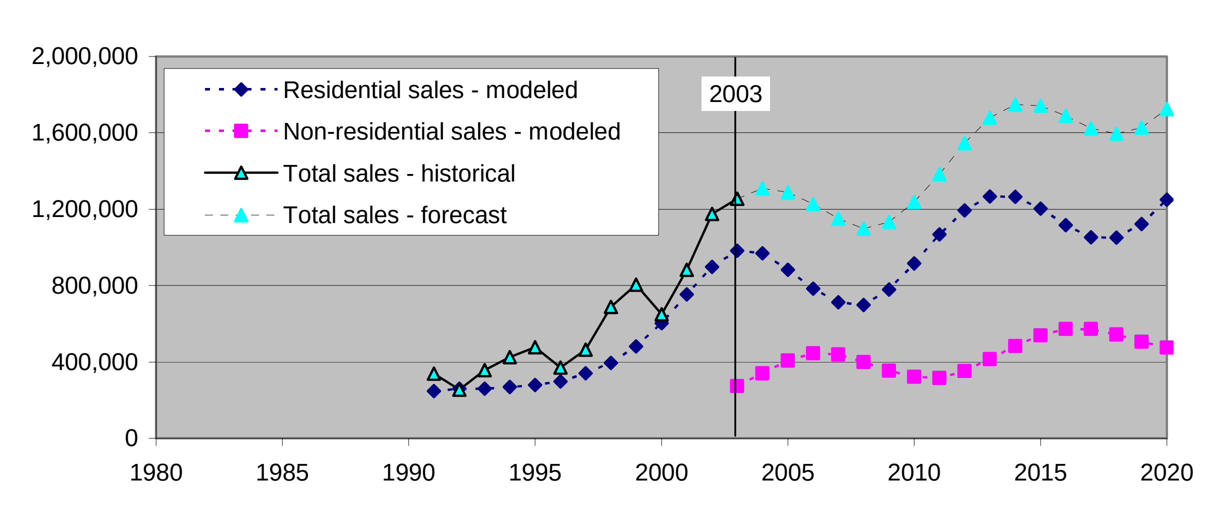
To explain, the most recent returns from a series of ABS surveys confirm that there has been a large increase in household ownership of air conditioners since the mid 1990s. These estimates are shown in figure A3.2, for surveys conducted in 1980, 1983, 1986, 1994, 1999 and 2002. The broad impression is that there was steady growth in ownership through to the mid-1980s but reached a ceiling at that point. According to the survey estimates, the industry broke through that ceiling in the late 1990s, delivering a large increase in the ownership ratio between 1999 and 2002 – from 0.318 to 0.459 appliances per households. This is somewhat at odds with the sales data, which date the upsurge from the mid-1990s. Accordingly, we have plotted a path for ownership that passes above the survey data for 1999 and 2002. Certainly it seems clear that ownership was increasing before 1999 and that the ABS figure for 1999 is an underestimate. However a number of other elements may also have contributed to the increased sales, for example, increasing sales to non-residential users or accelerated replacement of the existing stock as existing users take advantage of lower prices to upgrade their air conditioning arrangements.

To estimate sales beyond 2003 it is necessary to consider the likely size and timing of further increases in the ownership ratio, and also allow for the future flow of replacement purchases as the additional appliances purchased since the mid-1990s reach the end of their lives. Our projection for residential ownership is shown in figure A3.2 and the implied sales are shown in figure A3.1 as a forward projection from 2003.

Look first at projected ownership beyond 2003. It is shown as growing strongly till 2005 then at a progressively slower rate to approach 0.8 by 2008 and 0.9 by 2020. An ownership ratio of 0.8 is consistent with 60% of households using refrigerative air conditioners, with an average of 1.33 appliances each.

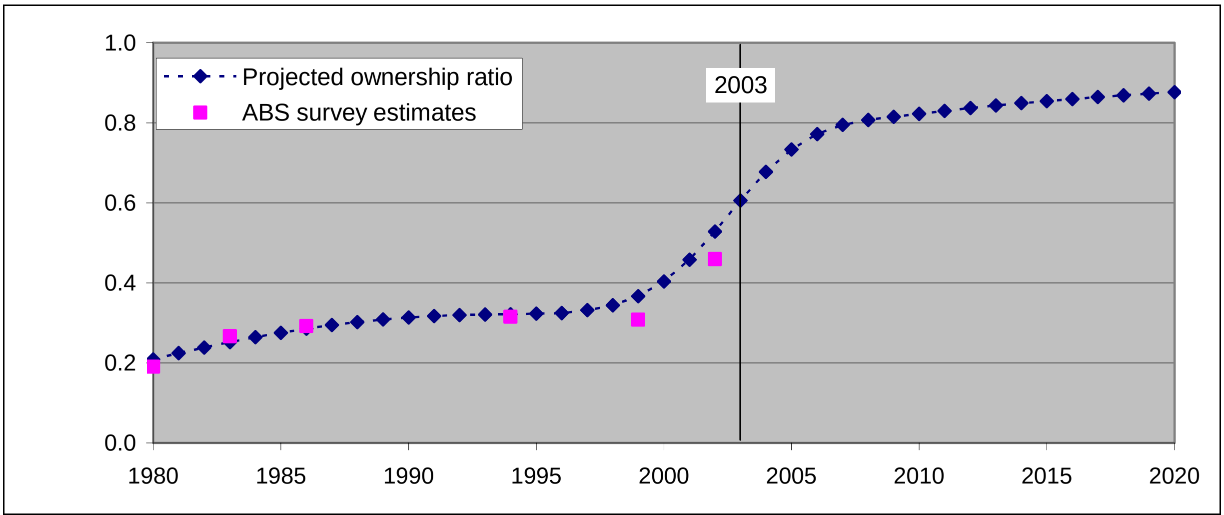
However the slower rate of increase in the ownership ration implies that the annual sales will actually fall, at least until the rate of replacement purchases starts to rise. This happens with a lag of 10 years after the mid 1990s, since an average service life of 10 years has been assumed. (Historically, it seems difficult to account for the level of sales if the service life is set significantly above 10 years.) These dynamics are shown in figure A3.1, with a temporary cooling of sales in the period to 2007 followed by a resumption of the upward trend in sales.

FIGURE A3.1: SALES OF REFRIGERATIVE AIR CONDITIONERS



Sources:
Historical sales have been derived from estimates published by BIS Shrapnel (*The Household Appliances Market in Australia, 2002-2004: Vol 3*) and with reference to import data for 1990-2003. The residential and non-residential modelling is by Syneca and assumes future growth in the number of Australian households according to the Series II projection published by the ABS in the 2004 edition of *Household and Family Projections, Australia* (cat. 3236.0)

FIGURE A3.2: FORECASTS AND BACKCASTS OF THE RESIDENTIAL OWNERSHIP RATIO (AIR CONDITIONERS PER HOUSEHOLD*)



Note:
* Note that, because a significant minority of households have 2 or more air conditioners, the proportion of households with air conditioners is somewhat less than the ownership ratio. For example, ABS returns indicate that 48.7% of households owned either an air conditioner or an evaporative cooler in 2002, with an average of 1.23 appliances each. The corresponding ownership ratio is 0.6 (= .487 * 1.23). This is the ratio of the total number of appliances to the total number of households.

Non-residential sales

It is reasonable to assume that the use of air conditioners by the commercial and industrial (non-residential) sector is undergoing a process of stock adjustment that mimics the process in the residential sector. For example, many schools are being fitted out with air conditioners, and packaged units are displacing cental air conditioning systems in some office buildings. Again, there would be a surge of sales as the stock of airconditioners is adjusted upwards, followed by some moderation of sales as the stock approaches a new equilibrium level and the continuing requirement is to accommodate further commercial and industrial growth and replacement needs.

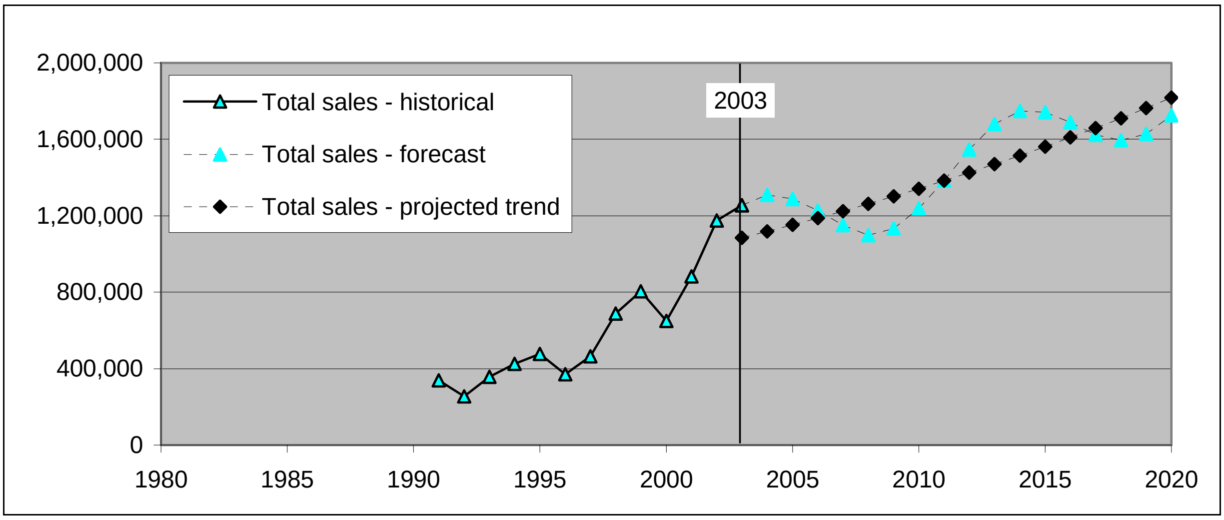
There is no non-residential equivalent of the ABS residential survey. It has therefore been assumed that the non-residential sector maintains a proportional relationship with the residential sector but that its adjustment process lags a few years behind the residential sector. This generates the forecasts of the non- residential sector that is shown in figure A3.1.

Trend growth of total sales

For the purposes of this RIS a trend has been plotted through the projection for total sales that is shown in figure A3.1. The elements have been brought together in figure A3.3. The key features of the projected sales are as follows:

- Total annual sales are shown as increasing 3-fold from about 0.4 million/year in the mid 1990s to 1.2 million/year in 2006.
- The projected trend growth in sales is 3.1%/year. Sales reach 1.3 million in 2010 and 1.8 million in 2020.
- Projected sales are divided 70:30 between the residential and non-residential sectors.

FIGURE A3.3: PROJECTED TREND FOR TOTAL SALES



APPENDIX 4: BASELINE ASSUMPTIONS FOR THE BENEFIT COST ANALYSIS

Sample frame and sample weights

The modelling of costs and benefits has been undertaken for 10 categories of room air conditioner, listed in the first column of table A4.1. The categories differ by size (cooling capacity), type of air conditioner (split or unitary, ducted or non-ducted), and configuration (cooling only or reverse cycle). The breakdown accommodates the various MEPS categories and the available data. However two categories that fall within scope of the regulation have been excluded. These are unitary air conditioners of 7.5-10 kW, both cooling only and reverse cycle, for which no models are recorded on the AGO register and/or few sales are recorded.

Estimates of the aggregate impact are obtained by weighting each of the 10 categories according to projected sales over the life of the regulation. Appendix 3 provides a sales projection for all refrigerative air conditioners – see figure A3.3. It has been assumed that sales of room air conditioners maintain a proportional relationship with total sales, with the proportion set at the level observed in 2002. Specifically, room air conditioners are set at 89% of the total number of units sold, and at 70% of the total cooling capacity that is sold. (It is convenient to conduct the aggregate analysis in terms of the total cooling and heating capacity of each category of air conditioner, rather than in terms of the actual number of units in each group. For example, 100 units with an average cooling capacity of 2 kW are treated as a group of air conditioners with a total cooling capacity of 200 kW.)

Table A4.1 reports the resulting estimate of sales of room air conditioners in 2010, with a breakdown by category of air conditioner. The breakdown is based on industry sales data for 2002 and is assumed constant over the life of the regulation.

TABLE A4.1 ON-TREND ESTIMATE OF SALES OF ROOM AIR CONDITIONERS - 2010

	Total cooling capacity (MW)	Heating capacity (MW)	Output energy (GWh/year)	Input energy (GWh/year)	Total installed cost ($M)
Single phase, non-ducted split					
Cooling only, 0-4kW	194		130	46	66
4-7.5 kW	284		231	86	66
7.5-10 kW	119		97	36	39
Reverse cycle, 0-4kW	663	759	476	168	283
4-7.5 kW	2,223	2,435	1,899	708	678
7.5-10 kW	596	653	509	199	251
Single phase, non-ducted unitary					
Cooling only, 0-4kW	449		300	113	99
4-7.5 kW	263		214	83	46
Reverse cycle, 0-4kW	269	278	183	69	64
4-7.5 kW	309	303	249	95	62
Total	**5,370**	**4,429**	**4,289**	**1,603**	**1,654**

Average characteristics affecting energy use

The average characteristics of the 10 categories of air conditioner are reported in table A4.2.

Size and efficiency

Each group of air conditioners has been assigned the average size and efficiency characteristics of the AGO-registered models within that group. It would be preferable to assign sales-weighted characteristics but sales data are not available at that level of detail. This would not be a significant source of error, given the reasonable expectation that, within each group, the number of models is correlated with the volume of sales.

Household share and average annual operating hours
The estimates of operating hours in table A4.2 have been obtained by putting residential and commercial use at 500 hours/year and 1,500 hours/year respectively, and assigning a household share in the range of 65-85% depending on the size of the air conditioner[12]. For commercial use, the assumption of 1,500 hours per year is conservative relative to US estimates. It is minimum estimate of annual average operating hours observed across all regions in the US – see table A4.3. For residential use, the estimate of 500 hours/year is also borrowed from the US DoE. It is somewhat higher than the average of 400 hours/year that is implicit in an earlier Australian study (EES 1999). However it is a considerable discount on the 750 hours/year used by the industry body in the US, ASHRAE.

Cooling share
The mix of cooling and heating cycles affects energy use, since reverse cycle units have different capacity and efficiency characteristics in the two cycles. The heating cycle is usually more efficient than the cooling cycle. In the absence of any better data, the split has been put at 50:50.

TABLE A4.2 AVERAGE MARKET CHARACTERISTICS - 2004

	Average cooling capacity (kW)	*EER*	*COP*	*Resident-ial share%*	*Annual operating hours*	*Share cooling hours*
	Single phase, non-ducted split					
Cooling only, 0-4kW	3.0	2.82		83%	669	100%
4-7.5 kW	6.0	2.69		68%	815	100%
7.5-10 kW	8.3	2.67		68%	815	100%
Reverse cycle, 0-4kW	3.0	2.70	2.97	83%	669	50%
4-7.5 kW	5.9	2.59	2.76	68%	815	50%
7.5-10 kW	8.3	2.55	2.58	68%	815	50%
	Single phase, non-ducted unitary					
Cooling only, 0-4kW	2.5	2.65		83%	669	100%
4-7.5 kW	5.2	2.59		68%	815	100%
Reverse cycle, 0-4kW	2.8	2.54	2.77	83%	669	50%
4-7.5 kW	5.3	2.53	2.76	68%	815	50%

TABLE A4.3 US REGIONAL ESTIMATES OF COMMERCIAL OPERATING HOURS

Building type	*Regional minimum*	*Regional maximum*	*Weighted average*
Small office	1,411	2,588	1,836
Large office	1,679	2,449	1,973
Small retail	1,120	2,005	1,540
Large retail	1,338	2,264	1,770
Warehouse	1,269	3,535	2,106
Sit down restaurant	1,289	2,882	1,922
Fast food restaurant	1,177	2,240	1,777
Hospital	1,382	2,494	2,025
School	1,110	2,072	1,602
All buildings	**1,515**	**2,201**	**1,801**

Source: Extracted from DoE (2003)

[12] Sales data can only be reconciled with estimates of household ownership by assigning a significant minority of sales to commercial use. Following industry advice, larger shares of the bigger units have been assigned to commercial use.

Energy savings due to the proposed regulation

The benefit cost model deals separately with the energy savings in the cooling and heating cycles. Only the efficiency of cooling cycle (EER) is directly regulated.

Cooling energy

It has been assumed that the efficiency of non-complying units will increase to the point where they achieve borderline compliance with the proposed regulation. In effect it is assumed that two opposing forces cancel out. On the one hand, many of the newly-complying models will deliver higher efficiencies than the required minimum. On the other hand, the monitoring scheme will be less than perfect, allowing the sale of some non-complying units.

Heating energy

It is apparent from examination of the AGO register that the relationship between the EER and the COP is much less than perfect; increases in the EER are not associated with equivalent or proportional increases in COP. It has been assumed that the COP increases by 75% of the increase in EER[13].

Emissions intensity

Estimates of greenhouse emissions are based on projections reported by the Interdepartmental Greenhouse Projections Group (AGO 2003a). The emissions intensity of electricity used is put at 0.97 tonnes CO_2e per MWh in 2000, and projected to decline at 1.2% per year in the period to 2020. This the average of a number of modelling exercises reported by the Projections Group.

Lifecycle cost of energy

The 'lifecycle cost' of energy is the discounted value of the energy that is used over the life of the air conditioner.

Asset lives

Consistent with the analysis of air conditioner sales and stocks, presented in appendix 3, the average service life of room air conditioners has been set at 10 years.

Cost of electricity

Marginal electricity tariffs have been put at 10cents/kWh in the commercial sector and 12cents/kWh in the residential sector, based on analysis of prices reported by the Electricity Supply Association of Australia (ESSA 2003). The average electricity charge then reflects the mix of household and residential use that has been assumed for each type and size of air conditioner.

Discount rate

The discount rate has been set at 6.3% and defined as a *real pre-tax discount rate.* This is the rate adopted by the Australian Building Codes Board for its analysis of energy efficiency measures, based on a report by Australian Building Codes Board[14]. This is a relatively low rate, reflecting a judgement that investments in the energy efficiency of buildings will be somewhat insulated from cyclical fluctuations in economic activity, and are therefore relatively low risk.

Installed cost of air conditioners

Modelling framework

The impact on the cost of air conditioners has been presented as an increase in their installed cost. The installed cost is the cost of manufacture plus the markups applied by wholesalers and by the home builders or other contractors who do the installation. Installation includes the

[13] Professor E Leonardi has provided informal advised that redesign to increase EER should also increase the COP by at least 50% of the increase in EER. The intermediate figure of 75% has been adopted, with testing on the downside at 50%.

[14] Atech (2003), *A Financial Analysis Procedure for Energy Efficiency in Buildings*, Report to the Australian Building Codes Board

costs of installing the airconditioning units themselves, but excludes the cost of ducts, refrigerant pipe-work and the like. Obviously, the installed cost is the price paid by consumers.

The increase in the installed cost has been calculated in four steps:

1. For each of the 10 categories of room air conditioner, a BAU estimate of the installed cost has been extracted from the 22nd edition of *Rawlinsons Australian Construction Handbook* (Rawlinsons 2004).
2. The percentage increase in energy efficiency has been determined for the non-complying models in each of the 10 categories.
3. It has been assumed that there is a relationship between the percentage increase in the installed cost and the percentage increase in energy efficiency, expressed as a ratio of the percentage increase in the installed cost to the percentage increase in energy efficiency. Given an estimate of this ratio, which is discussed further below, the percentage increase in the installed cost is readily calculated. For example, a ratio of 0.25 indicates that 10% increase in efficiency is accompanied by a 2.5% increase in the installed cost.
4. The dollar increase in the installed cost has been calculated by applying the percentage increase in installed cost to the BAU estimate of installed cost.

Ratio of percentage increase in installed cost to percentage increase in efficiency
The relationship between the percentage increases in installed cost and efficiency is obviously critical. Based on a review of the very limited evidence, the following two broad cases have been distinguished:

- In some cases the ratio has been put at 0.25. That is, a 10% increase in efficiency is accompanied by a 2.5% increase in installed cost. This applies to any increase in efficiency required to achieve either the existing 2007 MEPS or the European benchmarks that are ‘next best’ relative to the proposed 2007 MEPS.
- For any further increase from the European benchmarks to the proposed 2007 MEPS, the ratio has been put at 0.33. That is, a 10% increase in efficiency is accompanied by a 3.3% increase in installed cost. This makes an allowance for increasing marginal costs of delivering further increases in efficiency.

Empirical evidence – manufacturing cost of unitary (window/wall) units
It is necessary to separately consider the impacts of increased energy efficiency on manufacturing costs and on markups; most of the on-going costs associated with wholesaler and contractor markups would not be affected by increased efficiency. There are, of course, one-off costs associated with the implementation of MEPS. These are considered separately in sections 4.3 and 5.3 of the report.

The major source of evidence is a series of engineering studies commissioned by the US Department of Energy (DoE) and reported in the following documents.

DoE (1997), *Technical Support Document for Energy Conservation Standards for Room Air Conditioners,* prepared for DoE by LBNL.

DoE (2002), *Technical Support Document: Energy Efficiency Standards for Consumer Product - Residential Central Air Conditioners and Heat Pumps*, prepared for DoE by staff of Arthur D Little Inc. & LBNL.

DoE (2003), *National Energy Savings Spreadsheet: Commercial Unitary Air Conditioner and Heat Pumps,* downloaded from the following website in June 2003.
www.eere.energy.gov/buildings/appliance_standards/commercial/ac_hp.html

The first of these is concerned solely with room air conditioners, but only for the unitary (window/wall) types. These are the dominant form of room air conditioning in the US but have a relatively small market share in Australia. Estimates of the relationship between efficiency and manufacturing costs have been extracted from this study and are summarised in figures A4.1 and A4.2. Note that the estimates have been normalised to express costs relative to a cost of units with an EER of 2.75.

The broad patterns are as follows:

- Significant improvements in energy efficiency can be achieved at relatively low cost, but subsequent improvements are achieved at progressively higher marginal cost.
- The maximum EER of interest in the present context is 2.84, which is the MEPS level now proposed for October 2007. Leading up to that maximum, a 10% increase in efficiency is accompanied by a 4-6% increase in the cost of manufacture.

FIGURE A4.1: MANUFACTURING COST OF UNITARY ROOM AIR CONDITIONERS, COOLING ONLY

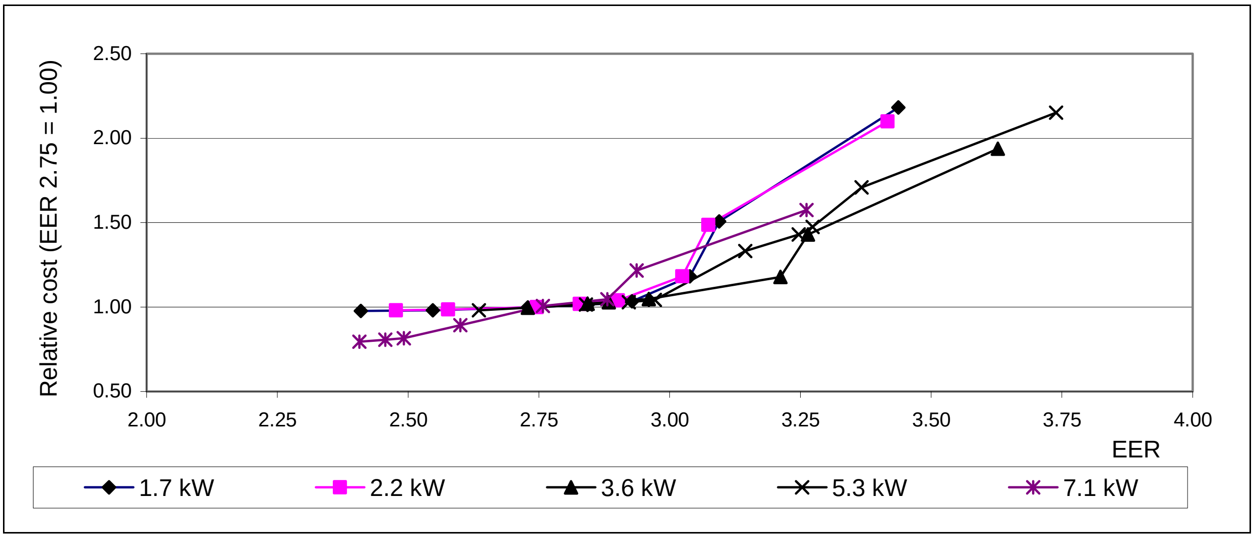
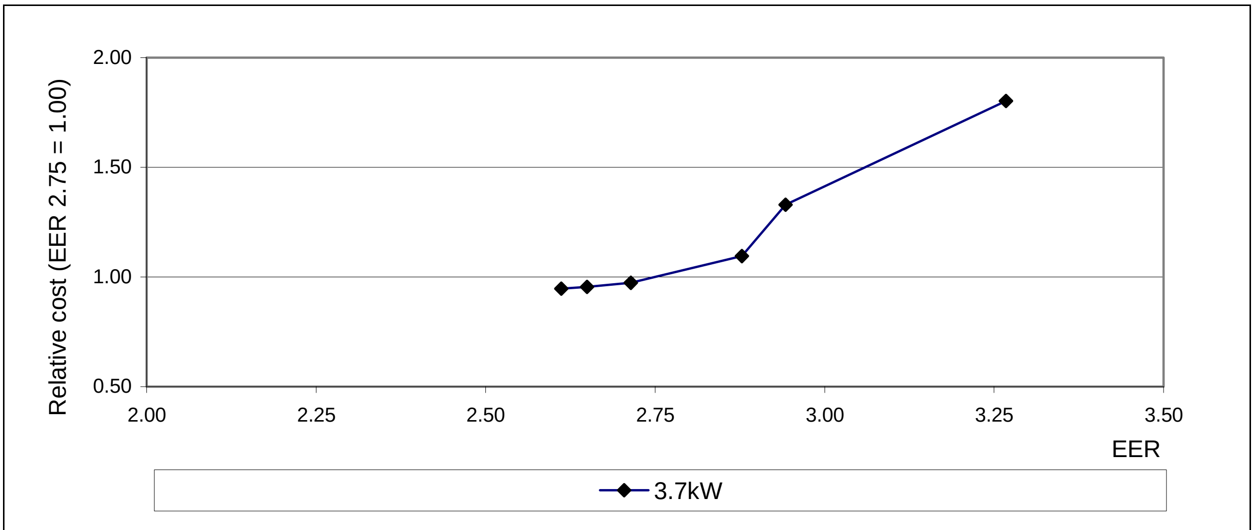


FIGURE A4.2: MANUFACTURING COST OF UNITARY ROOM AIR CONDITIONERS, REVERSE CYCLE



- In addition to the increase in efficiency, the DoE's assessment process usually involved re-designing[15] the sample units in such a way that their output power[16] was increased. That is, for a given input power, the re-designed units had greater cooling capacities. To properly compare like with like it would be necessary to also know what cost savings could be achieved by reducing the input power and restoring the capacity of the sample units to their original level; these were not calculated. It follows that the cost increases reported in figures A4.1 and A4.2 are overestimates of the additional cost of manufacturing a unit of equivalent output capacity.

There are two main exceptions to these broad findings. Firstly, the cost increases are much sharper for units without side louvres. Louvres are stamped on the outdoor section of the cabinet and enhance the movement of air over the outdoor condensing coil, thereby improving efficiency. They are of no use, and can be dispensed with, when the unit is largely embedded in a thick wall. However we understand that louvered units are the norm in Australia and their operation is not impeded when placed through a normal brick veneer wall.

There is also a significant difference between the cooling only and reverse cycle units, with sharper cost increases for the latter. Across the relevant EER range, a 10% increase in efficiency of the reverse cycle unit is accompanied by a 20% increase in manufacturing costs. Again, however, the redesigned units have higher capacity, which means that the potential savings from reducing input power have been ignored. There is also a suggestion in the data that larger cost increases are observed when the increment extends beyond the maximum EER (2.84) of interest to this RIS. The additional increment is small, to an EER of 2.88, but the cost increases are noticeably sharper in the two cases where this occurs – for the reverse cycle units and the largest cooling only units (7.1 kW).

Residential air conditioners of the 'central' or 'ducted' type were addressed in a subsequent DoE report (DoE 2002). These do not fall within the scope of the new Australian proposals, but the findings may be regarded as indicative – see figure A4.3. These estimates indicate that, across the relevant range (up to a maximum EER of 2.84), a 10% increase in efficiency is accompanied by a 7-9% increase in manufacturing costs. The lower figure applies to reverse cycle units in this case. DoE (2003) also commissioned engineering studies of commercial units (26-53 kW), which are very much larger than the residential units considered here. Efficiency increases over the relevant range appear to have no significant impact on manufacturing costs. Both of these studies include appropriate adjustments for the impacts of design changes on output capacity.

Empirical evidence – manufacturing cost of split units
DoE has not reported any analysis of split units that fall within range of the new Australian proposals; splits have only a small share of the US market for room air conditioners. The closest comparison is for the 'central' or 'ducted' type of split unit (DoE 2002) – see figure A4.4.

The maximum EER of interest in this case is 2.93, which falls in the second interval of the estimates shown in figure A4.4. Over this range, a 10% increase in efficiency is associated with an 8.5% increase in the manufacturing cost of two of the sampled units – cooling only units with a fan coil, and the reverse cycle unit. In the remaining case the increase in manufacturing cost is 15%. Again, appropriate adjustments have been made for the impact of design changes on output capacity.

[15] The estimates for room air conditioners were generated by reverse engineering a sample of low efficiency air conditioners, thereby identifying the most cost-effective design changes that will achieve the desired improvements in energy efficiency.
[16] 'Energy' and 'power' are related but different concepts. Energy refers to the total amount of electricity used to complete a particular task such as cooling a given area to a specified temperature. The power of the unit is the rate at which energy can be used.

FIGURE A4.3: MANUFACTURING COST OF UNITARY CENTRAL AIR CONDITIONERS

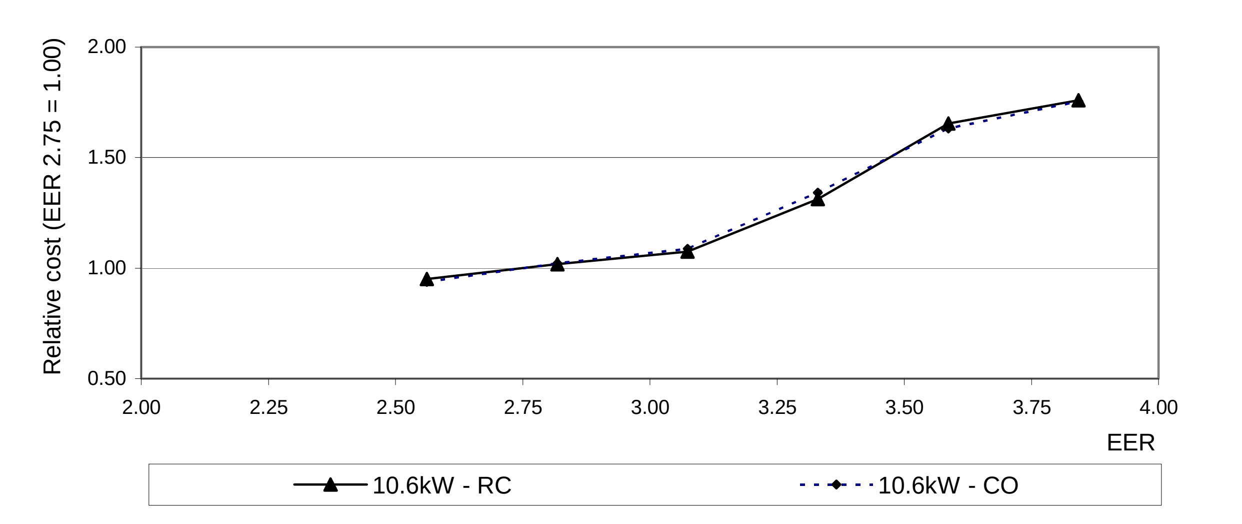
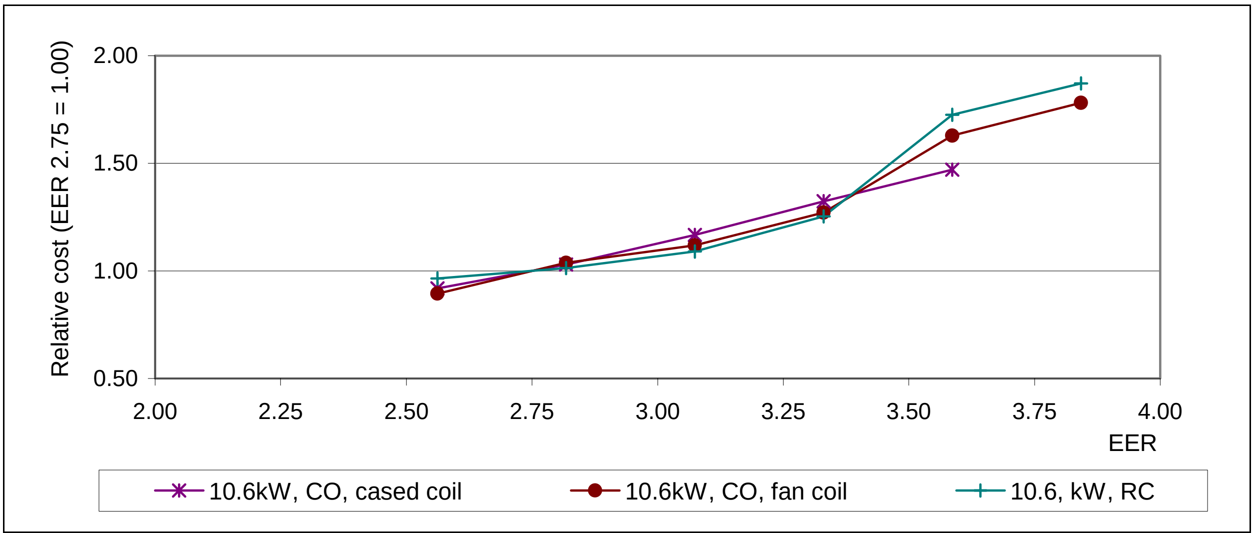


FIGURE A4.4: MANUFACTURING COST OF SPLIT CENTRAL AIR CONDITIONERS



Summary of US evidence on manufacturing costs
Overall, the US estimates indicate that a 10% increase in efficiency is usually accompanied by a 5-10% increase in manufacturing costs. Some of the case studies have returned larger cost increases, up to 20%. On the other hand, the costs estimates are smaller for the only units that fall within scope of the new Australian proposal. Allowing for capacity adjustments to the smaller units, the cost increases would generally be less than 5%.

The obvious gap in the US estimates is the absence of any analysis of room air conditioners of the split type, particularly the smaller (<7.5 kW) reverse cycle units that dominate the Australian market.

Empirical evidence - impact of additional wholesale and contractor costs
In the US studies listed above (DoE, 1997, 2002 & 2003), markups have been applied to the increase in manufacturing costs in a mechanical fashion. That is, it was assumed that the percentage increase in manufacturing costs flows through each of the intermediate stages, generating an equivalent percentage increase in the installed cost. However a change in that approach has been signalled recently, with the publication of a report by LBNL (Dale *et al* 2004). The new report recognises that most elements of wholesaler and contractor costs are

not affected by increases in the efficiency or manufacturing cost of air conditioners and the flow-through effect should be moderated accordingly.

The effect is quite dramatic if wholesaler and contractor costs are unaffected by the increase in manufacturing costs. Given overall baseline markups of 2.75 and 3.17 for commercial and residential products respectively, it follows that the percentage increase in installed cost is about one third of the percentage increase in manufacturing cost[17]. For example, a 7.5% increase in manufacturing cost would be equivalent to a 2.5% increase in installed cost.

However it is unlikely that wholesaler and contractor costs will be entirely unaffected. There will be some additional transport and storage costs if the units are somewhat larger or heavier, and some additional costs associated with more expensive inventory, such as interest, insurance and losses from bad debts. Dale *et al* nominate certain elements of wholesaler and contractor costs that would vary with manufacturing costs, including the following:

- All wholesaler and contractor profits.
- All advertising and promotional expenses
- All vehicle operating expenses of contractors
- All depreciation and repairs to contractor machinery
- All ‘other’ expenses not elsewhere classified.

However we don’t see why these expenses should increase in proportion to the manufacturing costs. Our view is that the impact on wholesaler and contractor costs is uncertain and probably minor, to the point where they can be ignored for the purposes of the base case. The effect is small relative to the sensitivity tests that are reported in this RIS.

Ex-post evidence of regulatory impact on appliance costs
LBNL has also provided DoE with a retrospective review of the regulatory impacts on the market for household appliances, including the impact on financial consumer prices (Meyers *et al* 2002). While the analysis is not statistically sophisticated – being limited to inspection of graphs of average prices over time – there is no evidence that US efficiency regulations have interrupted the steady downward movement in the real cost of household appliances, including for room air conditioners. This is despite clear evidence that the regulations have bite, resulting step changes in energy efficiency at the time of the regulatory interventions. The authors believe that the DoE-commissioned ex-ante assessments have systematically overestimated the actual increase in costs.

Previous Australian studies
There is no Australian work that matches the detailed engineering work reported by DoE. However Unisearch (1998) and GWA (2000) have reported some rough estimates for larger three-phase units used mostly in commercial applications, not overlapping in any way with the units covered by the new Australian proposals. At best, the figuring might be regarded as suggesting orders of magnitude.

Unisearch and GWA put the additional ongoing costs at $50/unit and $100/unit respectively, but with those costs expressed relative to the sum of all air conditioner sales, including both complying and non-complying models. Given that about a third of the sales comprised non-complying units, the implied estimates of the increase in costs *per non-complying unit* are $150 and $300 respectively. GWA reports that the $300 estimate is about 6% of the average retail price, which means that Unisearch puts the increase at 3%. The other key difference between the two estimates is that only GWA is referring to additional production costs, that is, the costs of improved materials and components. Unisearch refers to the $50/unit as the costs of administration, labelling and information activities of both industry and government. The

[17] An overall markup of 3.17 indicates that a unit that cost $1 to produce will eventually be installed for a total cost of $3.17.

published information in the two reports is not sufficient to calculate the implied ratio of percentage increase in installed cost to percentage increase in efficiency.

Conclusion

There is unavoidable uncertainty about the impact of the proposed measures on the installed cost of air conditioners. However, in the light of the available evidence, it seems reasonable to define the base case as follows:

- a 10% increase in energy efficiency is associated with a 5-10% increase in manufacturing costs and the average increase can be put at 7.5%;
- manufacturing costs account for one third of the installed cost, which means that a 10% increase in energy efficiency is associated with a 2.5% increase in the installed cost, and the ratio of percentage increase in energy efficiency to percentage increase in installed cost is 0.25.

The ratio of 0.25 has been adopted to provide an estimate of the impact on the installed cost of any increase in efficiency required to achieve either the existing 2007 MEPS or the European benchmarks that are ‘next best’ relative to the proposed 2007 MEPS. For any further increase from the European benchmarks to the proposed 2007 MEPS, the ratio has been put at 0.33. Sensitivity tests have been reported over a wide range, with a 25% reduction on the downside and a 50% increase on the upside.