



Retrospective Review of the E3 Program

Lessons learnt from two reviews

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**A joint initiative of Australian, State and Territory
and New Zealand Governments.**

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Executive Summary

The year 2011 marks the 25th anniversary of the start of energy rating labelling in Australia and over 12 years since the first Minimum Energy Performance Standards (MEPS). The first regulations for the energy labelling of refrigerators and freezers took effect in NSW in December 1986. The energy labelling of air conditioners began the following year. The first MEPS for refrigerators, freezers and water heaters were implemented nationally in October 1999.

It is based on two detailed evaluation studies carried out in 2010. These assume that there would have been an increase in product energy efficiency even without energy rating labelling or MEPS, and focus on identifying the impacts of those measures. They also compare their findings with the impact projections in the Regulation Impact Statements (RISs) published prior to the implementation of each measure.

Energy savings from these products accounted for about three quarters of the accumulated savings from E3 household energy efficiency measures up to 2008. Therefore the findings have implications for not only the products in question but also are representative of the E3 program as a whole.

For refrigerators and freezers, average energy consumption per new unit sold declined at a rate of 3% per annum between 1993 (when sales data collection began) and the present. Average consumption per unit was 40% lower in 2008 than in 1993. Real average purchase prices declined by 20% to 50% over the same period, depending on product class. This contradicts the hypothesis that forcing up energy efficiency must also force up prices. Nor has there been any apparent reduction in market competition, as indicated by the rising number of models and brands available to the public.

The air conditioner evaluation was restricted to the impacts of increases in MEPS levels between 2003 and 2007, which applied to domestic size models only. It found that the annual rate of increases in sales-weighted efficiency before MEPS was around 0.5%, but rose to around 3% at the time of the 2003/04 MEPS and 4% at the time of the 2006/07 MEPS.

It is estimated that national refrigerator and freezer energy use in 2010 was about 7,330 GWh/yr (or

50%) below the no-measures baseline, and national air conditioner use was 1,730 GWh/yr (9%) below. At the current CO₂-e intensity of the electricity supply system, this represents a combined reduction of about 8.8 Mt CO₂-e/yr in 2010. This is projected to rise to 11.8 Mt CO₂-e/yr in 2020.

The specific MEPS measures evaluated were about twice as effective as projected in the pre-implementation RISs, and the savings were realised without perceptible impact on product prices or any reduction in market choice. This contradicts many of the key assumptions previously adopted by agencies such as the Productivity Commission.

Conclusions

The two program evaluations used the best available data and analytical techniques to estimate the impacts of E3 energy efficiency programs for refrigerators, freezers and the most common types of household air conditioners.

The general findings are:

- The energy efficiency of appliances on the market increased sharply at the times of first implementation of labelling and MEPS, and when MEPS levels increased, directly demonstrating the effect of the measures.
- The cost-effectiveness of regulatory action for both product types was significantly higher than originally projected - about twice as much energy was saved by householders at less cost than projected in the RISs.
- Much of this difference is due to the fact that population and household numbers grew more rapidly than projected in the Regulation Impact Statements (RISs) prepared prior to implementation (which were generally based on Australian Bureau of Statistics (ABS) projections).
- Refrigerator ownership increased somewhat more than projected, freezer ownership declined as projected, but air conditioner ownership increased far more rapidly than envisaged.
- Even so, there appears to have been a consistent conservative bias in past RISs.

There is no evidence that the real price of appliances increased at all as a result of the rise in energy efficiency. The assumption that the Australian public will pay a higher price for

energy efficient goods is not borne out by experience.

- There was no evidence of a reduction in the number of brands or models available, or any other evidence of reduced market competition as a result of the rise in energy efficiency imposed by regulation.

It is recognised that when energy efficiency measures are implemented for a product type for the first time, it is prudent for the analyses to be conservative. However, the same level of conservatism is not necessary for longer standing programs, where previous impacts have been thoroughly evaluated and there is a considerable body of market data.

Although evaluations can be costly, they can increase the administrative efficiency of the E3 program by reducing the resource requirements for future RISs. This resource trade-off could become a formal part of the arrangements between E3 and Office of Best Practice Regulation (OBPR).

Recommendations for future analyses

Data Collection

- E3 should examine the practicalities of requiring suppliers of regulated products to provide sales and other relevant data to enable retrospective evaluations to be conducted in a timely fashion. The New Zealand agency the Energy Efficiency and Conservation Authority (EECA) has such authority under its legislative mandate. This could be used as a model for nationally consistent powers to require sales and related data from suppliers in Australia.

Further Evaluations and Reviews

- All equipment regulations should be regularly reviewed by the E3 Committee for opportunities for further increases impact and effectiveness, even for long-standing measures.
- Retrospective evaluations should become part of the E3 arsenal of evaluation and review where the following circumstances apply:

- The product has been subject to regulation for at least 5 years.

- Data of sufficient reliability and detail are available (either from commercial market monitoring or directly from suppliers).
- The resources required for the evaluation can be recovered (at least in part) by the streamlining of subsequent regulatory proposals for that product (while continuing to comply with Council of Australian Government (COAG) RIS Guidelines).

Revised assumptions in future RISs under the COAG Guideline

On the basis of these evaluations, the E3 Committee should approach OBPR to seek agreement regarding the assumptions embodied in RISs:

- There should not be an automatic presumption in RISs that product prices will increase. Supplier and administrative costs should be factored in (e.g. testing and registration if not previously required, physical labelling) but no increase in equipment prices due to higher efficiency should be presumed, unless there are discrete technology-cost levels and the proposal is forcing consumers to a higher level.
- In markets with a continuous energy efficiency range (as opposed to discrete technologies), it should not be automatically assumed that there will be a reduction in product choice or market competition. The E3 committee should continue to seek supplier views on the post-implementation market impacts of a proposal, but submissions should be considered in the light of the evidence from these evaluations.
- When MEPS or labelling coverage is proposed for a product for the first time, conservative assumptions regarding costs and benefits should still be used, as in the past, to ensure that the proposal if implemented will return a net community benefit.
- For program changes to products already covered by the E3 program, a projected benefit/cost ratio of 1.0 (at OBPR's preferred central discount rate, currently 7%) should be sufficient to demonstrate cost-effectiveness in any future MEPS revisions.

1. Background

Evaluating the E3 Program

The year 2011 marks the 25th anniversary of the start of energy rating labelling in Australia and over 12 years since the first Minimum Energy Performance Standards (MEPS). The first regulations for the energy labelling of refrigerators and freezers took effect in NSW in December 1986. The energy labelling of air conditioners began the following year. The first MEPS for refrigerators, freezers and water heaters were implemented nationally in October 1999.

This report reviews retrospective evaluations of the refrigerator, freezer and air conditioner energy labelling and MEPS programs, which are currently administered by the Equipment Energy Efficiency (E3) Committee consisting of Commonwealth, State, Territory and New Zealand officials. The E3 Program is an element of the National Strategy on Energy Efficiency (formerly the National Framework for Energy Efficiency).

This report is a further step in the ongoing evaluation of the energy labelling and MEPS program. The need for regular evaluation has been acknowledged by the E3 Committee itself, as well as by external reviewers such as the Productivity Commission, which found in its 2005 report on *The Private Cost Effectiveness of Improving Energy Efficiency*:

“...Elements of the National Framework for Energy Efficiency Stage One could result in further improvement, particularly if there is:

- Greater clarity as to the objectives of government intervention.*
- More emphasis on priority setting.*
- Rigorous evaluation of past policies and programs...” (PC 2005)*

Following the Productivity Commission inquiry, the E3 Committee determined to address these perceived shortcomings. In 2008 it sought expert advice from the international consultancy firm Ernst and Young which completed a review of international program evaluation practices and prepared a framework for the ex-post evaluation of appliance and equipment energy efficiency programs (Ernst and Young 2009). Several workshops involving consultants undertaking product evaluations were conducted to test these concepts

with practitioners. Two evaluations consistent with the Ernst and Young framework were undertaken in 2010. The present report notes this history and explores the lessons learnt from the two evaluations.

While the evaluations offer insights into the specific impacts for the subject product groups – refrigerators, freezers and air conditioners – many of the findings can be applied to other equipment types within the E3 program. This report draws the policy implications from the two product evaluations and makes recommendations to the E3 Committee regarding the conduct of retrospective reviews, their relationship to regulatory impact projections and other lessons learned.

How household energy use has changed

In the 25 years since the program commenced, the population of Australia has increased by 44% and the number of households by 66%. Despite the growth in the number, size, quality and complexity of electric equipment and lighting in the average home, and the growth in the average size of the homes themselves, electricity use per household has increased by only 7%, partly due to the success of the E3 program.

This study reviews the experience of the E3 program and its predecessors in increasing the energy efficiency of two key product groups – refrigerators/freezers and air conditioners. The average electricity consumption per refrigerator and freezer has fallen by around 40% over the period, despite the fact that the average volume of products has increased and there has been an almost complete shift from cyclic defrost to frost-free refrigerators, which are more energy intensive.

The air conditioner energy consumption trend is more difficult to read because of the phenomenal growth in ownership over the period. There are now 3.4 times as many refrigerative air conditioners in domestic use throughout Australia as there were in 1986. The average volume of conditioned space per home has grown with floor area, as has the number of air conditioners per dwelling. Reverse cycle air conditioners are fast displacing electric resistance heaters (and in some states, gas heaters) as the preferred mode of winter heating. Under the circumstances, a 27% increase in average air conditioner energy use seems moderate.

Table 1 - Changes in population, appliance stock and energy use 1986 - 2011

	1986	2011	Change
Population (million)	15.9	22.8	44%
Households (million)	5.60	9.28	66%
Persons/household	2.84	2.46	-13%
Electricity/household/yr (kWh)	6,157	6,594	7%
Total Residential Electricity (PJ)	124.1	220.3	78%
Total Residential Electricity (GWh)	34,472	61,198	78%
Total Refrigerator Energy Use (GWh)	5,552	6,254	13%
Refrigerators per household	1.25	1.40	12%
Refrigerator Stock (million units)	7.00	12.99	86%
kWh/yr per refrigerator	793	481	-39%
Total freezer energy use (GWh)	1,996	1,450	-27%
Freezers per household	0.50	0.38	-24%
Freezer stock (million units)	2.80	3.53	26%
kWh/yr per freezer	713	411	-42%
Share of homes with refrigerative air conditioning (a)	25%	57%	126%
AC units per AC owning home (a)	1.24	1.45	17%
Number of refrigerative air conditioners (million)	1.74	7.64	339%
Total residential air conditioning energy (PJ)	2.5	13.9	456%
Total residential air conditioning energy (GWh)	694	3861	456%
kWh/yr/refrigerative AC	399	505	27%

The Measures Evaluated

The E3 program embodies a number of research, policy, administrative, compliance and evaluation functions. The two evaluations reviewed here do not cover ‘internal issues’ such as administrative efficiency. As a shared Commonwealth, State, Territory and New Zealand Government program reporting to the Ministerial Council on Energy, E3 budgets and work programs are subject to continuing scrutiny by all agencies involved. The participating agencies contribute to the budget under an agreed population-based formula, and continue to participate because they obtain the efficiency benefits of consistent and cost-effective regulation across all participating jurisdictions.

The evaluations are concerned with the ‘external’ market impacts of E3 measures. There are several types of potential failure in the markets for energy goods and services that may result in consumers making sub-optimal product purchase choices:

- ‘Imperfect information’ – markets may under supply energy efficient technologies and services because consumers (and sometimes vendors) do

not have access to sufficient or accurate information about their energy efficiency options. Without the correct information buyers are not able to make fully informed choices.

- Split incentives – markets may under supply technologies and services because the person purchasing an energy using technology is different from the person who benefits from its use. Therefore the incentives facing the purchaser differ from those of the user. A landlord for example, may not take full account of the running costs when making decisions about the installation of appliances and equipment.
- Bounded rationality – in an ideal world, individual consumers and producers would have sufficient information and the ability to process that information, to make the most appropriate decisions. But individuals are limited in their ability to obtain and process complex information and to handle the uncertainties that invariably arise in a dynamic and evolving operating environment. In this sense, their rationality is said to be bounded. (PC 2005).

The main objective of energy labelling is to address information failure in appliance markets by ensuring

that consistent and reliable information on comparative energy efficiency is made available to consumers in an understandable format, at the most useful stages in the purchase decision. MEPS are intended to address the market failures of split incentives and bounded rationality.

Since the Productivity Commission report, a number of other inquiries have examined the economic rationale for the E3 Program including Garnaut (2008), Wilkins (2008) and the Prime Minister's Task Group on Energy Efficiency (DCCEE 2010). In general, all of the inquiries have come to the conclusion that market failures are expected to persist even after the introduction of measures to

internalise the costs of greenhouse gas pollution in energy prices. Therefore programs which directly address these market failures should be retained, with or without carbon pricing measures, so long as their effectiveness can be demonstrated.

The 'external' impacts of MEPS and labeling are the differences in the target product markets brought about by the measure, compared to what would have been the case otherwise. The development of each energy labeling and MEPS proposal is documented in pre-implementation studies and regulation impact statements (RISs), and in some earlier post-implementation evaluations.

Table 2 - Energy Efficiency Measures for Refrigerators and Freezers

RIS and Publication Date	Regulatory Measure	
	Refrigerators	Freezers
AMEC (1983) (Predates COAG RIS Process)	Labelling mandatory in NSW and Victoria, 1986	Labelling mandatory in NSW and Victoria, 1987
GWA (July 1993)	MEPS, October 1999	MEPS, October 1999
GWA (December 1999)	Label rescaled 2001	Label rescaled 2001
GWA (October 2001)	MEPS, October 2005	MEPS, October 2005
EES (June 2008)	Label rescaled 2010	Label rescaled 2010
	Next review 2013?	Next review 2013?

NB: Shaded cells indicate measures subject to impact evaluation in EES (2010)

The initial economic cost-benefit studies for energy labeling were prepared in the early 1980s, pre-dating the adoption of national guidelines for regulatory impact analysis. The Council of Australian Governments (COAG), formed in 1992, endorsed its Principles and Guidelines for National Standards Setting and Regulatory Action by Ministerial Councils and Standard-Setting Bodies in 1995.

In 1996 a national governance framework for appliance energy regulation was established – the National Appliance and Equipment Energy Efficiency Committee (NAEEEC) which later evolved into the E3 Committee. All regulatory changes to the program since then have been subject to a RIS process carried out to the published COAG Guidelines and reviewed by the Office of Best Practice Review (OBPR), formerly part of the Productivity Commission and transferred, in 2007 to the Commonwealth Finance and Deregulation portfolio.¹

The introduction of MEPS was one of the measures adopted by COAG in the 1992 National Greenhouse Response Strategy. After considering the recommendations of a cost-benefit analysis (GWA 1993), energy ministers agreed in 1995 that MEPS would be introduced for refrigerators, freezers and electric storage water heaters. Following years of discussions between Commonwealth and State officials and the appliance industry, MEPS finally took effect in October 1999, an interval of over 6 years.

Since then, there has been one revision of MEPS levels and two re-scalings of the energy label for refrigerators and freezers (Table 2). The intervals between RIS publication and implementation have been 1 to 4 years which does not necessarily include the period of investigation leading up to the RIS, which can take several years, and the stages of RIS consultation and review, which can take well over a year.

¹ Some of the first E3 RISs were identified as examples of 'best practice' by OBPR's predecessor.

The progression for air conditioners has been even more complex (Table 3). Refrigerators and freezers effectively comprise a unified group of products, all of which become subject to measures at the same time. By contrast, different measures have been applied to different groups of air conditioners at different times.

Air conditioner labelling was first applied to products intended for household use, which in 1987 was defined as units of up to 7.5 kW cooling capacity. The scope of labelling was subsequently redefined to single-phase units, which with technology changes and increases in energy efficiency began to achieve outputs of 10 to 12 kW. In 2001 MEPS was introduced for 3-phase packaged units up to 65 kW cooling capacity (a measure first recommended in 1994), largely to target non-residential applications. Different MEPS levels were adopted for different output ratings.

As houses have increased in size and their cooling demands have grown (despite efforts to improve building thermal performance) the distinction between residential and non-residential products has blurred. MEPS requirements for different product categories and capacities have progressively been harmonised and simplified, although this process

was disrupted in 2009-10 when the states of South Australia and Queensland adopted different MEPS levels. As a result, air conditioner suppliers have had to deal with more frequent changes in requirements than refrigerator and freezer suppliers.

From October 2011, the air conditioner MEPS regime will be simplified, with only three product configurations (ducted, non-ducted split (including multi-split) and non-ducted unitary), a limited number of output capacity categories and a limited number of MEPS levels.

Energy labelling is now mandatory for single-phase air conditioners but optional for three-phase products. If a product is registered for energy labelling it must be physically tested, but otherwise MEPS compliance for products over 30 MW output capacity may be demonstrated by computer simulation alone. All refrigerators and freezer models must be energy labelled, and a report of a physical test is required for registration for energy labelling and MEPS compliance.

Table 3 - Energy Efficiency Measures for Air Conditioners

RIS and Publication Date	Regulatory Measure	
	Single Phase Units	Three Phase Units
AMEC (1983) (Predates COAG RIS process)	Labelling mandatory in NSW and Victoria, 1987	No requirements
GWA (December 1999)	Label rescaled 2001	No requirements
GWA (September 2000)		MEPS, October 2001, optional labelling
Syneca (August 2003)	MEPS, October 2004	
Syneca (February, June 2005)	MEPS increase, most types April 2006	
Syneca (February, June 2005)	Labelling expanded to non-operating energy, March 2006	
Syneca (February, June 2005)	MEPS increase, other types October 2007	MEPS increase, most types October 2007
EES (April 2009)	MEPS increase April 2010	
EES (April 2009)	Label rescaled 2010	
EES (April 2009)	MEPS expanded to non-operating energy, April 2011	
EnergyConsult (2010)	MEPS increase October 2011	MEPS increase October 2011
EnergyConsult (2010)	Next review 2014?	Next review 2014?

Shaded cells indicate measures subject to impact evaluation in EnergyConsult (2010)

2. Impact Evaluations

Testing Prior Assumptions

Impact evaluations provide an opportunity to test the assumptions and projections of all parties involved in the energy labelling and MEPS process, including the authors of RISs, the E3 Committee and others.

In 2004 the Productivity Commission was commissioned by the Commonwealth Government to '...examine and report on the economic and environmental potential offered by energy efficiency improvements which are cost-effective for individual producers and consumers' (PC 2005). The Commission's report *Inquiry into The Private Cost Effectiveness of Improving Energy Efficiency* made the following observations about appliance energy labelling and MEPS:

“Appliance standards have most relevance where products are purchased infrequently, consumers rarely inspect the appliances in the showroom, and split incentive problems are significant. These conditions may apply for appliances such as electric water heaters (where householders may have little influence on choice), but are less relevant for most other household appliances, such as refrigerators and freezers, and equipment used by commercial and industrial consumers. But it does not necessarily follow that minimum standards will achieve privately cost-effective outcomes for consumers purchasing such appliances. Indeed, it seems counterintuitive that a measure that denies consumers choice and can increase purchase prices could be in their interests.”

Notwithstanding these reservations, many ex ante assessments have alleged that MEPS can generate substantial savings in operating costs and net benefits overall for appliance users. But these assessments depend on what would have happened in the absence of MEPS, and this is largely unknowable. Clearly MEPS will have a dramatic effect when first introduced, but to the extent that they bring forward technological developments that would have occurred anyway, their effectiveness is limited.

Furthermore, higher levels of energy efficiency may only be sustained through trading off other features that consumers value, cost cutting that affects quality, or increases in price.”(PC 2005, xxxvi; emphasis added).

The Inquiry also made the following Finding and Recommendations on appliance labels and standards:

Finding 9.1

Appliance energy performance labels have some influence on consumers after they have short-listed products on the basis of characteristics such as price, performance, capacity and style. While the benefits of labelling may have been overstated in regulation impact assessments, it is likely to have produced net benefits for consumers.

Recommendation 9.1

Future regulation impact assessments of appliance minimum energy performance standards (MEPS) should include a more comprehensive analysis of:

- Whether MEPS reduce competition and how this affects prices and service quality.
- Why individuals with guidance from an energy-performance label are not best placed to judge what is in their best interests.
- Whether a disendorsement label and/or voluntary standard would be a more cost-effective policy and the distributional impacts, including the extent to which MEPS are regressive and prevent consumers from buying products that are more cost effective for them.
- The extent to which individuals are forced to forgo product features they value more highly than energy efficiency should also be reported in regulation impact assessments if MEPS are to continue to be promoted as privately cost effective. (PC 2005, xviii, emphasis added)

Although the Commission's recommendations relate to future RISs, they can only be properly addressed by comparing observed outcomes with the projections and assumption in previous RISs, which is what these impact evaluations have done. The findings enable some light to be cast on the key issues raised by the Productivity Commission, for example:

- The impacts of MEPS are largely unknowable.
- The effectiveness of MEPS is limited.
- MEPS leads to reduced competition.
- MEPS increase purchase prices.
- The benefits of labelling may have been overstated in regulation impact assessments.

Previous E3 Impact Evaluations

The impact of energy labelling on refrigerator and freezer energy efficiency were evaluated as early as 1991 (GWA 1991), and the impacts of the 1999 and 2005 MEPS were evaluated in 2006 (EnergyConsult 2006).

In 2010 EES assessed the impacts of refrigerator and freezer measures on energy efficiency, product price and consumer choice, and compared these outcomes with the projections in the pre-implementation RISs (EES 2010).

Also in 2010, EnergyConsult assessed the impacts of the air conditioner MEPS implemented in 2004 and 2007 on energy efficiency, product price and consumer choice, and compared these outcomes with the projections in the pre-implementation RISs (EnergyConsult).

It is acknowledged that the consultants undertaking the evaluations have previously been involved in preparing RISs for the E3 program. However, E3 ensured that neither consultant evaluated the outcome of measures for which they themselves had prepared the RISs, and required the work to be performed within the evolution framework developed by Ernst and Young (2009). Impartiality was further assured by requiring one of the consultants to work with a UK expert² and having the evaluation reports peer reviewed at the draft stage.

² Dr Kevin Lane worked with EES.

3. Evaluation Findings

Energy

The aim of energy labelling and MEPS is to influence the sales weighted energy efficiency of new product purchases. MEPS will remove the least efficient products, and labels will influence buyers to select the more efficient among those on the market. The measures interact in many ways – energy labelling prompts suppliers to introduce more efficient products than they would otherwise have done (or to introduce them more quickly), and MEPS forces a regrading of labels, because after each increase in MEPS stringency the least efficient products (typically those rated 1 and 2 stars) are excluded from the market.

Ultimately, assessing the impact of energy efficiency measures comes down to the difference between two trends – what energy efficiency would have been in the absence of the measure, and the energy efficiency trend with the measure.

For RISs, both trends are projections, and therefore hypothetical. For evaluations the 'with-measures' trend lines, at least for these products, are known because the E3 program has monitored the retail sales, product characteristics and prices of large household appliances, including refrigerators and freezers, since 1993 (EES 2010). The monitoring of air conditioner retail sales commenced in 2003, but as a large section of the market is supplied by non-retail channels (e.g. specialist installers) the coverage is less complete.

Once a measure is implemented, the 'no-measure' projection trend line becomes hypothetical, so any impact assessment still requires a degree of judgement and a number of assumptions – as is the case with all government programs or market interventions, energy related or other.

The impacts of MEPS changes are easier to demonstrate than labelling changes. They occur more rapidly and they can be more clearly related to dates of implementation, because selling non-compliant product incurs a penalty after that time.

If the shape of a long term energy efficiency trend line is a smooth curve, with sharp upward movements at the times of MEPS implementations, this itself is evidence that MEPS has impacted on a product market. Eventually the 'no-intervention baseline' must catch up, but the energy use, cost and emissions avoided by forcing the efficiency improvements earlier than the market would otherwise have delivered them are permanent savings.³

EES (2010) detected sharp upward movements in product energy efficiency trends in response to both the 1999 and 2005 MEPS. The study was also able to detect a sharp increase in the energy efficiency of refrigerators and freezers in the early 1980s, as suppliers removed their least efficient appliances from the market in anticipation of labelling. In that respect, the initial introduction of labelling can be seen to act on product suppliers in the same way as MEPS, and produced a similar upward movement in efficiency even before consumers become aware of the energy label.

The ongoing impact of energy labelling on consumer purchase behaviour is more difficult to ascertain. For energy labelling to impact on buyers (as distinct from suppliers) a proportion of buyers must see the labels or become aware of the ratings from websites or advertising, and must act on that information. In 2006, 88% of appliance buyers said that they referred to the energy label during the search or final decision process (Artcraft 2006). A 2009 survey indicated that about 98.5% of refrigerators and freezers on display in showrooms carried an energy label (E3 2009a). The conditions for the label to be effective were definitely present for refrigerators and freezers, and this was taken into account in the impact evaluation (EES 2010).

The conditions for labelling to be effective are somewhat weaker for air conditioners. A smaller proportion are sold through retail showrooms, where buyers can easily compare different products, and the rate of labelling in showrooms is somewhat

³ For products that are not subject to continuous technology improvement due to global market competition, increases in energy efficiency may not actually occur at all in the absence of MEPS. For example, electric storage water heaters are all built to the same maximum heat loss levels in the Australian Standard, and may never have increased in efficiency had not MEPS raised that standard.

lower: a 2010 survey indicated that about 89% of air conditioners carried an energy label (E3 2011).⁴

The data for assessing the impact of labelling on the air conditioner market is also weaker. EnergyConsult reports that 'The lack of sales data prior to 2003 also meant it was not possible to assess the impact of [labelling] on air conditioner efficiency, therefore the study focuses on the impacts of the 2004 and 2006/07 MEPS.'

The lowest line on Figure 1 illustrates the best estimate of the energy use of the Australian household refrigerator and freezer stock, given the combined impact of all energy efficiency measures all measures in place to 2010. The top-most line indicates the estimated baseline on the assumption that the 'autonomous' energy efficiency improvement would have been low, and the next line down the assumption that autonomous energy efficiency improvement would have been high. Even now, the impact of labelling is higher than the impact of the 1999 and 2005 MEPS, because labelling caused such a major market change in the early 1980s, and because it has been in effect for so much longer.

Figure 2 illustrates the equivalent estimates for all air conditioner programs - not just the measures evaluated in EnergyConsult 2010 (i.e. those shaded in Table 3).⁵ The same vertical scale is used as for refrigerators, to better compare the energy impacts for the two product groups.

Figure 3 and Figure 4 (to different vertical scales) illustrate the energy savings from each measure, i.e. the differences between the trend lines in Figure 1 and Figure 2. It is estimated that national refrigerator and freezer energy use in 2011 is up to 7,700 GWh/yr (or 50%) below the no-measures baseline, and national air conditioner use is up to 1,700 GWh/yr (9%) below. At the current CO₂-e intensity of the electricity supply system, this

⁴ The technical accuracy of the information on the label is a separate issue. Buyers could select products which appear to be more efficient from the label, but if the efficiency is over-stated (inadvertently or deliberately) there may be no energy benefit from preferring the model to another which is correctly labelled but appears to have a lower rating. Over-stating efficiency can also indicate that a model meets MEPS when it does not. The E3 Program enforces monitors technical compliance though check testing.

⁵ The impacts of MEPS for close control air conditioners and chillers are not included.

represents a combined reduction of about 8.8 Mt CO₂-e/yr in 2010, rising to 11.8 Mt CO₂-e/yr in 2020.

Previous RISs have routinely embodied the assumption that if a regulatory proposal forces an increase in product energy efficiency, this will be accompanied by an increase in average product price, or a reduction in consumer choice, at least until the market adjusts. This assumption seems to be a reasonable primary hypothesis and builds a conservative bias into cost-benefit analyses. In the past, it has been maintained even when statistical analyses of all the models on the market prior to the implementation of MEPS found no relationship between price and efficiency.

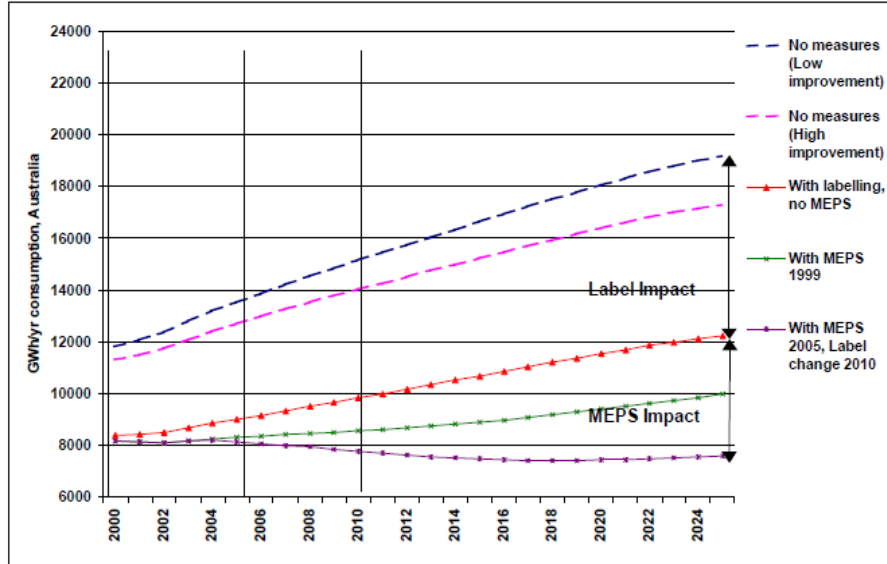
The Productivity Commission and others have also generally assumed that the imposition of mandatory energy efficiency measures, especially MEPS, must have some negative consequences for suppliers and buyers through higher prices or reduced consumer choice (see previous section).

However, neither the refrigerator/freezer evaluation nor the air conditioner evaluation found any evidence of this. There has been a general decline in the real price of all appliances (and most other manufactured goods) over the period that the energy efficiency measures have been in place.⁶ The refrigerator/freezer evaluation analysed trends for 10 separate product categories, and the air conditioner evaluation for four.⁷

⁶ A slightly faster fall in real purchase prices may have occurred in the absence of MEPS, but it is not possible to prove this one way or the other, although the trend in prices is generally smooth and does not show any significant reaction to the introduction of stringent MEPS in 2005. This does not mean that infinite efficiency gains can be made at zero marginal purchase cost. However, it does imply that mandatory increases in efficiency, within the bounds of what is technically available on the market (best available technology) can, with sufficient notice to industry, continue to be made at very low marginal costs' (EES 2010).

⁷ The only category where prices increased more or less as predicted in the RIS was frost-free freezers, which represent a very small share of the total household refrigeration market.

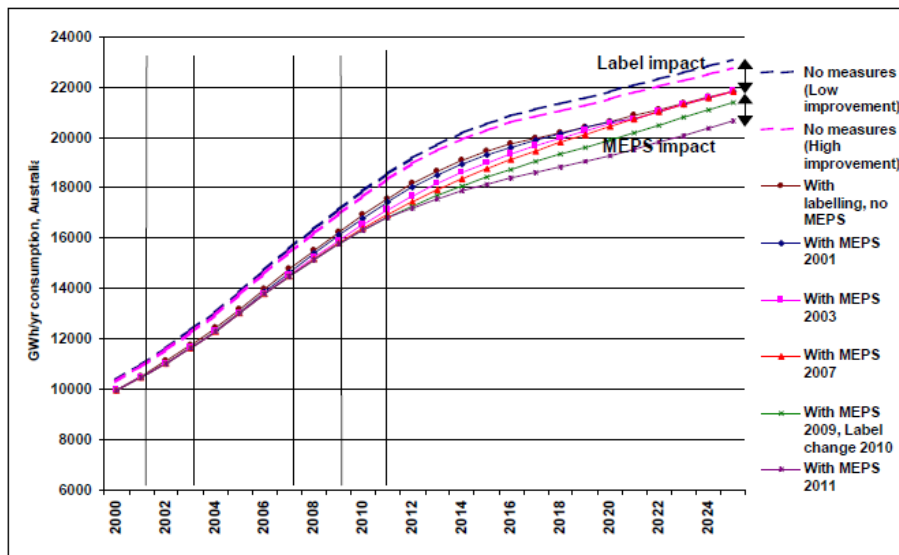
Figure 1 - Energy use with and without measures - refrigerators and freezers



Note: Data to 2020 from EES (2010) – projection to 2025 by GWA

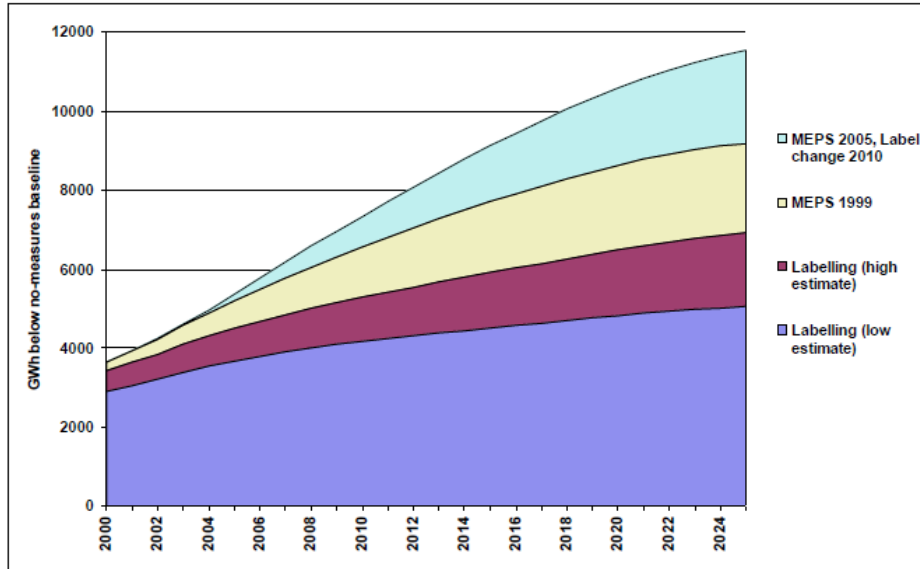
While there are differences by category, the average price of refrigerators and freezers declined at a rate of 2.5% to 5.0% per annum between 1993 (when data collection began) and the present, while average energy consumption declined at 3% per annum. In 2008 average real (inflation-adjusted) purchase price was 20% to 50% lower than in 1993, while average energy use per unit was about 40% lower (EES 2010). This contradicts the hypothesis that forcing up energy efficiency must also force up prices. Nor has there been any reduction in the number of models or brands or refrigerator and freezer available to the public, even after the introduction of stringent MEPS levels in 2005.

Figure 2 - Energy use with and without measures, air conditioners



Note: Energy use without labelling and MEPS 2001 estimated by GWA – other estimates derived from EnergyConsult (2010, 2010a)

Figure 3 - Estimated energy savings, refrigerator and freezer energy efficiency measures

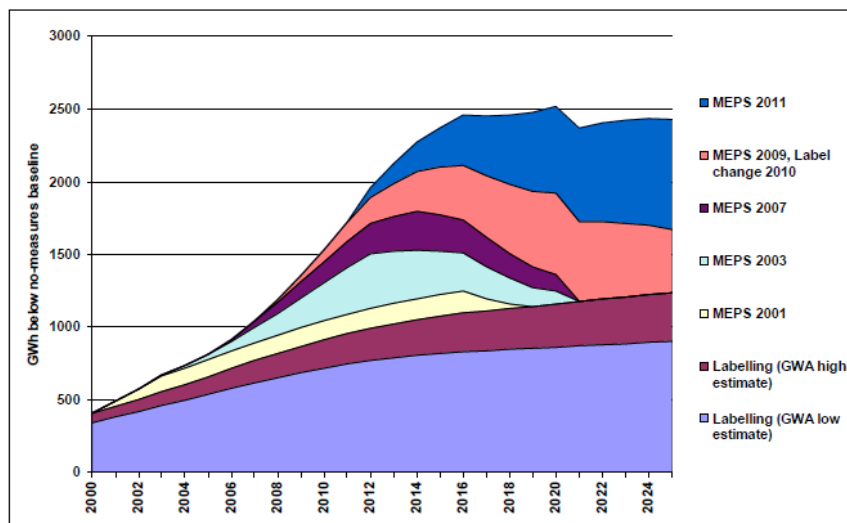


The air conditioner evaluation found that MEPS:

- Did not generally affect the price of air conditioners. However, it is possible that the 2006/07 MEPS slowed the rate of decline in air conditioner prices, but other market trends may equally have been the cause of changes in price trends over 2005-2008.
- Did not affect the number of models available in the marketplace and hence did not appear to affect consumer choice (EnergyConsult 2010).

These findings are likely to apply to all products for which there is a continuous range in energy efficiency, as is the case for refrigerators, freezers and air conditioners. They would not necessarily apply to products for which there are distinct technologies, with discrete levels of energy efficiency (e.g. water heaters, lamps).

Figure 4 - Estimated energy savings, air conditioner energy efficiency measures



Note: Energy labelling and MEPS 2001 estimates by GWA, on assumption that energy labelling is about a third as effective for residential air conditioners as for refrigerators. MEPS 2003 and 2007 estimates (shaded) from EnergyConsult (2010); MEPS 2009 and 2011 estimates from EnergyConsult (2010b).

Comparison with pre-implementation projections

The evaluations also reviewed the accuracy of the energy efficiency & product price impact projections in the pre-implementation RISs. In general:

- The impacts on product energy efficiency trend were reasonably accurate.
- The total energy savings were significantly underestimated, because growth in population and household numbers (generally based in the best ABS data available at the time) were

underestimated, there were differences in product mix and size, and especially for air conditioners, the rate of household take-up was underestimated.

- The impacts on product prices were greatly overestimated (see preceding section).

Table 4 summarises estimated energy impacts in 2010, & compares them with the impacts projected prior to implementation. The combined impacts are twice as high as projected, largely because of higher than expected growth in population and appliance ownership.

Table 4 - Comparing actual and predicted impacts of measures in 2010

Energy Efficiency Measure	GWh below BAU 2010 (a)		Actual / Projected
	Projected in RIS	Actual (estimated)	
Refrigerator & Freezer MEPS 1999	550	1250	2.3
Refrigerator & Freezer MEPS 2005	500	750	1.5
Air Conditioner MEPS 2003 – 2007	162	410	2.5
Combined	1212	2410	2.0

(a) Compared with non-implementation i.e. baseline includes effect on all preceding measures

Conclusions regarding pre-evaluation assumptions

Comparing the evidence of the evaluations with previous assumptions made by the Productivity Commission (PC 2005) & others leads to the following conclusions:

Hypothesis: ‘That the impacts of MEPS are largely unknowable’.

Conclusion: While there may be some uncertainty about the longer term impacts, the magnitude of the impacts around the time of implementation are clearly evident in the data.

Hypothesis: ‘That the effectiveness of MEPS is limited’.

Conclusion: This is strictly correct, if it is assumed that each MEPS increment brings forward efficiency improvements that would eventually have occurred anyway. The ‘no intervention’ trend line would have caught up at some point, after which there will be no further benefit, although the energy savings realised up to that point are real and permanent. There is

nothing to prevent repeated raising of the MEPS levels (at reasonable intervals) to secure additional permanent tranches of savings. In this respect the potential of continually raising MEPS levels as a regulatory strategy is effectively unlimited, at least up to the point where technological barriers are approached. Even then, forcing the market from one discrete efficiency level to the next may be both possible and cost effective, depending on product costs and energy prices.

Hypothesis: ‘That MEPS leads to reduced competition’.

Conclusion: The evaluations found no evidence of a reduction in the number of models or the number of brands available to consumers after the introduction of each successive MEPS. The numbers of models and brands have actually increased over time.

Hypothesis: ‘That MEPS increases purchase prices’.

Conclusion: The evaluations found no evidence of any departure from the long term declining trend in the real price of refrigerators, freezers and air

conditioners at times of MEPS implementation (with the exception of one category of freezer).

Hypothesis: ‘The benefits of labelling may have been overstated in regulation impact assessments’.

Conclusion: As the original projections of energy labelling impacts were carried out in the early 1980s, over a decade before national guidelines for RISs were established, and sales data collection did not begin until 1993, it is not possible to form a definite view on whether the impacts of labelling were overstated. For MEPS, the two evaluations found that the benefits were significantly understated in regulation impact assessments.

4. Implications for the E3 Program

Wider applicability of evaluations

The findings of the two evaluation studies reviewed in this report are applicable to the wider E3 program because they cover a long time span, analyse several market interventions and the products involved cover about three quarters share of the total energy savings delivered by the E3 program to date.

The refrigerator and freezer evaluation covers the entire program impact on those appliances from the original introduction of energy labelling 25 years ago, through two separate MEPS implementations and two label rescalings, involving five RIS projections. The air conditioner evaluation is somewhat more limited in scope, but it still covers a period of over 16 years, three separate MEPS implementations and two RIS projections.

Evaluations of this type are only possible if there is data on the retail sales (or other means of supply to the market) of nearly every model for which energy efficiency characteristics are known. This enables the development of a reliable 'with measures' trend line, so only the 'no-intervention' baseline remains uncertain (as it always will).

The E3 program has been able to purchase model-level retail sales data since 1993 for refrigerators, freezers, dishwashers, clothes washers and clothes dryers, and since 2003 for some categories of air conditioner. It is understood the data are also being collected for televisions, which became subject to MEPS and labelling in 2009.

No comparable data is available for the other products covered by the E3 program. The data is particularly poor for non-residential equipment, which are generally supplied direct from the manufacturer or through non-retail distribution channels, which are difficult and expensive to monitor.

Governments are currently considering the inclusion of data collection powers in the proposed national legislation for MEPS and labelling that would replace the current patchwork of State and Territory regulations. One of the recommendations in the RIS for the new legislation is 'The new regulatory framework should include requirements for suppliers of registered products to report annually on the national import, sales or supplies of each registered model' (GWA 2010). This regulatory power already exists in New Zealand, where the

Energy Efficiency and Conservation Authority (EECA) has been collecting data for several years.

It is important that systematic data collections are implemented as soon as possible, to allow evaluations of program impacts on non-residential products to proceed.

For the products that have been evaluated – refrigerators, freezers and air conditioners in this instance – it is clear that there is now enough accumulated data on energy use, appliance technology and the product markets to predict, with reasonable confidence, the impacts of future energy efficiency measures. This should no longer be seen as a speculative area, and for mature programs with a long history it should no longer be necessary for regulatory impact analyses to go back to first principles each time. There should be a presumption that market interventions which have been shown to be effective and cost-effective can be repeated with further success, unless a RIS finds that market conditions or technology have so changed that this is no longer the case.

In the past this process has been easier to approximate for refrigerators and freezers, which are all part of the one unified product group, than for air conditioners. Once the 2011 MEPS are implemented for air conditioners, the MEPS regimes for different product categories will be unified and simplified, and conflicting state requirements should be reconciled.

The E3 program should then aim to maintain this nationally harmonised MEPS regime, and maintain and increase its impact over time.

Conclusions

The two program evaluations have used the best available data and analytical techniques to estimate the impacts of E3 energy efficiency programs for refrigerators, freezers and the most common types of household air conditioners. The general findings are:

- The energy efficiency of appliances on the market increased sharply at the times of first implementation of labelling and MEPS, and when MEPS levels increased, directly demonstrating the effect of the measures.
- The cost-effectiveness of regulatory action for both product types was significantly higher than originally projected – about twice as much energy

- was saved by householders at less cost than projected in the RISs.
- Much of this difference is due to the fact that population and household numbers grew more rapidly than projected in the Regulation Impact Statements prepared prior to implementation (which were generally based on ABS projections).
- Even so, there appears to have been a consistent conservative bias in past RISs.
- Refrigerator ownership has increased somewhat more than projected, freezer ownership has declined as projected, but air conditioner ownership has increased far more rapidly than envisaged.
- There is no evidence that the real price of appliances increased at all as a result of the rise in energy efficiency. The assumption that the Australian public will pay a higher price for energy efficient goods is not borne out by experience.
- There was no evidence of a reduction in the number of brands or models available, or any other evidence of reduced market competition as a result of the rise in energy efficiency imposed by regulation.

When energy efficiency measures are implemented for a product type for the first time, it is prudent for the analyses to be conservative to ensure the community benefits even in a worst-case scenario. However, the same level of conservatism is not necessary for proposed changes to longer-standing programs, where previous impacts have been thoroughly evaluated and there is a considerable body of market data.

While the E3 program must comply with the COAG Guideline for RISs and cost-benefit projections, there is no formal requirement to undertake retrospective evaluations other than as an element in internal 'best practice' reviews. Although evaluations are costly, they can increase the administrative efficiency of the E3 program and even reduce the resource requirements for future RISs. This resource trade-off could become a formal part of the arrangements between E3 and OBPR.

For products where regulation to increase energy efficiency is proposed for the first time, it is certainly appropriate for the RIS to canvass a broad range of alternatives, and to err on the conservative side in cost-benefit analysis.

For products where sufficient experience and data have accumulated and evaluations have been carried out, subsequent proposals to increase MEPS levels or otherwise alter regulatory arrangements can be much more concise while still meeting COAG Guidelines. It should be sufficient to update population and household growth projections and energy price projections, and review market and technology trends, and then determine the best options for maintaining the impacts of the program – whether by more stringent MEPS levels, label re-scaling or both. A target benefit/cost ratio of 1.0 should be adequate given the experience in these retrospective evaluations.

It is likely that a regulation will need to be in place for several years before sufficient data has accumulated to attempt an evaluation – possibly two MEPS review cycles which would usually be between 4 to 6 years. Given the limitations of E3 resources, it may be reasonable to aim for every product included in the program to be evaluated after not less than 5 and not more than 7 years after first implementation, provided data has been collected (or can be purchased). More stringent MEPS could still be implemented before a full evaluation, if conservative cost-benefit analysis supports it.

The E3 committee should also reflect on the relationship between impact assessment and compliance enforcement. The evaluation studies are based on the assumption that actual product energy efficiency matches the registered value. This is known not to be so in all cases – over the years, the compliance testing regime has revealed several instances where suppliers have over-stated product efficiency to the extent that they have had to re-label models or remove them from the market entirely (GWA 2010, E3 2009b). If the differences between reported and actual efficiency are more or less constant, then the trends in Figure 1 to Figure 4 are valid, even if the absolute values are displaced slightly. However, if it is found that the tendency to misstate performance has changed over time, some adjustment may be required to the impact estimates.

Recommendations for future analyses

Data Collection

- E3 should examine the practicalities of requiring suppliers of regulated products to provide sales

and other relevant data to enable retrospective evaluations to be conducted in a timely fashion. (The New Zealand agency, the Energy Efficiency and Conservation Authority has such authority under its legislative mandate. This which might be used as a model for nationally consistent powers to require sales and related data from suppliers in Australia).

Further Evaluations and Reviews

- All equipment regulations should be regularly reviewed by the E3 Committee for opportunities for further increases impact and effectiveness, even for long-standing measures.
- Retrospective evaluations should become part of the E3 arsenal of evaluation and review where the following circumstances apply:
 - The product has been subject to regulation for at least 5 years.
 - Data of sufficient reliability and detail are available (either from commercial market monitoring or directly from suppliers).
 - The resources required for the evaluation can be recovered (at least in part) by the streamlining of subsequent regulatory proposals for that product (while continuing to comply with COAG RIS Guidelines).

Revised assumptions in future RISs under the COAG Guideline

On the basis of these evaluations, the E3 Committee should approach OBPR to seek agreement regarding the assumptions embodied in RISs:

- There should not be an automatic presumption in RISs that product prices will increase. Supplier and administrative costs should be factored in (e.g. testing and registration if not previously required, physical labelling) but no increase in equipment prices due to higher efficiency should be presumed, unless there are discrete technology-cost levels and the proposal is forcing consumers to a higher level.
- In markets with a continuous energy efficiency range (as distinct from discrete technologies), it should not be automatically assumed that there will be a reduction in product choice or market competition. The E3 committee should continue to seek supplier views on the post-implementation market impacts of a proposal, but submissions should be considered in the light of the evidence from these evaluations.

- When MEPS or labelling coverage is proposed for a product for the first time, conservative assumptions regarding costs and benefits should still be used, as in the past, to ensure that the proposal if implemented will return a net community benefit.
- For program changes to products already covered by the E3 program, a projected benefit/cost ratio of 1.0 (at OBPR's preferred central discount rate, currently 7%) should be sufficient to demonstrate cost-effectiveness in any future MEPS revisions.

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