FINAL

REGULATORY IMPACT STATEMENT:
Minimum Energy Performance Standards and Alternative Strategies for
LINEAR FLUORESCENT LAMPS

Prepared for the Australian Greenhouse Office
by
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GLOSSARY and ABBREVIATIONS

BaU	Business as usual
CFL	Compact fluorescent lamp
CO^2e	Carbon dioxide equivalent units
E2G2	Working Group for Energy Efficiency and Greenhouse Gas
Efficacy	A measurement of the efficiency with which electrical power is converted into visible light. Measured in lumens per watt (lm/W)
HVAC	heating, ventilation and air conditioning
Lumen (lm)	Unit of measurement of the visible radiated power (also known as luminous flux) emitted by a light source
Lux	Unit of measurement of illuminance, which is the ratio between the luminous flux and the area to be illuminated. An illuminance of 1 lux occurs when a luminous flux of 1 lumen is evenly distributed over an area of 1 square metre
mA	Milliamperes, unit of electrical current measurement
MCE	Ministerial Council on Energy
MEPS	Minimum energy performance standards
Mt	Mega-tonne (metric) = 1,000 tonnes
NAEEEP	National Appliance and Equipment Energy Efficiency Program
NZ	New Zealand
Ra	Colour rendering index. A measure of the correspondence between the colour of an object and its appearance under a reference light source. To determine the Ra values, eight test colours defined in accordance with DIN 6169 are illuminated with the reference light source and the light source under test. The smaller the discrepancy, the better the colour rendering property of the lamp being tested. A light source with an Ra value of 100 displays all colours exactly as they appear under the reference light source. The lower the Ra value, the worse the colours are rendered.
t	tonne (metric)
TTMRA	Trans-Tasman Mutual Recognition Agreement
UNFCCC	United Nations Framework Convention on Climate Change
UV	Ultra-violet light
Watt (w)	Unit of measurement of power (in this context electrical power)

1 THE PROBLEM

1.1 Energy-Related Greenhouse Gas Emissions

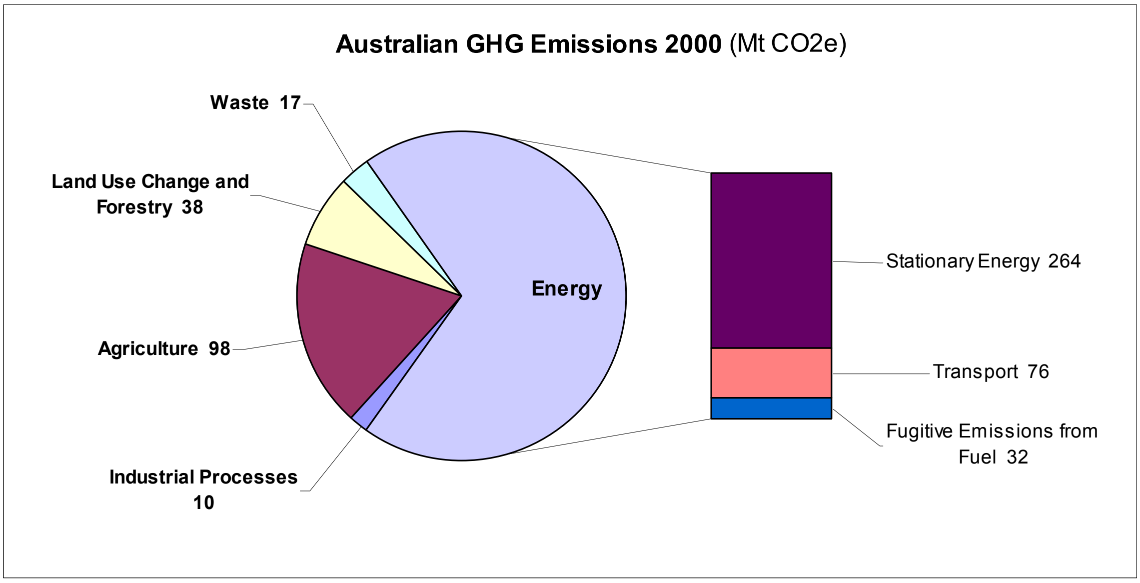
In recognition of the risks and costs of climate change, Australia accepts its fair share of the global task to reduce greenhouse gas emissions below what they would otherwise be in the 'business as usual' (BaU) scenario. The Australian Commonwealth, State and Territory governments adopted a National Greenhouse Strategy to give effect to this objective (NGS 1998).

The United Nations Framework Convention on Climate Change (UNFCCC) was agreed in 1992 and came into force in 1994. It places much of the responsibility for taking action to limit greenhouse gas emissions on the developed countries, including Australia, which are collectively referred to as Annex 1 countries. Annex 1 countries are required to report each year on the total quantity of their greenhouse gas emissions and on the actions they are taking to limit those emissions.

The Kyoto Protocol to the UNFCCC was agreed in December 1997, but has not been ratified by the required number of its signatories to bring it in to force. The Australian Government has announced its reasons for not ratifying the Kyoto protocol though it is committed to meeting the greenhouse reduction target for 2008 – 2012 (Kemp 2003).

Figure 1 shows estimated Australian greenhouse gas emissions by sector for 2000. The estimated total greenhouse gas emissions for 2000 is 535 million tonnes of CO_2-e (NGGI 2000). Emissions have increased by 2.1% from 1999 to 2000 and by 6.3% from 1990 to 2000 (NGGI 2000). The stationary energy sector represents the greatest contribution to Australia's greenhouse gas emissions, as illustrated in Figure 1.

Figure 1 - Australian Greenhouse Gas Emissions by Sector 2000 (Source: NGGI 2000)



ABARE 2003 projects total electricity use to increase by an average of 2.2% p.a. between 2001 and 2020. Energy use the commercial and services sector is projected to increase by 2.5% p.a. and by 2.2% in the manufacturing sector. Slowing, and ultimately reversing, the growth in electricity-related emissions is thus a high priority in Australia's greenhouse gas reduction strategy.

1.2 Contribution of Linear Fluorescent Lamps to Emissions

Lighting represents a considerable proportion of electricity use in Australia, and therefore is a significant contributor to greenhouse gas emissions. Table 1 (reproduced from GWA 2001) lists estimated greenhouse gas emissions from the residential and business sectors, by end-use, for years 1990, 2000 and 2010.

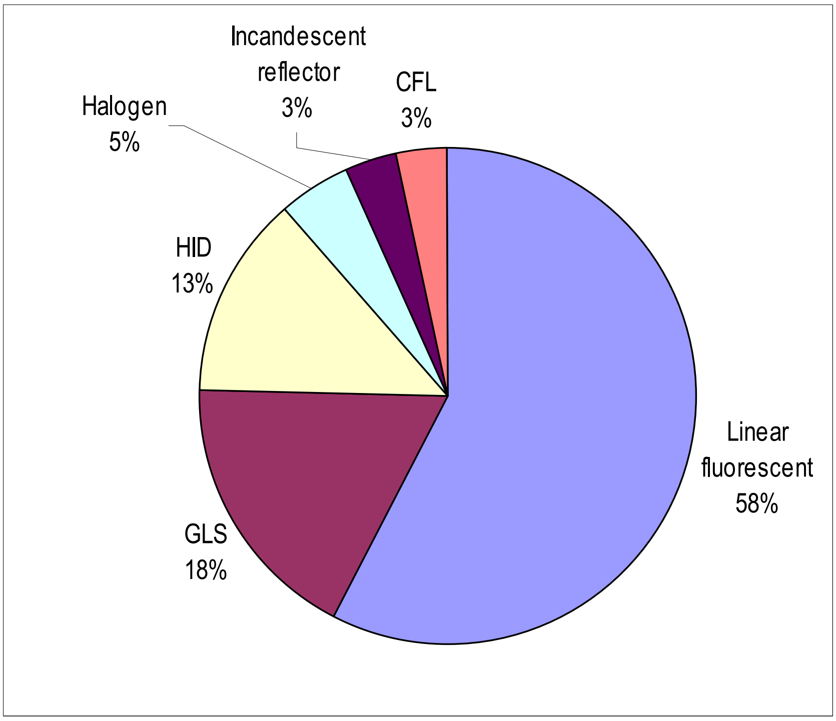
Table 1 - Estimated end uses of residential and commercial energy, 1990 - 2010

Energy end use	Res-1990	Com-1990	Res - 2000	Com-2000	Res-2010	Com-2010
HVAC - electric	7.1	59.4	8.4	83.3	9.1	110.3
Heating - fuels	91.5	46.5	121.8	65.0	143.3	85.5
Water heating, cooking	90.2	9.8	105.3	13.1	114.7	16.6
Lighting	12.9	22.4	15.8	35.3	17.7	52.5
Appliances, other	68.7	13.1	84.2	18.3	94.5	24.0
Total – all energy types	270.4	151.2	335.5	214.9	379.3	288.9
Total electricity	140.0	97.5	162.2	140.3	173.7	191.7
Lighting proportion of total electricity	**9.2%**	**23.0%**	**9.7%**	**25.2%**	**10.2%**	**27.4%**

(source: GWA 2001 using EMET 1999 and EES 1999)

Figure 2 illustrates the estimated contribution to Australian greenhouse gas emissions of various lamp types in 2000. Included are the estimated indirect effects of lighting on emissions from air conditioning.

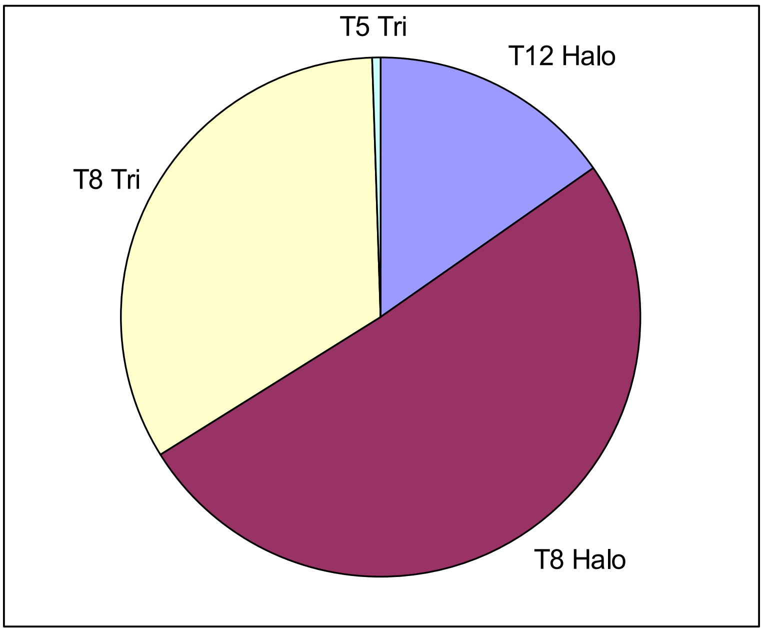
Figure 2 – Contribution of Lamp Types to Greenhouse Gas Emissions in Australia



(source: MEA 2001)

From MEA 2001, and from calculations derived from the stock model constructed for this report, linear fluorescent lamps (including indirect air conditioning effects) are responsible for the consumption of between 10,000 and 13,000 GWh per annum and the emission of around 2.5% of Australia's total greenhouse gas emissions. Figure 3 illustrates the estimated proportions of linear fluorescent lamp (and associated air conditioning) energy consumption for each lamp type, based on the stock estimates discussed in section 3.1.

Figure 3 – Estimated Energy Consumption Proportions of Linear Fluorescent Lamp Types



From Figure 3 it is evident that halophosphate lamps consume around two-thirds of the total energy consumed by linear fluorescent lighting in Australia (including air conditioning effects). Given these estimations, it is reasonable to conclude that linear fluorescent lamps, and in particular halophosphate lamps, are worthy of efforts to improve their overall efficiency.

1.3 NAEEEP Abatement Strategy

Regulation of linear fluorescent lamps is an element of the National Appliance and Equipment Energy Efficiency Program (NAEEEP). NAEEEP is part of the National Greenhouse Strategy, which targets the energy efficiency of consumer appliances as well as industrial and commercial equipment. The primary tools of the Program are mandatory energy efficiency labelling and minimum energy performance standards (MEPS), as well as voluntary measures including endorsement labelling, training and promotion of efficient products.

NAEEEP's governance structure is as follows:

> The Program is the direct responsibility of the National Appliance and Equipment Energy Efficiency Committee (NAEEEC), which comprises officials from the Commonwealth, State and Territory government agencies, together with 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 overall policy and budget of the national program.

NAEEEP relies on State and Territory legislation to give it legal effect. This use of state and territory laws involves using the relevant Australian Standard for the specific product type, which is called up as mandatory by State and Territory legislation.

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.

Lighting meets many of these criteria and hence the lighting strategy occupies a key position in NAEEEP. Lamp regulation is part of a the lighting strategy, which aims to holistically reduce greenhouse gas emissions from lighting systems. Other related activities include:

- Regulation of lamps
- Regulation of ballasts
- Information program for luminaires
- Best practice and training program for lighting professionals.

For example, the Best Practice Lighting program aims to increase the use of daylight and the demand for energy efficient lighting, with consequential reductions in energy consumption and greenhouse gas emissions. The program will also document and communicate international research into lighting related improvements in productivity and occupant health.

1.4 Fluorescent Lamp Technology and Energy Efficiency

1.4.1 Fluorescent Lamp Technology

A fluorescent lamp is a sealed glass tube, coated on its internal surface with a phosphor material and filled with argon gas or an argon/krypton gas mixture, with a small amount of mercury. When a suitable high voltage is applied across the electrodes located at each end of the tube (for double-ended tubes), an electric arc discharge is initiated, and the resulting current ionises the mercury vapour. The ionised mercury emits ultra-violet radiation, which strikes and excites the phosphor coating, causing it to fluoresce and produce visible light. Around 22% of the energy used by the lamp is converted to light.

Fluorescent lamps are broadly divided into double ended lamps (also called tubular or linear fluorescents), single ended lamps (also called compact fluorescents or CFLs) and self ballasted lamps (generally CFLs with the ballast and lamp permanently attached). This RIS is concerned with tubular (linear) fluorescent lamps only.

All fluorescent lamps require a ballast for correct operation. The ballast is electrically inserted between the electricity supply and the lamp(s). The ballast serves primarily to limit the lamp current to the required value, by means of inductance, capacitance, electronic circuitry or a combination of these. The ballast may consist of one or more separate components and may include means for transforming the supply voltage and arrangements which assist in providing the starting voltage and preheating current, reduce stroboscopic effects, correct the power-factor and/or suppress radio interference, etc. Magnetic ballasts use a magnetic transformer as the primary means of current limiting, and operate the lamp at mains frequency (50 Hz in Australia). Electronic ballasts use solid state circuitry to provide current limitation and operate the lamp at high frequency.

Halophosphate Lamps

The makeup of the phosphor coating on the inside of the lamp's tube determines the colour properties of the lamp's light output. Halophosphate lamps use phosphors based on calcium halophosphate. These inexpensive lamps are available in generic colours such as white, warm white and daylight.

Triphosphor Lamps

Triphosphor lamps use three narrow band ('rare earth') phosphor coatings which are more efficient at converting UV to visible light and emit light with good colour rendering qualities. There is some evidence to indicate that these lamps produce greater visual clarity at equal illuminance, and that equal visibility can be achieved at slightly lower light levels. Triphosphor lamps generally have a higher colour rendering index than halophosphate lamps and embody long lifetimes and excellent lumen maintenance characteristics.

T12 Lamps

Linear fluorescent lamps are available in various diameters, usually designated by a 'T' number that defines the diameter of the tube, in eighths of an inch. The older technology is

38mm (T12). Newer and more efficient are 26mm (T8) and 16mm (T5). The majority of T12 lamps are only available with a halophosphate coating. They are declining in popularity due to the reducing cost of newer and better performing T8 and T5 lamp systems.

T8 Lamps

The T8 lamp was introduced in the US in 1981 (NLPIP 1993). They are a tubular lamp with a diameter of one inch and use a medium bi-pin base that allows them to fit into the same luminaires as a T12 lamp of the same length. They have improved efficacy and colour characteristics compared to those of standard T12 lamps. Today the T8 lamp is becoming the standard for new construction and is increasingly popular as a retrofit replacement for T12 lamps.

All major lamp manufacturers supply T8 lamps, and they are readily available in a variety of configurations through standard distribution channels. T8 lamps are available with either halophosphate or triphosphor coatings.

T5 Lamps

T5 lamps are 5/8" (16mm) diameter and use a triphosphor coating. They have a very high efficacy and long life characteristics. T5 lamps are slightly shorter than T8 lamps, and therefore cannot ordinarily be used as a replacement for T8 lamps, although some T8 / T12 luminaries can be made to accept T5 lamps by changing the sockets and ballasts. T5 lamps are available in standard output and high output and have a rated average lamp life of around 20,000 hours. T5 lamps need electronic ballasts to operate, as they are designed to operate at frequencies in excess of 20 kilohertz.

1.4.2 Energy Efficiency Levels

The linear fluorescent lamps considered in this RIS, in order of increasing efficacy, are: T12 halophosphate, T8 halophosphate, T8 triphosphor and T5 triphosphor lamps. Longer lamps are generally slightly more efficient, as they suffer proportionately smaller energy losses at the lamp electrodes. Figure 4 illustrates the efficacies of halophosphate versus triphosphor lamps, in relation to tube length, tested after 100 hours of operation. Also included in Figure 4 are calculated linear trend lines for each lamp group.

Figure 4 - Indicative Efficacy (@100 hrs operation) of Linear Fluorescent Lamps (source: Sylvania 2003a)

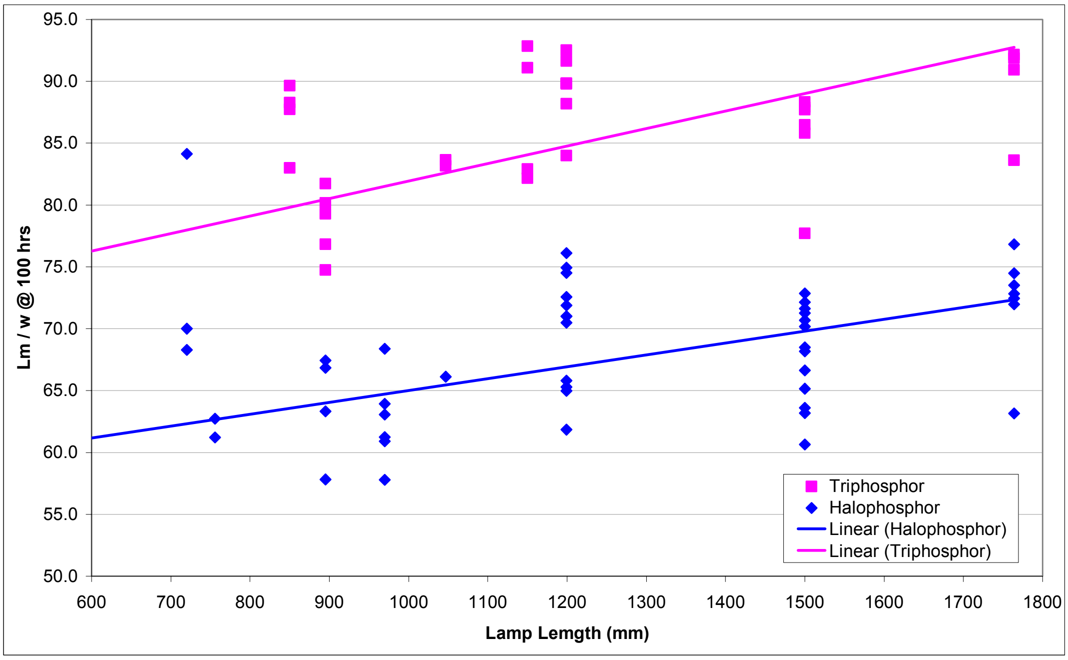


Table 2 lists the characteristics for the standard linear fluorescent lamps used throughout the modelling in this RIS, taken from the current lamp catalogues of Sylvania, Philips and Osram. The initial wattage and efficacy is indicated, along with the average quoted trade price, exclusive of GST.

Table 2 - Lamp Characteristics

Lamp length:	600mm	900mm	1200mm	1500mm	1800mm	Weighted Av.
T12 Halophosphate Lamps						
Wattage (w):	20	30	40	65	78	**35**
Efficacy (lm/w):	52	59	65	70	74	**61**
Trade price ($):	$4.24	$9.20	$4.74	$7.86	$12.30	**$5.37**
T8 Halophosphate Lamps						
Wattage (w):	18	30	36	58	70	**32**
Efficacy (lm/w):	65	71	77	76	83	**73**
Trade price ($):	$2.97	$7.14	$3.20	$5.59	$12.95	**$3.86**
T8 Triphosphor Lamps						
Wattage (w):	18	30	36	58	70	**32**
Efficacy (lm/w):	68	72	82	79	85	**76**
Price ($):	$8.63	$10.09	$9.35	$11.97	$18.55	**$9.53**
T5 Triphosphor Lamps						
Wattage (w):	14	21	28	35	0	**23**
Efficacy (lm/w):	84	88	91	93	0	**89**
Trade price ($):	$15.06	$16.28	$16.36	$18.05	$0.00	**$16.04**

The weighted averages in Table 2 are calculated using the following penetration rates for lamp lengths:

- > 600 mm: 30%
- > 900 mm: 10%
- > 1200 mm: 53%
- > 1500 mm: 5%
- > 1800 mm: 2%

These rates have been estimated using ABS 2003 and information from discussions with lighting industry representatives.

1.4.3 Lamp Energy Testing and Other Requirements

Australian Standard 1201:1989 *Tubular Fluorescent Lamps for General Lighting Service* specifies the technical requirements for tubular fluorescent lamps with preheated cathodes operated with or without a starter and for lamps with non-preheated cathodes operated without the use of a starter. It provides a test methodology for the measurement of initial lumens and lumen maintenance (defined as the luminous flux of an individual lamp after 2000 hours of operation, or 70% of its rated life as appropriate)

The standard also specifies the sampling quantities for type testing, for individual batches or for the whole production of a manufacturer. The characteristics of specific lamp types are provided in the form of separate data sheets along with a number of other lamp characteristics. This standard is technically identical with and reproduced from IEC 60081:1984 (latest version is IEC 60081:1997).

In August 2002, the Standards Committee EL-04-1 released a new standard designed to replace AS 1202 for public comment, called AS 4782.1:200X *Double-Capped Fluorescent Lamps - Performance Specifications*. This Standard is identical with and has been reproduced from IEC 60081:1997, *Double-Capped Fluorescent Lamps - Performance Specifications* and its Amendment 1:2000. Government agencies propose that Minimum Energy Performance Standards will be contained in Part 2 of this standard.

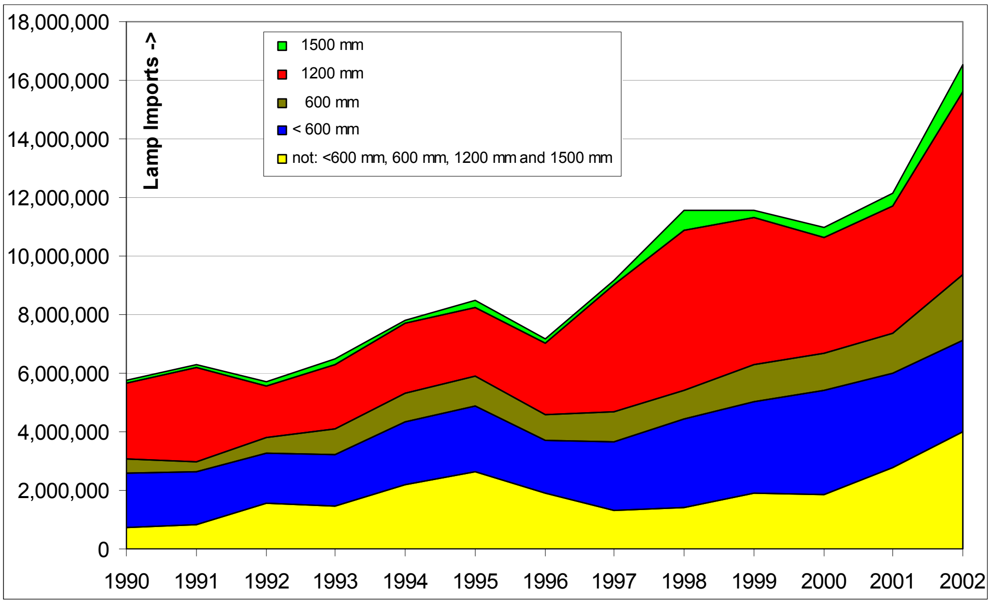
1.5 The Fluorescent Lamp Market

1.5.1 Product Supply

All linear fluorescent lamps are currently imported into Australia. Some local production occurred at the ELMA plant in Newcastle until it's closure in April 2002. The ELMA plant was established in 1931 to produce incandescent lamps and halophosphate fluorescent lamps. During the past ten years the plant faced declining domestic demand due to the growing trend towards triphosphor lamps and decreasing world lamp prices.

ABS import data for linear fluorescent lamps is indicated in Figure 5, which shows a marked increase in imports in 2002, which is most likely due to the closure of the ELMA lamp factory. Current imports are around 16.5 million lamps per annum. Figure 5 also indicates reasonably consistent penetration rates for the various lamp lengths.

Figure 5 - ABS Imports Data - Linear Fluorescent Lamps



The major lamp manufacturers represented in Australia are Philips, Osram, Sylvania and General Electric. These manufacturers import lamps and generally supply products to electrical contractors and lighting wholesalers.

1.5.2 Product Selection

Cost-Benefit Analysis – National Average

In order to calculate the overall cost effectiveness of various lamp types, a number of factors must be taken into account, such as energy consumption, running hours per annum, efficacy, lamp lifetime, capital and installation costs, etc. Using this data, a 'total annual cost per lumen' was calculated. This was calculated as a weighted average for each of the four fluorescent lamp types under consideration (i.e. weighted by the percentage penetration of various lamp lengths within each lamp type as discussed in section 1.4.2). It essentially comprises an energy cost, replacement cost and capital cost. Table 3 contains the data necessary to calculate these amounts. Note that some of the values in the table are calculated from other values in the table and are reproduced for information. Note also that Table 3 does not include the impact of any 'program costs' related to implementing MEPS for linear fluorescent lamps. These costs are further discussed in section 4.

Table 3 - Weighted Average Lamp Characteristics

Weighted Average	T12 Halo	T8 Halo	T8 Triphosphor	T5 Tri
Lamp wattage (w):	35.1	31.8	31.8	23.4
Lamp efficacy (lm/w):	61.0	72.9	76.3	88.7
Output per lamp (lm):	2139	2320	2429	2071
Average lamp lifetime (hrs):	11,000	12,000	20,000	20,000
Lamp run time p.a. (hrs):	2785	2785	2785	2785
Average lamp lifetime (years):	3.9	4.3	7.2	7.2
Lamp energy consumption (kWh p.a.):	98	89	89	65
Air conditioning energy consumption (kWh p.a.):	34	31	31	23
Total energy consumption (kWh p.a.):	132	120	120	88
Lamp import price ($):	$1.54	$1.11	$2.74	$4.61
Lamp trade price ($):	$5.37	$3.86	$9.53	$16.04
Lamp end-user price ($):	$6.17	$4.44	$10.96	$18.45
Lamp replacement labour cost ($):	$2.00	$2.00	$2.00	$2.00
Incremental electronic ballast trade price (T5):	-	-	-	$33.00
Annualised lamp capital cost (enduser) ($ p.a.):	$2.22	$1.62	$2.09	$8.61
Annualised lamp capital cost (national) ($ p.a.):	$0.96	$0.78	$0.76	$6.38
Annual lamp energy cost (enduser) ($ p.a.):	$17.76	$16.13	$16.13	$11.84
Annual lamp energy cost (national) ($ p.a.):	$17.76	$16.13	$16.13	$11.84
Total annual cost (enduser) ($ p.a.):	$19.98	$17.75	$18.22	$20.45
Total annual cost (national) ($ p.a.):	$18.72	$16.91	$16.90	$18.22
Total annual cost per lumen (enduser) (cents p.a.):	0.93	0.77	0.75	0.99

Table 3 includes calculations from the national, and end-user perspectives. The key difference is that the national perspective uses the import price for lamps, rather than retail price. The national perspective is used in the national cost-benefit analysis in this RIS.

Energy costs and run times used to calculate the total annual cost per lumen are given in Table 4 and are assumed to remain constant in real terms over the life of the evaluation. The weighting in Table 4 refers to the estimated numbers of residential versus business fluorescent lamp stocks.

Table 4 - Energy Costs & Run Times (sources: GWA 2001 & GWA 2003)

Energy Costs & Run Times	$/MWh	Runtime (hrs p.a.) (GWA 2001)	Weighting (MEA 2001)
Residential:	$127.73	600	9%
Business:	$135.60	3000	91%
Weighted average:	$134.89	**2785**	

The national average costs of electricity in Table 4 are calculated using marginal electricity prices from each state (from GWA 2003) and state energy consumption weightings from GWA 2001. The cost-benefit model used in this RIS does not accurately replicate the end user perspective, but calculates costs and benefits directly at the national level from national average values. For example, users with longer lamp operating hours (business users) will derive greater benefits from a particular MEP level, while those with shorter operating hours (residential users) will be worse off at MEPS levels that are cost-effective nationally. The effects on these end use classes are analysed below.

Additional data and assumptions used to calculate the figures in Table 3 are as follows:

> Margin of 15% applied to quoted lamp trade prices in order to reflect end-user prices.

> In order to calculate the import price of lamps, a margin was deducted from the trade price. The average gross margin was calculated using the weighted average import price of lamps ($1.47, from ABS 2003), and the weighted average trade price from supplier catalogues ($5.11). Thus the margin was calculated to be 250% of the import price.

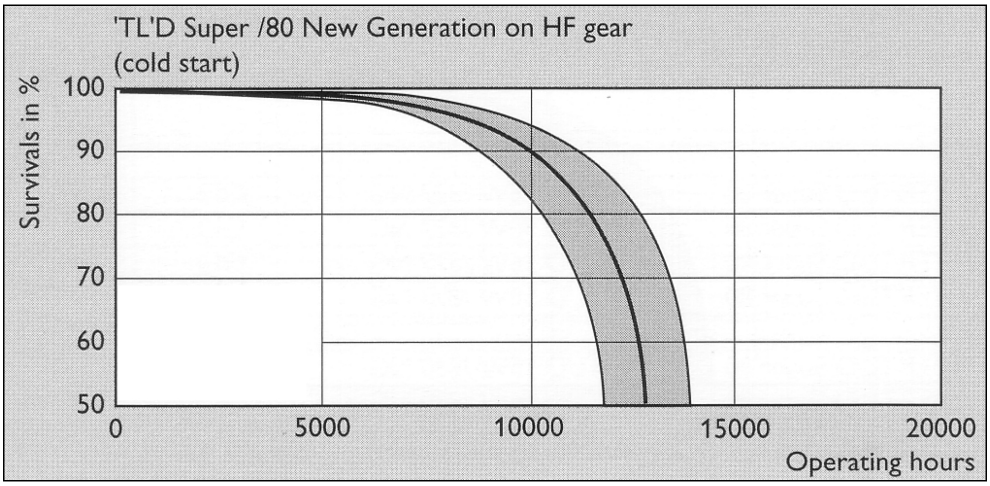
> A weighted cross-sectoral average allowance of 35% is applied to lamp energy consumption in order to estimate air conditioning energy consumption due to the lamp heat load (GWA 2001).

> An estimate of $2.00 per lamp used for labour cost of replacing each lamp (30 lamps replaced per hour @ $60 per hour labour charge).

> Additional cost of $33 per lamp applied to T5 lamps, to reflect the additional cost of fitting the required electronic ballast (based on discussions with ballast manufacturers).

> The average lamp lifetime is taken from manufacturers' specifications, and represents the time at which 50% of a sample of lamps have expired. A typical fluorescent lamp lifetime curve is illustrated in Figure 6, which shows that the majority of lamps expire within +/- 20% of the average lamp lifetime.

Figure 6 – Typical Lamp Lifetime Curve (reproduced from Philips 2003)



From Table 3 it is evident that T8 triphosphor lamps are currently the most cost effective, in terms of lifecycle cost per unit of light output (from the enduser perspective). They are marginally more cost effective than T8 halophosphate lamps. T12 halo lamps are considerably more expensive over their lifetime. T5 triphosphor lamps are the most expensive, due primarily to their high capital cost and the additional cost of fitting an electronic ballast. Ballast efficiencies are not taken in to account in this analysis, because MEPS for ballasts have already been introduced, and to avoid 'double counting' of ballast savings. However, it is expected that taking this in to account would increase the cost effectiveness of T5 triphosphor lamp systems.

Cost-Benefit Analysis – End Users' Perspective

Table 5 shows the cost benefit analyses of three different lamp upgrade options, from the point of view of the average business user. Option 1 is a swap from T12 halophosphate to T8 triphosphor lamps. Option 2 is a swap from T8 halophosphate to T8 triphosphor lamps. Option 3 involves replacing T8 halophosphate lamps with T8 triphosphor lamps and 'de-lamping' the installation, which is possible because T8 triphosphor lamps on average emit 5% more light than T8 halophosphate lamps. This results in the ability to fit 5% fewer lamps. This is in turn reflected in the initial cost and the energy and replacement costs for the installation. Note that the analysis includes the impact of differing lifetimes between lamp types. Note also that the analysis does not include the impact of any 'program costs' related to implementing

MEPS for linear fluorescent lamps, but is purely from the end user perspective. Program costs are further discussed in section 4.

Table 5 – 10 year Cost Benefit Analyses of Lamp Upgrade Options (Business User)

Case 1: Swap T12 halo for T8 tri	
Capital cost difference	$4.79
Running cost difference (NPV)	-$24.63
Ratio of benefits : costs	5.1
Case 2: Swap T8 halo for T8 triphosphor	
Capital cost difference	$6.52
Running cost difference (NPV)	-$3.19
Ratio of benefits : costs	0.5
Case 3: Swap T8 halo for T8 triphosphor & De-Lamp	
Capital cost difference	$6.03
Running cost difference (NPV)	-$10.64
Ratio of benefits : costs	1.8

The replacement cost is calculated as the cost of replacing the lamp after the original lamp fails at the end of its life, equivalent to the annualised lamp capital cost (from Table 3) applied each year from the year of initial lamp failure until the final year (year 10). The NPV of running costs are calculated using a discount rate of 5% and a CPI of 3% is applied to all costs (i.e. all costs assumed to remain constant in real terms).

From Table 5 it is evident that a straight swap of T12 halophosphate with T8 triphosphor is very cost effective (benefit/cost ratio of 5.1) whereas a straight swap of T8 halophosphate with T8 triphosphor is not cost effective (benefit/cost ratio of less than 1.0). This is due to the fact that T8 halophosphate and T8 triphosphor lamps consume the same amount of energy. It is possible to capitalise on the superior efficacy of T8 triphosphor lamps by installing a reduced number of lamps, as in case 3. This results in a benefit / cost ratio of 1.8.

Swapping to T5 triphosphor lamps does not currently result in a benefit / cost ratio greater than 1.0, due largely to the high capital cost of T5 lamps and associated electronic ballasts.

Due largely to significantly lower operating hours, the scenarios modelled in Table 5 are not cost effective for residential users. Table 6 indicates the results of cost-benefit analyses for residential end users. Note that the de-lamp option is not considered viable for residential users, who would only have a very small number of lamps installed. Note also that this analysis does not include the effects of air conditioning.

Table 6 – 10 year Cost Benefit Analyses of Lamp Upgrade Options (Residential User)

Case 1: Swap T12 halo for T8 triphosphor	
Capital cost difference	$4.79
Running cost difference (NPV)	-$2.26
Ratio of benefits : costs	0.5
Case 2: Swap T8 halo for T8 triphosphor	
Capital cost difference	$6.52
Running cost difference (NPV)	$0.00
Ratio of benefits : costs	0.0

From Table 6 it is evident that changing to T8 triphosphor lamps is not cost effective for residential users, due to the small number of lamp operating hours. The national benefits of mandating triphosphor lamps is discussed in section 4.1.3.

User concern with energy efficiency

The transition to T8 triphosphor lamps is currently occurring at a rapid rate, due primarily to their superior efficiency and reducing price. Discussions with lamp suppliers reveal that the sales of T12 and T8 halophosphate lamps are both decreasing at around 15% p.a., whilst sales of T8 triphosphor lamps are increasing at between 20% and 30% p.a. It is inferred from this that T8 triphosphor lamps are taking market share away from halophosphate lamps.

However, although efficient lighting technology is highly cost effective, market failure in the commercial sector in particular currently prevents optimum penetration. The majority of commercial buildings are tenanted and the tenants typically do not participate in the purchase and replacement of lamps, which is the task of building managers. Since the tenants pay the electricity bills for lighting, there is little incentive, apart from the additional labour cost of changing lamps on a more frequent basis, for purchasers to buy efficient lamps if they have a higher capital cost.

This market failure is not as pronounced in the residential sector. Linear fluorescent lamps are not common in new houses or renovations. While there are a significant number of linear fluorescent lamps in use in the existing housing stock, it is usually the householder who pays the running costs as well as purchases replacement lamps. The market failure in the residential sector is therefore more likely a lack of information about lamp performance and lifecycle costs.'

2 OBJECTIVES OF THE REGULATION

COAG Guidelines:

> Objective: the objective which the regulation is intended to fulfil must be stated in relation to the problem. The objectives of a regulation are the outcomes, goals, standards or targets which governments seek to attain to correct the problem.

2.1 Objective

The primary objective of the proposed regulation is to bring about a reduction in greenhouse gas emissions from the use of linear fluorescent lamps below what they are otherwise projected to be in the business as usual case.

2.2 Assessment Criteria

The primary assessment criterion is the extent to which an option meets the primary objective. In addition, the following secondary assessment criteria have been adopted:

1. Does the option address market failures, so that the average lifetime costs of linear fluorescent lamps are reduced, when both capital and energy costs are taken into account?
2. Does the option address information failures, so that buyers have ready access to product descriptions that are consistent and accurate with regard to energy efficiency?
3. Does the option minimise the risk of negative impacts on product quality and function?
4. Does the option minimise the risk of negative impacts on manufacturers and suppliers?
5. In light of any potential restriction in competition, do the benefits outweigh the likely costs?
6. Is the restriction in competition is no more restrictive than necessary in the public interest?

3 PROPOSED REGULATION AND ALTERNATIVES

COAG Guidelines:

> Statement of the proposed regulation and alternatives: this should describe the proposed regulation and distinct alternatives in sufficient detail to allow comparative assessment and evaluation in the rest of the RIS.

The following options for achieving the regulatory objectives were considered for linear fluorescent lamps:

1. Status quo (termed business as usual, or BaU).
2. The proposed regulation (mandatory MEPS).
3. Voluntary MEPS.
4. Mandatory product labelling.
5. Another regulatory option involving a levy imposed upon inefficient equipment to fund programs to redress the greenhouse impact of equipment energy use.
6. A levy on electricity reflecting the impact it has on greenhouse gas emissions abatement.

The following sections describe the options in more detail, and assess the non-MEPS options (4, 5 and 6). The MEPS options (2 and 3) have been subject to detailed cost-benefit analysis, which is reported in section 4.

3.1 Status Quo (BaU)

Stock Estimates

The average efficacy of linear fluorescent lamps has improved since their introduction. Within each of the four linear fluorescent lamp types (T12 halophosphate, T8 triphosphor, etc.) there have been small, incremental improvements in efficiency. Larger 'step' improvements have come with the introduction of new lamp types such as T8 and T5. T12 halophosphate lamps are the oldest and least efficient type. The introduction of T8 halophosphate lamps brought an improvement in efficacy, as did the subsequent introduction of T8 triphosphor and then T5 triphosphor lamps. However it is the persistence of significant sales of the older, less efficient lamp types that has lead to the need for intervention.

The BaU case modelled in this RIS assumes that the efficacies of each lamp type remain unchanged, but that the less efficient lamp types continue to decline in popularity, in favour of triphosphor lamps. The rate of changeover from halophosphate to triphosphor lamps is the critical variable in modelling the impacts of the linear fluorescent lamp market.

The base year for stock modelling was chosen as 2000 and lamp stock for 2000 is indicated in Table 7.

Table 7 - Lamp Stock in 2000 (source MEA 2001)

T12 Halo	T8 Halo	T8 Tri	T5 Tri	Total
14 million	51 million	13 million	0.2 million	**78 million**

There are no readily available figures on the number of lamps installed. The estimates in Table 7 draw on MEA 2001, which in turn draws on the following sources:

> Sectoral electricity consumption and estimates of the proportion of consumption used for lighting (residential sector).

> Earlier estimates of the national stock of ballasts (commercial and industrial sectors).

> Discussions with lighting suppliers.

> ABS data for imported lamps.

The assumptions for stock estimates in MEA 2001 are as follows:

- Residential sector: According to industry sources, on average each household is assumed to have one tubular fluorescent lamp (often in the kitchen). The stock of tubular fluorescents in this sector is therefore estimated at 7 million, which are all assumed to be T12 halophosphate.
- Business sector (combined commercial / industrial sector): There were an estimated 65 million lamp ballasts in Australia in 1993, across all sectors (Energetics and GWA 1994). The 2000 figure would be 78 million if annual growth was around 3%. Assuming one ballast per fluorescent tube (multiple-lamp capable electronic ballasts represented a very small percentage of the market in 2000), and allowing for 7 million tubes in residential applications, this results in an estimate of 71 million tubes in the business sector in 2000.
- Commercial sector: From energy consumption data and industry estimates, MEA 2001 calculates the number of tubular fluorescents in the commercial sector as 59 million, comprised of:
  - T12: 6 million
  - T8: 53 million, including 42 million halophosphate and 11 million triphosphor.
- Industrial: The number of fluorescent tubes is estimated on the same basis as the commercial sector, at 12 million. No information was readily available on the distribution between 38mm and 26mm tubes and the same distribution as in the commercial sector has been assumed, as follows:
- T12: 1 million
- T8: 11 million, including 8.8 million halophosphate and 2.2 million triphosphor.
- T5 triphosphor: 0.2 million for 2000, growing rapidly as the sales share of this lamp type increases.

The accuracy of these stock assumptions is supported by the following:

- A subsequent meeting of the industry steering committee was held in 2001, at which the industry delegates agreed that the MEA 2001 assumptions were reasonable.
- ABS Import data and lamp lifetime. ABS import data suggest lamp imports of 16.5 million in 2002. Adjusting for the estimated final ELMA production January-March 2002 (1 million units), total Australian sales would be around 17.5 million in 2002. Using a weighted average lamp lifetime of 4.7 years (from manufacturer lamp life data), this sales figure represents a simple stock estimation of 82.3 million lamps in 2002. This compares favourably with the above estimated figure of 78 million lamps in 2000 (which would be 82.8 in 2002 with 3% growth). Note that ABS import data is considered to be reasonably accurate, as linear fluorescent lamps are readily identifiable by customs staff, and that lamp lifetimes are also considered accurate as lamp lifetime tests are undertaken by manufacturers during routine product testing. Hence this method of stock calculation is held to be a reasonable check for the above global stock assumptions.

Table 8 indicates the percentage penetration of lamp lengths used throughout this RIS. These are based on ABS import data and discussions with industry, which indicate that the penetration rates appear to remain reasonably constant over time.

Table 8 - Lamp Length Penetration

Lamp Length Category	Penetration
600 mm	30%
900 mm	10%
1200 mm	53%
1500 mm	5%
1800 mm	2%

Table 9 contains estimates of percentage changes in sales levels for lamp types from 2002 to 2003, from discussions with industry. It should be noted that these figures represent a percentage change in sales from 2002 to 2003 only, not an ongoing linear decline in sales of halophosphate lamps that will lead to their rapid extinction. It is not anticipated that these change rates will be sustained, as it is likely that they represent readily accessible transformation as well as the recent cessation of halophosphate lamp production in Australia.

Table 9 - Estimated % Change in Sales from 2002 to 2003

Lamp Type	% Change in Sales p.a.	Direction
T12 Halophosphate	15% to 20%	Decrease
T8 Halophosphate	10% to 15%	Decrease
T8 Triphosphor	20% to 30%	Increase
T5 Triphosphor	10% to 15%	Increase

In order to model the BaU case, a lamp stock model was constructed. The model is based largely on the stock estimates from Table 7, ABS import data, lamp lifetimes from Table 2 and rates of change of yearly sales estimated by industry representatives.

As T8 halophosphate and T8 triphosphor lamps consume approximately the same amount of power, there is no potential to achieve energy savings through the direct replacement of T8 halophosphate lamps with T8 triphosphor lamps (referred to as 'suboptimal configuration'). However as T8 triphosphor lamps emit more light than T8 halophosphate units, the potential for energy savings comes with fitting fewer lamps (referred to as 'optimal configuration'). In all cases including the BaU case, it has been assumed that T8 triphosphor lamps will only be fitted in the optimal configuration when a lighting installation has reached the end of its life. Limited data is available relating to the average lifetime of a lighting installation in Australia. A value of 15 years has been used, although in many cases it is likely that lighting installations are replaced more frequently than this, for example when tenancies change or office fitouts are upgrades to suit new uses or styles, etc.

It has been estimated that the growth in floor area lit with linear fluorescent lamps is 3% p.a. This corresponds with MEA 2001 which estimates a 3% growth in energy consumption for lighting (using Energetics and GWA, 1994) and also reflects UK projections for a 3% growth in lighting energy consumption between 1998 and 2010 (DETR, 2000).

Scenarios

Three BaU scenarios were modelled:

> *Scenario B1*: Stock of T12 halophosphate and T8 halophosphate lamps decreasing at 5% p.a. from 2000.

> *Scenario B2*: Stock of T12 halophosphate and T8 halophosphate lamps decreasing at 15% p.a. from 2000.

> *Scenario B3*: Stock of T12 halophosphate and T8 halophosphate lamps decreasing at 5% p.a. from 2000 and T5 triphosphor stocks increasing significantly from 2010 onwards.

Note that the percentage reduction in stock refers to a year-on-year reduction, resulting in a non-linear decrease in lamp stocks. Stocks for the three BaU scenarios are illustrated in Figure 7 to Figure 9.

Figure 7 – Stock - BaU Scenario B1

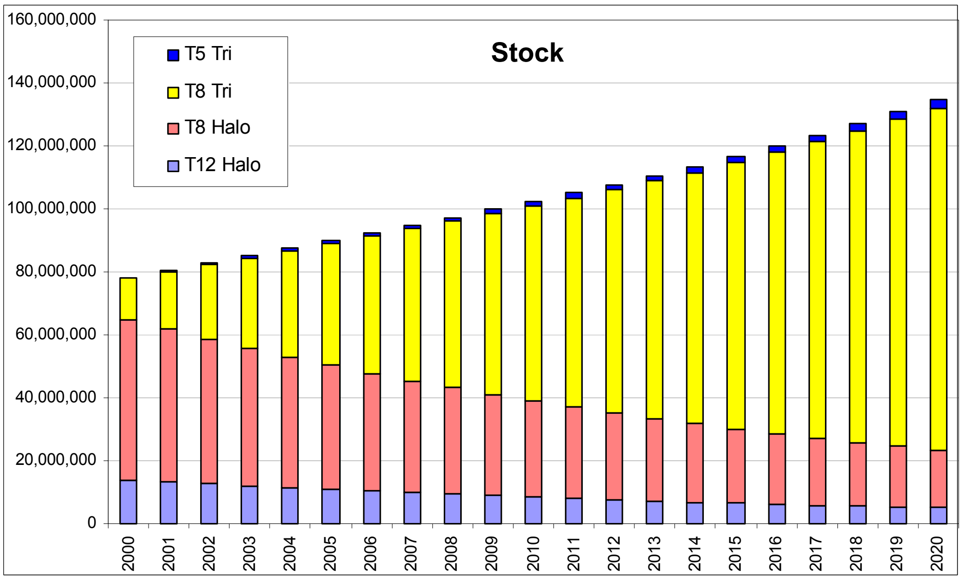


Figure 8 - Stock - BaU Scenario B2

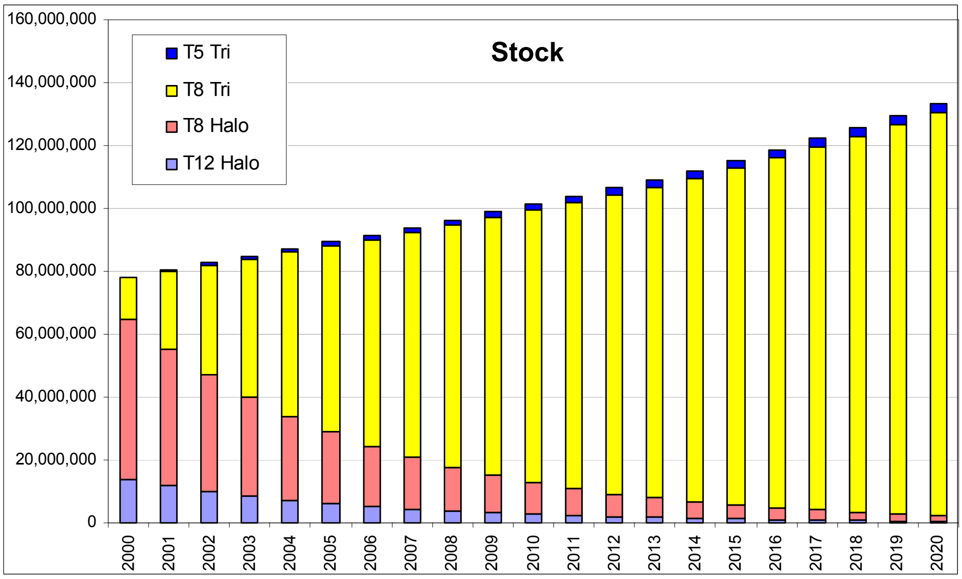


Figure 9 - Stock - BaU Scenario B3

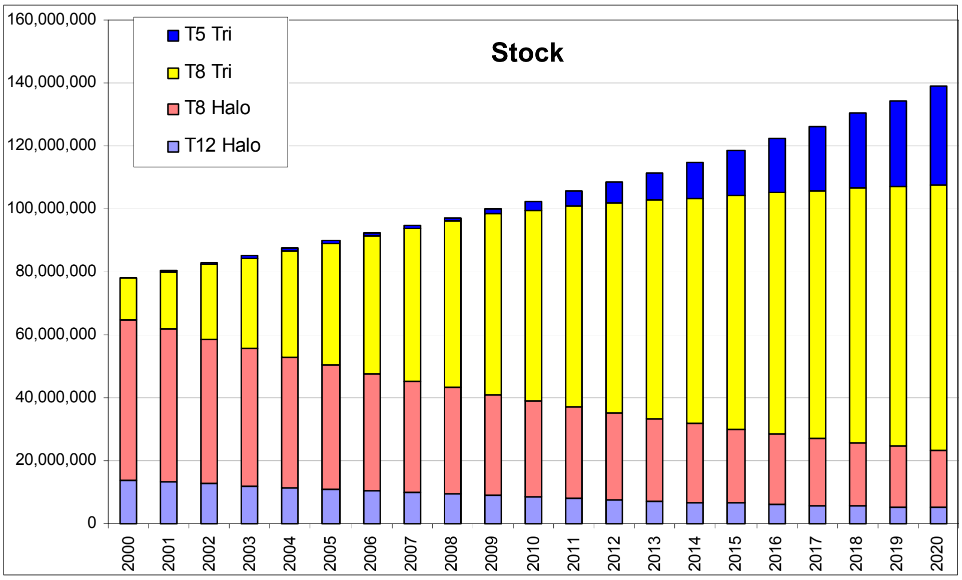
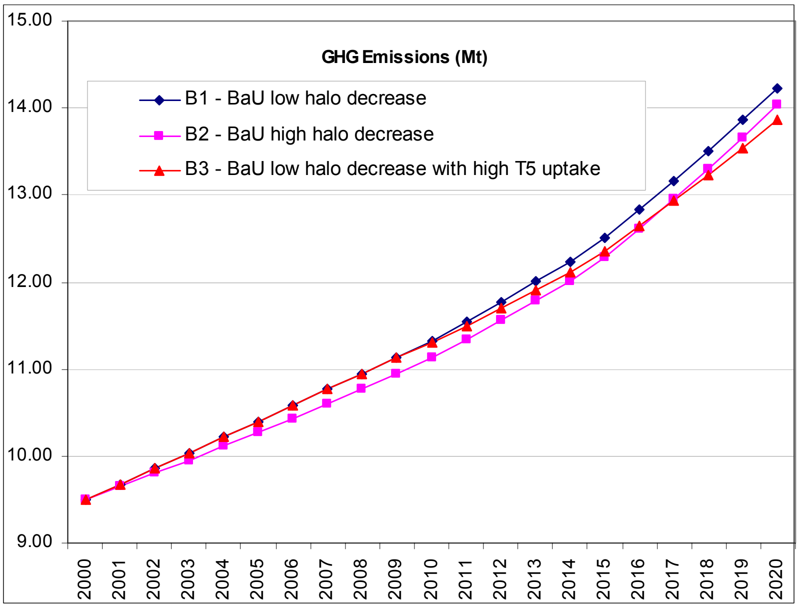


Figure 10 illustrates greenhouse gas emissions from the three BaU scenarios.

Figure 10 - GHG Emissions from BaU Scenarios



These projections form the baseline for quantitative analysis of the impacts of the various MEPS options. The status quo option would, by definition, fail to meet the primary objective of the regulation. That is, there would be no reduction in Australia's greenhouse gas emissions below the BAU case.

In addition, there would be no correction of the identified market failures or information failures that currently lead to the average lifetime costs of linear fluorescent lamps not being optimised. On the other hand, there would be no negative impact on product quality or function, no negative impacts on manufacturers and suppliers, and no restrictions placed on market participants.

3.2 Voluntary MEPS

Success of this option relies on lamp suppliers being effectively encouraged to meet certain minimum energy efficiency levels voluntarily. i.e. in the absence of regulation. This would require suppliers to decrease their model ranges to eliminate less efficient lamps. As there are few commercial incentives for doing so, it is unlikely that suppliers would willingly make these changes without significant government incentives.

In addition, lamp efficiency is a key component in reducing overall lighting energy consumption and hence a key element of the NAEEEP lighting strategy. Assuming that all other elements of the lighting strategy are implemented (i.e. regulation of ballasts, information program for luminaires, best practice and training program), a voluntary and therefore less effective lamp efficiency program would threaten the overall effectiveness of the NAEEEP lighting strategy.

3.3 Levies

Equipment Levy

Another option involves a levy imposed upon inefficient appliances to fund programs which would redress the greenhouse impact of equipment energy use. Two variations of this option are worthy of consideration:

a) The proceeds from the levy are diverted to greenhouse-reduction strategies unrelated to lamp efficiency (ie the levy is 'revenue-positive').

b) The proceeds are used to subsidise the costs of more efficient lamps so that any cost differentials between these and inefficient lamps are narrowed or eliminated (ie the levy is 'revenue-neutral').

Electricity Levy

At present, the electricity prices faced by consumers reflect – however imperfectly - the cost of the capital invested in the electricity generation and transmission systems, operating and maintenance costs and taxes. They may also reflect the costs of controlling pollutants such as oxides of nitrogen and sulphur (NOx and SOx), for which emissions standards are currently in force in some areas. They do not reflect the value of greenhouse gas emissions, or rather they implicitly assign a value of zero to such emissions. In other words, greenhouse costs are not internalised in the electricity price.

It may be possible to introduce a levy on the price of electricity to reflect the cost of greenhouse gas emissions from the production and combustion of the fuels used to generate it – in effect, a carbon tax. Alternatively, if a cap and trade emissions permit scheme were implemented, electricity generators and other major emitters would have to obtain sufficient permits to cover their emissions. Some of these may be obtained free (ie by 'grandfathering') and some may have to be purchased, but if there is an open market then all permits will ultimately have the same monetary value. The permit value would thus be reflected in the price of electricity and all greenhouse-intensive goods and services. The effect of a permit trading scheme would be similar to a carbon tax in its pervasiveness, but the magnitude of the electricity price impact would vary with the market price of permits.

Conclusions

The two levy options proposed are not currently government policy and would require extensive consultation at the highest levels of government. Hence these options are not worthy of consideration until such time as government policy changes to favour levy schemes.

3.4 Mandatory Labelling

A mandatory labelling scheme would involve improving information flow to the end user, relating to lamp efficiency. Similar to the appliance star rating scheme, an energy label would simplify information by way of an easily recognised and well understood symbol. Initially, labelling should be supported by informational programs to educate consumers of the meaning of the labels, and their impact on running costs, etc.

The problem with applying a label to linear fluorescent lamps is that, in the business sector, these lamps are not usually specified by the end user. In fact, as discussed in section 1.5.2, end users rarely have the opportunity to influence lamp choice in the business sector. Hence labelling should also be aimed at the lighting designer, who does not have a substantial commercial interest in the efficiency of the lighting system. As a result it is predicted that mandatory labelling would have a less than optimal impact on the sale of efficient lamps.

Additionally, in other product areas (for example domestic refrigeration), it has been found that mandatory MEPS schemes are required in addition to labelling. Labelling serves to promote more efficient appliances, but does not effectively remove very inefficient appliances from the marketplace, and these continue to be sold in significant quantities. This failing, and the limited effectiveness of lamp labelling due to far-removed end users, results in labelling not being considered an effective option for reducing energy consumption from linear fluorescent lighting.

3.5 Mandatory MEPS

Australian Government agencies propose to introduce mandatory MEPS for linear fluorescent lamps. MEPS could be set to phase out T12 halophosphate lamps, to phase out all halophosphate lamps, or to phase out all halophosphate and T8 triphosphor lamps leaving only T5 triphosphor lamps. The impacts of setting MEPS levels that would result in the effective elimination of all halophosphate lamps from the Australian market are modelled extensively in section 4.1.3. The impacts of setting other MEPS levels are also modelled for comparison in section 4.1.5.

Canada, the United States and New Zealand have set MEPS for linear fluorescent lamps that eliminate halophosphate lamps (the US doing so in 1994/5). Their decision reflects, in part, the potential for some purchasers to continue to focus on the short term capital costs in spite of the benefits that can be achieved through the use of triphosphor lamps. The MEPS levels for the US and Canada are summarised in Appendix A.

China has recently introduced MEPS levels and these are also shown in Appendix A, together with those in Korea, and other country programs targeted at double-ended fluorescent lamps. There are no MEPS levels for lamps in the EU, but labelling of lamps has been mandatory since 1992 (although each country has its own timeframe for implementing regulations).

Regulations in Canada and the United States are required to undertake rigorous consultation and cost-benefit analysis processes before adoption and this was the case with MEPS for fluorescent lamps. The processes required by other countries are not known. As far as we are aware, no country has considered mandatory standards for these products but decided not to proceed.

Both the Canadian and US regulations have been in force for a considerable time (1996 and 1994/5 respectively) and appear to have been effective in meeting their objectives to remove inefficient models from the market. There are no known reports of adverse reactions.

New Zealand MEPS levels are discussed further in section 8.

The proposed Australian regulation will cover products from a length of 550mm to 1500mm inclusive. The Canadian and US standards do not include specifications for 1500mm and 1800mm lamp sizes, whilst the New Zealand standard includes specification for lamp sizes up to and including 1500mm.

The joint Australian and New Zealand Standard proposes to specify both initial and maintained minimum average lamp efficacy figures. Table 10 shows the proposed MEPS for linear fluorescent lamps.

Table 10 – Proposed MEPS levels

Lamp nominal length (mm) (mandatory):	550 ≤ l < 700	700 ≤ l < 1150	1150 ≤ l < 1350	1350 ≤ l ≥ 1500
Lamp typical power (watts) (informative):	16 – 24	17 – 40	28 – 5	35 – 80
Initial efficacy: Maintained efficacy:	$F_{100} \geq 66.0$ and $F_M \geq 57.5$	$F_{100} \geq 74.0$ and $F_M \geq 61.0$	$F_{100} \geq 80.0$ and $F_M \geq 70.0$	$F_{100} \geq 85.0$ and $F_M \geq 70.0$

Figure 11 to Figure 14 show the proposed Australian MEPS levels, New Zealand MEPS levels, and their impacts on currently available halophosphate and triphosphor lamps.

Figure 11 – MEPS level for nominal 600mm lamps

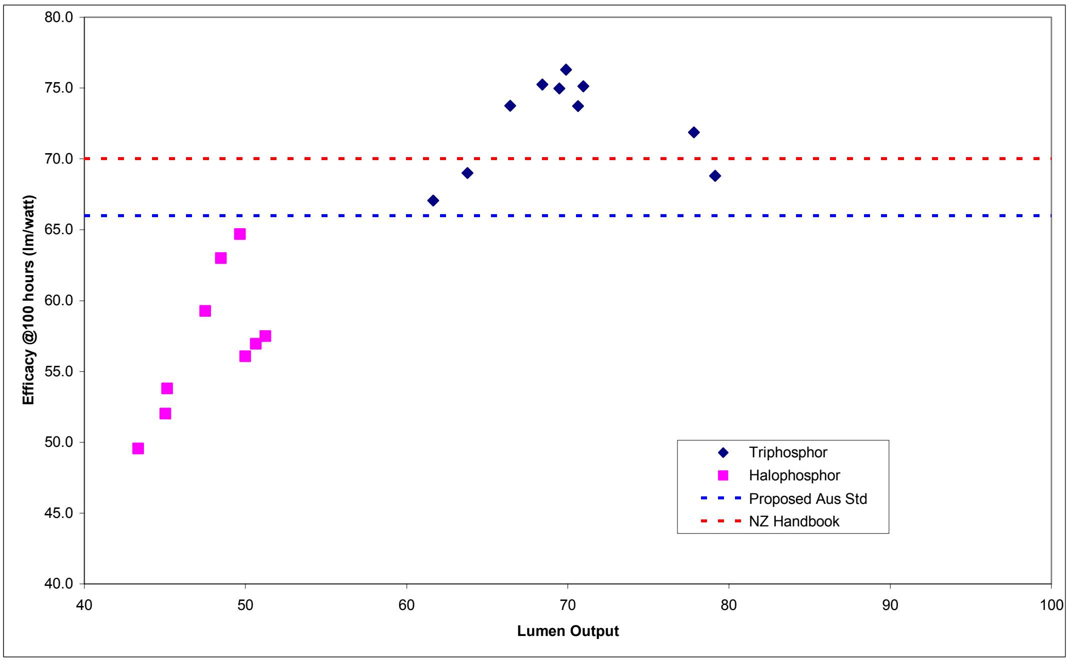


Figure 12 – MEPS level for nominal 900mm lamps

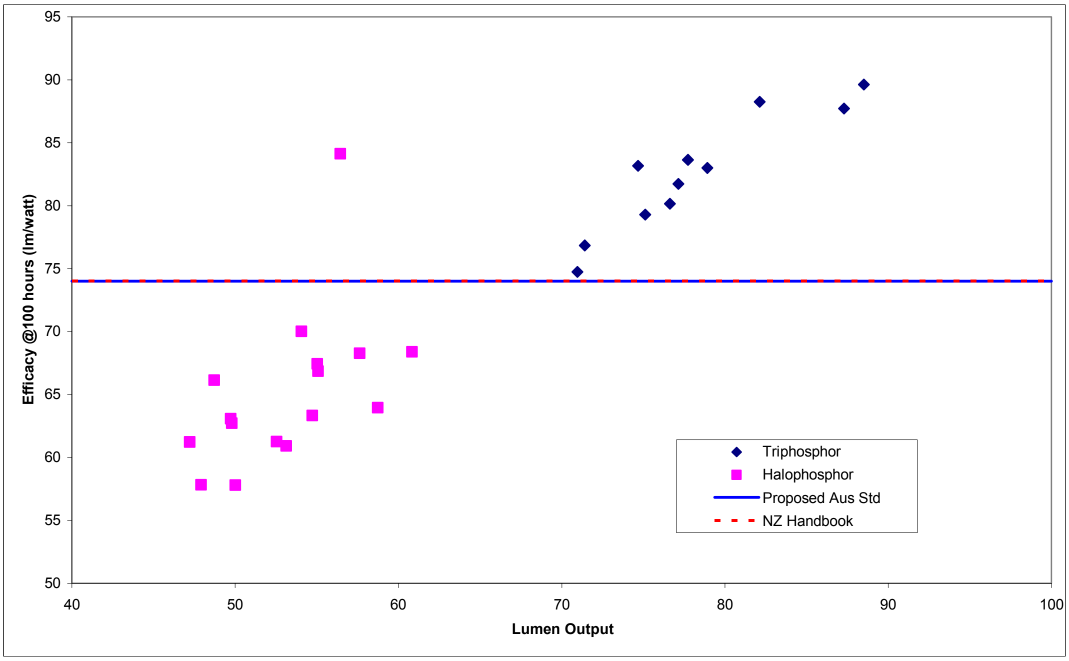


Figure 13 – MEPS level for nominal 1200mm lamps

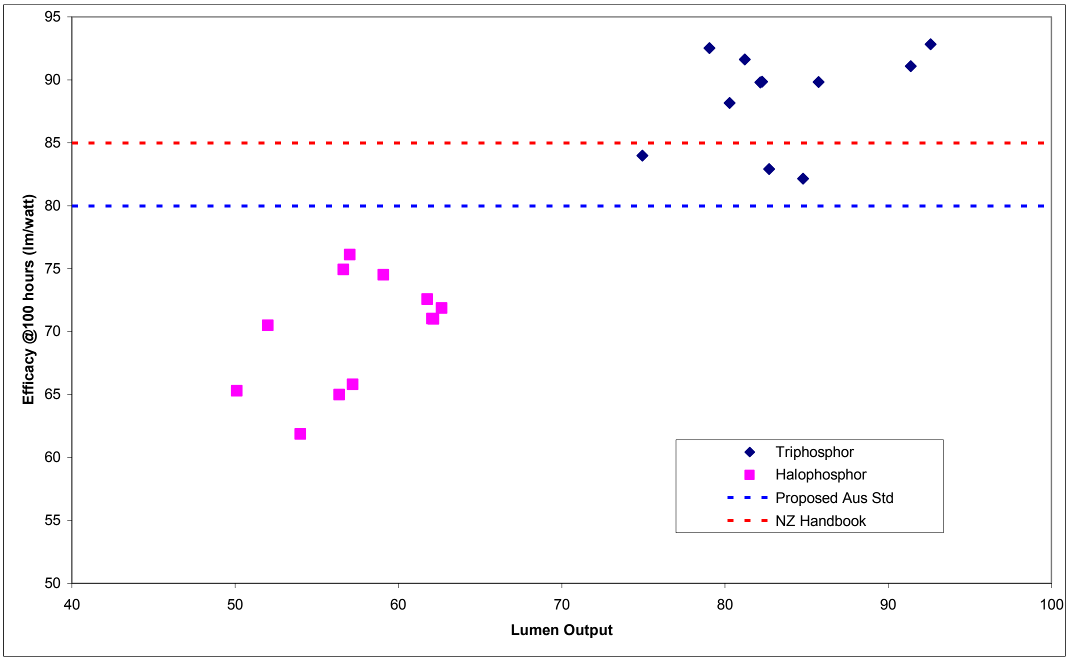
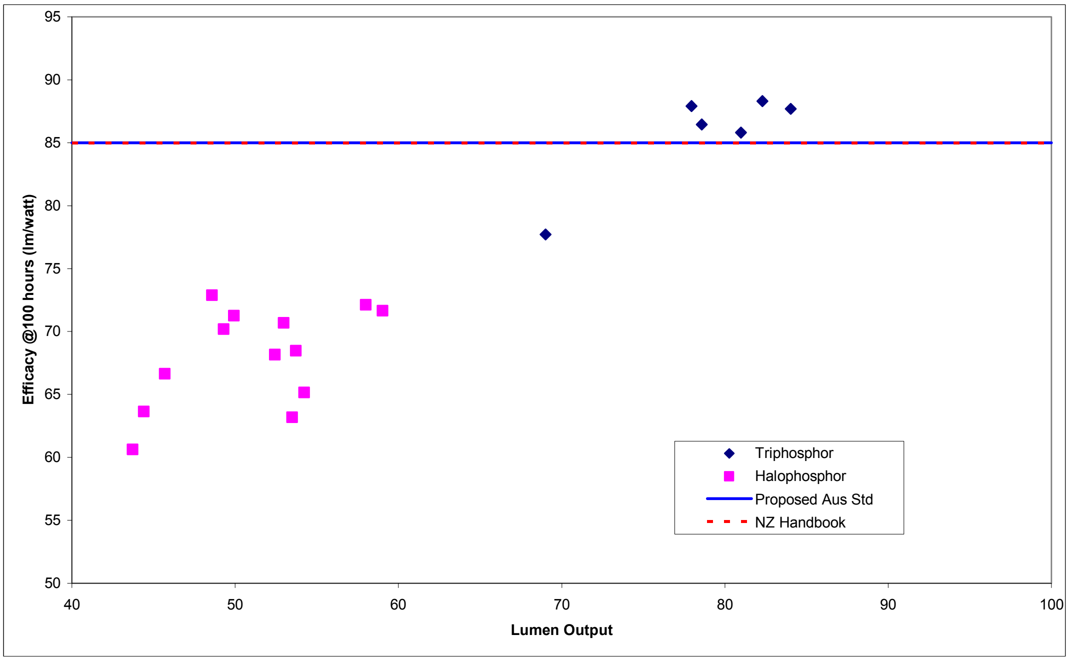


Figure 14 – MEPS level for nominal 1500mm lamps



The maintained efficacy is defined at lamp life of 5000 hrs. The initial efficacy level will be used for testing purposes. Check tests will not be based on maintained efficacy levels, as it is considered impractical to test lamps for 5000+ hours prior to taking enforcement action. It is anticipated that MEPS would come into effect from October 2004.

4 COSTS, BENEFITS AND OTHER IMPACTS

COAG Guidelines:

> Costs and benefits: There should be an outline of the costs and benefits of the proposal(s) being considered. This should include direct and indirect economic and social costs and benefits. There should also be analysis of distinct alternatives to the proposed regulation (including the 'do nothing' option).

4.1 Benefits and Costs of Mandatory MEPS

4.1.1 Lamp Characteristics

Due to the fact that the efficacy of halophosphate lamps is largely unchangeable, mandatory MEPS for linear fluorescent lamps would result in the phasing out of halophosphate lamps in favour of triphosphor. T12 halophosphate and T8 halophosphate lamps would be prohibited, and the market forced to adopt, as a minimum, T8 triphosphor lamps. T5 triphosphor lamps are also a suitable yet more expensive alternative. It is assumed that the penetration of T5 lamps would not increase beyond BaU as a result of mandatory MEPS. That is, mandatory MEPS would only force change from T12 halophosphate and T8 halophosphate to T8 triphosphor. The effects on efficacy and price of linear fluorescent lamps is summarised previously in Table 2 and Table 3.

4.1.2 Scenarios

It is assumed that mandatory MEPS would take effect in October 2004, and that this would cause the stock of halophosphate lamps to decrease in a linear fashion to zero over the eight years 2005 – 2012. This means that half of the halophosphate lamp stock is eliminated in the first four years of MEPS (equal to the average lifetime of halophosphate lamps) and the remainder eliminated over the following four years.

That the lamp stocks decay in a linear fashion is a reasonable assumption to make for the purposes of this study, given that:

> Modelling the 'typical' lamp is reasonable given the aims of this study.

> The majority of linear fluorescent lamps expire within +/- 20% of the average lamp lifetime (discussed in section 1.5.2) and the majority of linear fluorescent lamps are used in the business sector and are therefore subject to similar usage patterns.

Mandatory MEPS is modelled in three scenarios, with identical assumptions to the three BaU scenarios:

> Scenario M1: Stock of T12 halophosphate and T8 halophosphate lamps decreasing at 5% p.a. from 2000-2004. MEPS introduced in October 2004.

> Scenario M2: Stock of T12 halophosphate and T8 halophosphate lamps decreasing at 15% p.a. from 2000-2004. MEPS introduced in October 2004.

> Scenario M3: Stock of T12 halophosphate and T8 halophosphate lamps decreasing at 5% p.a. from 2000-2004. MEPS introduced in October 2004. T5 triphosphor stocks increasing significantly from 2010 onwards.

Figure 15 to Figure 17 illustrate the stocks of various lamp types under these three MEPS scenarios.

Figure 15 - Stock – Scenario M1 – Mandatory MEPS with initial low halo decrease

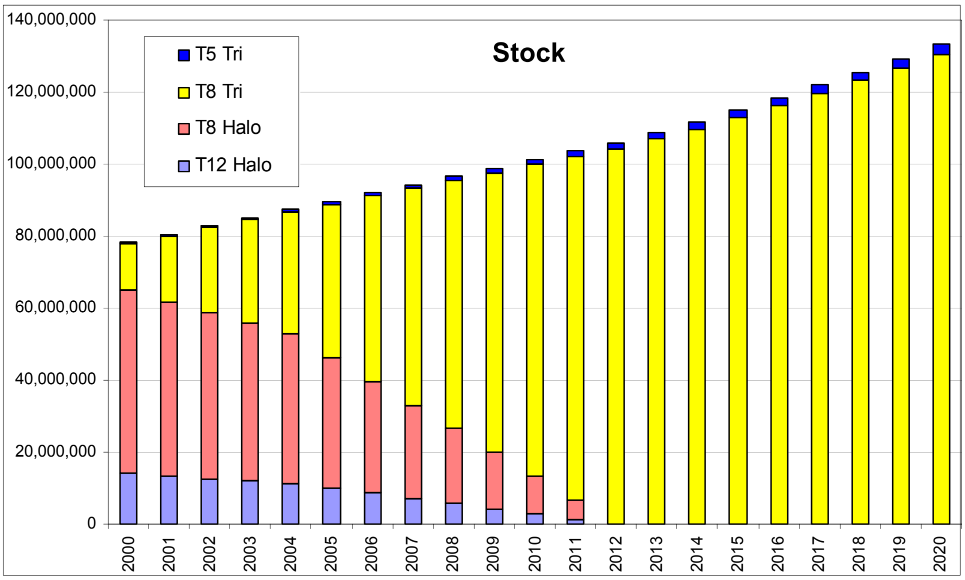


Figure 16 - Stock – Scenario M2 – Mandatory MEPS with initial high halo decrease

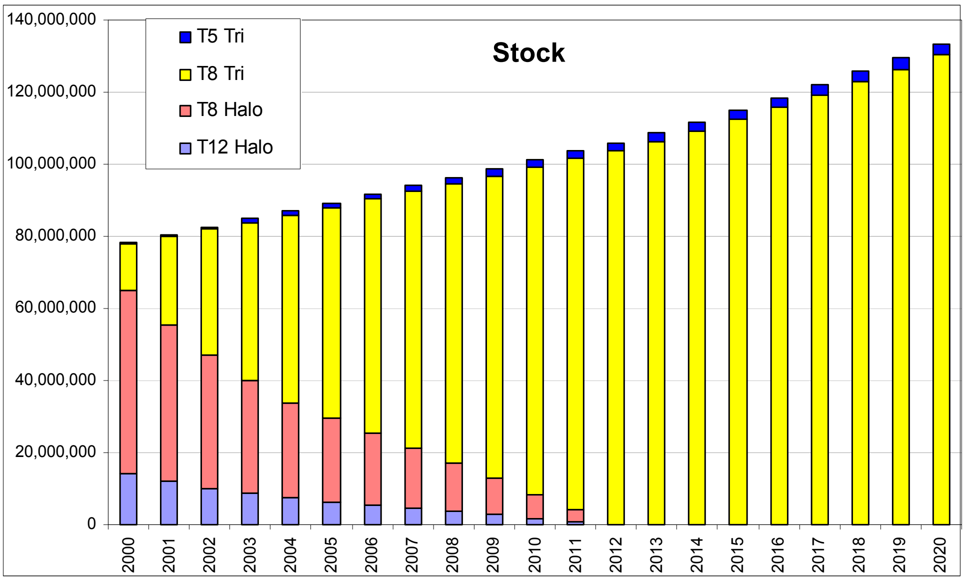


Figure 17 - Stock – Scenario M3 – Mandatory MEPS with initial low halo decrease and higher T5 uptake

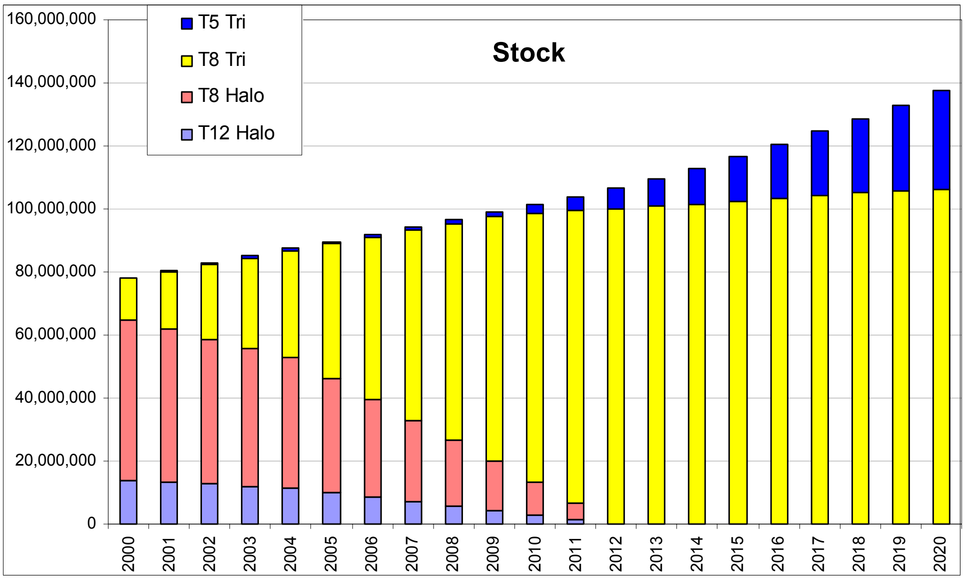
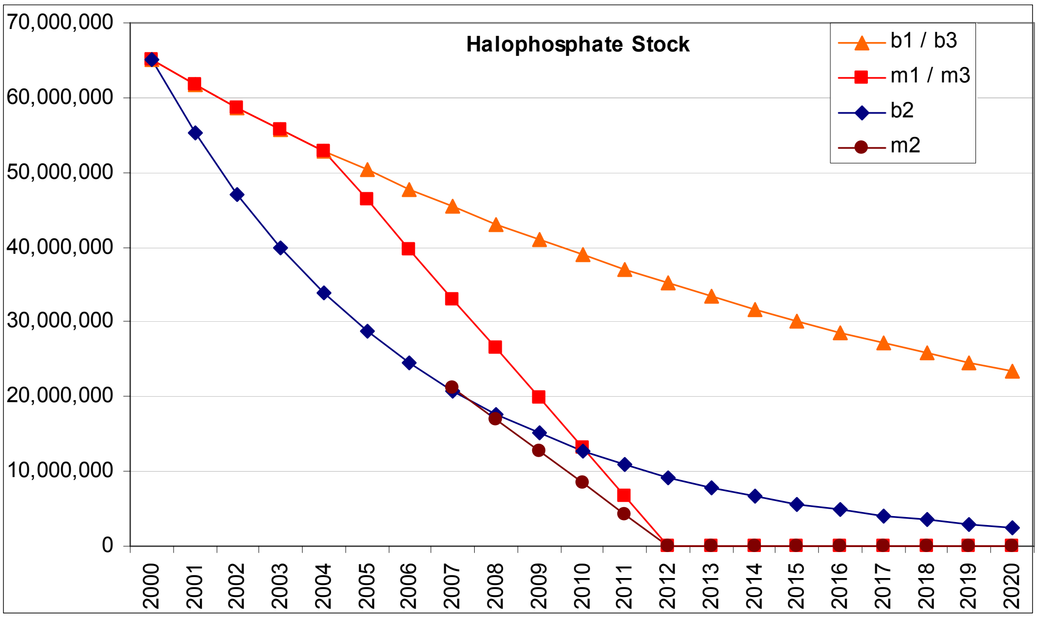


Figure 18 shows the stock of halophosphate lamps (T12 and T8) for the three BaU and three MEPS scenarios. Note that B1 and B3 (as well as M1 and M3) involve the same rate of decline of halophosphate stocks.

Figure 18 – Halophosphate Stock – BaU and Mandatory MEPS



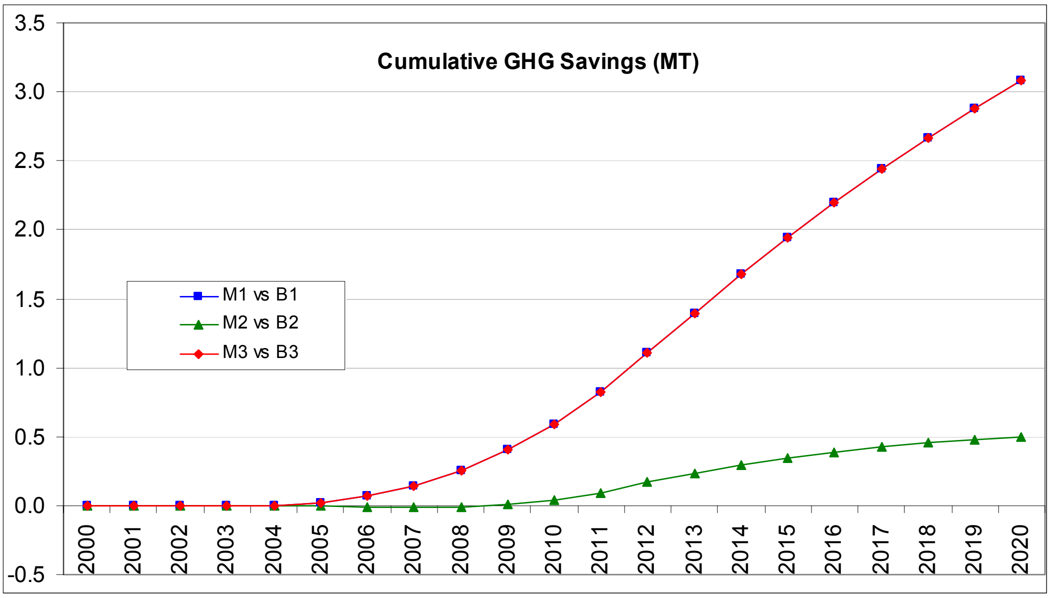
4.1.3 National Benefits And Costs

Greenhouse Gas Emissions

Each of the three mandatory MEPS scenarios modelled results in greenhouse gas emissions reductions. Figure 19 illustrates the cumulative greenhouse gas emissions reductions of each MEPS scenario, against its corresponding BaU scenario. MEPS scenario M1 and M3 result in the greatest reductions.

M2 results in the least reductions, due to the fact that M2 assumes a rapid BaU decline in halophosphate lamps (see figure Figure 18), which will be only slightly accelerated by mandatory MEPS.

Figure 19 - Cumulative Greenhouse Gas Emission Savings, 2005-2020



From the scenarios modelled, it is estimated that mandatory MEPS will result in cumulative greenhouse gas abatement of between 0.5 and 3.1 million tonnes CO^2e over the period 2005 – 2020.

Lamp Lifecycle Costs

The cost-effectiveness of lamp selection from the end user's perspective was explored in section 1.5.2. It depends on the electricity price, the additional costs of more efficient lamps, annual operating hours, the lamp service life and whether the space is air conditioned. This section aggregates the costs and benefits at the national level. Calculation of the national weighted average electricity costs is also explained in section 1.5.2.

The cost-benefit model used in this RIS does not accurately replicate the end user perspective, but calculates costs and benefits directly at the national level from national average values. For example, users with longer lamp operating hours (business users) will derive greater benefits from a particular MEP level, while those with shorter operating hours (residential users) will be worse off at MEPS levels that are cost-effective nationally. The effects on these end use classes are analysed in section 1.5.2.

Figure 20 to Figure 22illustrate the lifecycle costs of MEPS (including capital and operating costs) versus each BaU case, for each of the three modelled MEPS scenarios.

Figure 20 – Lifecycle Costs - MEPS M1 vs BaU B1

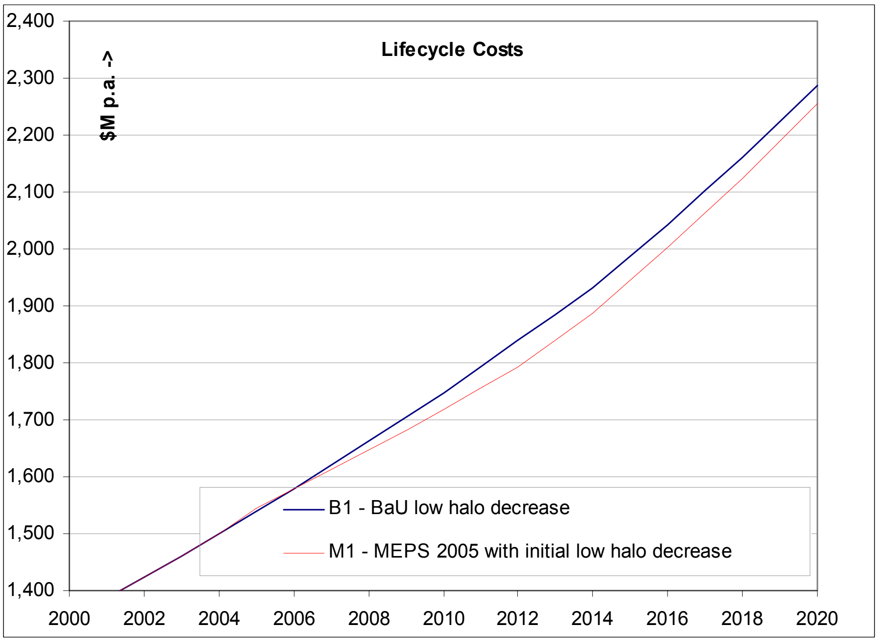


Figure 21 – Lifecycle Costs - MEPS M2 vs BaU B2

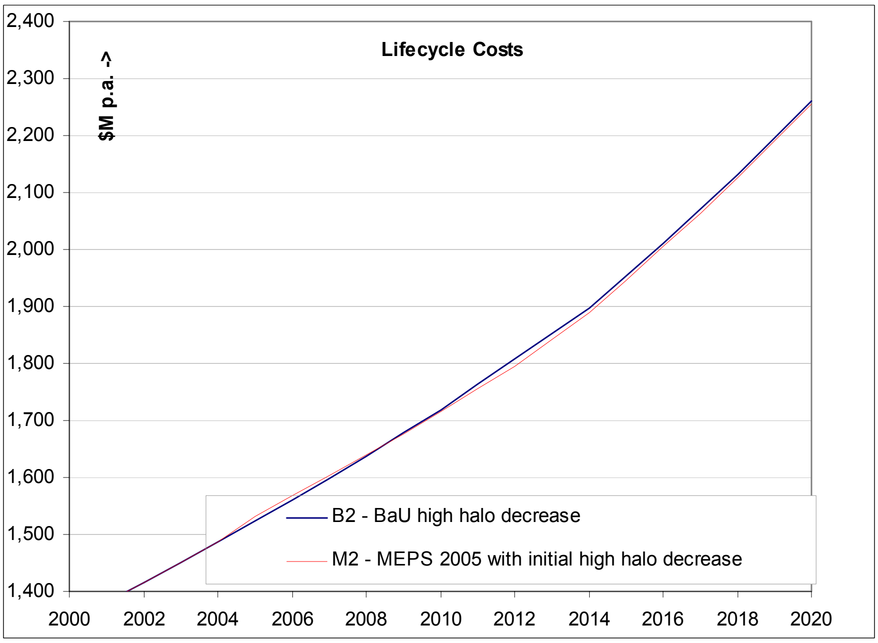
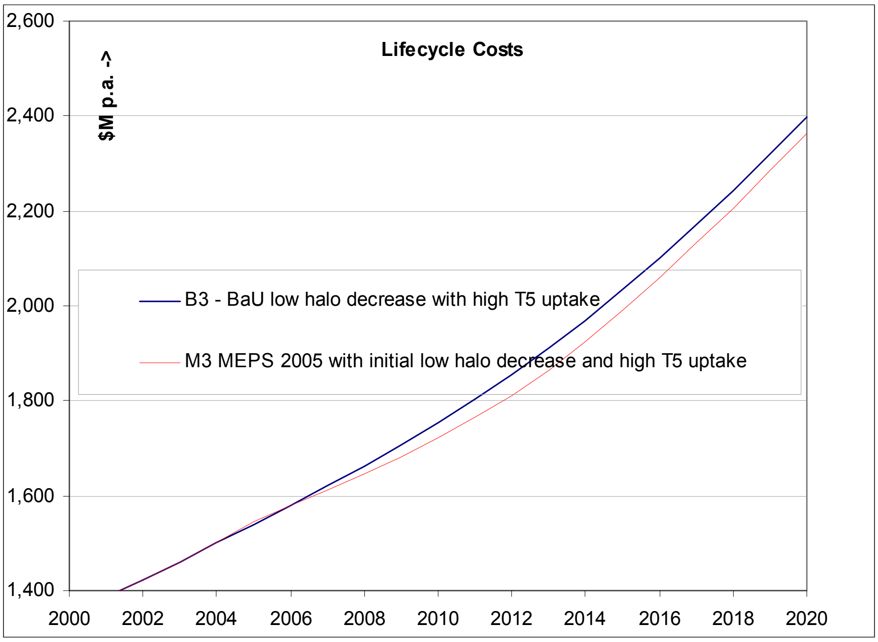


Figure 22 – Lifecycle Costs - MEPS M3 vs BaU B3



Each scenario creates a national cost advantage. Scenario M2 creates only a marginal cost advantage, due to the rapid BaU decline in halophosphate lamps being only slightly accelerated by mandatory MEPS.

Program Costs

Conformance with mandatory MEPS will require lamp manufacturers to carry out tests in accordance with the relevant Australian standards. However, most manufacturers carry out energy testing as part of normal product development, so the actual marginal cost of preparing a test report for MEPS compliance purposes is negligible. The mandatory MEPS program would also impose costs on governments. Some of these are fixed and some vary from year to year. The government costs comprise:

> Administration of the program by government officials (salaries and overheads, attendance at NAEEEC and Standards meetings etc).

> Cost of maintaining a registration and approval capability.

> Random check testing to protect the integrity of the program.

> Costs of producing leaflets and other consumer information.

> Consultant costs for Standards development, market research, RIS, etc.

It is difficult to identify the actual costs to each jurisdiction, so the following simplified assumptions have been made:

> Salary and overheads for officials administering the program total $50,000 per year.

> Check testing, research and other costs underpinning the program total $ 75,000 per year, half of it borne by the Commonwealth and the other half by other jurisdictions in proportion to their population, in accordance with long-standing cost-sharing arrangements for NAEEEC activities.

> Printing and promotional activities at $25,000 per year.

Hence the total cost of administering the program is estimated at approximately $150,000 per year. These costs have been included in the national cost-benefit analyses.

4.1.4 Lamp / Ballast Compatibility

From discussions with industry, the majority of existing T12 and T8 halophosphate lamp installations are compatible with T8 triphosphor lamps. The exception is when installations are installed with older style 'rapid start' control equipment for T12 lamp installations. This style of control equipment is quickly declining in popularity, and discussions with industry reveal that currently only around 15% of existing installations fall into this category, for example in NSW public schools.

There are two options for addressing this incompatibility. Changing the rapid start circuitry to suit T8 triphosphor lamps would involve replacing the ballast and starter switch (total cost around $10), but would require around 20 minutes of labour to undertake (estimated cost around $20) resulting in a total cost of around $30 per lamp.

Alternatively, lamp suppliers report that there are compatible 900mm and 1200mm T12 triphosphor lamps available that could be used as a substitute in the meantime, and that potentially 600mm and 1500mm T12 triphosphor versions could also be manufactured. The modelling undertaken for this RIS suggests that the total Australian stock of 600mm and 1500mm rapid start units is in the order of 700,000 (14 million T12 lamps x 15% being rapid start x 35% being either 600mm or 1500mm). Hence the one-off cost of addressing this issue is estimated at $30 x 700,000 = $21M. This cost has been included in the national cost-benefit analysis, over the first four years of the MEPS program. However, the cost-benefit analysis is not particularly sensitive to this cost, as the net total (undiscounted) benefit of mandatory MEPS (to 2020) varies from $58M (worst case) to $474M (best case).

T5 lamps are not compatible with halophosphate lighting installations. They are shorter in length and require a high frequency electronic ballast. However this does not have any effect as this RIS assumes that MEPS will lead to the installation of T8 triphosphor lamps, and that the uptake of the more expensive T5 lamp installations will follow business as usual, regardless of MEPS.

4.1.5 Other MEPS Levels

The MEPS option analysed above is based on the phasing out of all halophosphate lamps (T12 and T8). It would also be possible to phase out only T12 halophosphate lamps, or indeed to phase out T12 halophosphate, T8 halophosphate and T8 triphosphor (effectively mandating T5 triphosphor). These are the only three MEPS options available, as the efficacies of common linear fluorescent lamp types exist in four discreet narrow bands.

Phasing out only T12 halophosphate lamps results in (best-case) reduced lifecycle cost savings of $280M (undiscounted total cost savings until 2020) when compared to $474M for phasing out all halophosphate lamps (best-case). Total greenhouse gas abatement (to 2020) of 1.9 Mt results for phasing out T12 halophosphate, when compared to 3.1 Mt for phasing out all halophosphate lamps. Thus, it can be concluded that the proposed MEPS option of phasing out all halophosphate lamps, when compared to phasing out only T12 halophosphate lamps, results in improved cost savings and more significant greenhouse gas abatement.

Phasing out of all lamp types except T5 triphosphor would result in greenhouse gas abatement of 26 Mt (to 2020), but would not be cost effective, with a significant net increase in lifecycle costs. Although this does not include any positive impact from future reductions in the cost of T5 lamps, mandating these lamps would not become cost effective until such a reduction occurs. It should also be noted that mandating T5 lamps would be likely to hasten their reduction in price, although this effect is uncertain at this time.

In conclusion, the proposed MEPS option of phasing out all halophosphate lamps results in the greatest combined greenhouse gas abatement and economic benefit. It should also be noted that New Zealand has already taken this approach (discussed in section 4.2). The Trans-Tasman Mutual Recognition Agreement (TTMRA) states that any product that can be lawfully manufactured in, or imported into, either Australia or New Zealand may be lawfully sold in the other jurisdiction. Adoption of differing MEPS levels in Australia, for example MEPS that only phases out T12 halophosphate lamps, would result in the ability for T8 halophosphate lamps to be sold in New Zealand, which would undermine the NZ intent.

4.2 Industry, Competition And Trade Issues

Industry Issues

The previous section examines the costs and benefits of the MEPS options from the perspective of lamp buyers and users. It was assumed that all compliance costs incurred by suppliers are eventually passed on to buyers in the normal course of business. Hence for the purposes of cost-benefit analysis the cost impact on lamp suppliers as a group is neutral. There may however be some cost benefits for suppliers due to a reduction in the range of lamp types carried, and some increased profit derived from the transition to higher priced lamps (assuming a consistent percentage profit margin).

As all linear fluorescent lamps are currently imported, MEPS will not affect material and sub-component suppliers within Australia.

Competition

It is understood that, since ELMA ceased supplying halophosphate lamps, all major lamp suppliers in Australia supply approximately equal proportions of halophosphate and triphosphor lamps. Hence MEPS is not considered to favour one supplier over another.

Trade

GATT issues

One of the requirements of the RIS is to demonstrate that the proposed test standards are compatible with the relevant international or internationally accepted standards and are consistent with Australia's international obligations under the General Agreement on Tariffs and Trade (GATT) Technical Barriers to Trade (GTBT) Agreement. The relevant part of the *GTBT Technical Regulations and Standards* is Article 2: *Preparation, Adoption and Application of Technical Regulations by Central Government Bodies*. These are addressed below.

As all linear fluorescent lamps are currently imported, MEPS would not discriminate against imports.

It is a particular concern of the GTBT that where technical regulations are required and relevant international standards exist or their completion is imminent, members should use them, or the relevant parts of them, as a basis for their technical regulations. The energy test procedures and conditions in the forthcoming Australian Standard are fully consistent with, and in some cases reproduced verbatim from, the most widely used international standards. Since many countries have lamp test standards based on the same international models, it will be possible for importers to use pre-existing test data.

The GTBT urges GATT members to give positive consideration to accepting as equivalent the regulations of other Members, even if these regulations differ from their own, provided they are satisfied that these regulations adequately fulfill the objectives of their own regulations.

There would be scope for accepting the results of lamp tests conducted in other countries under comparable standards. However, there is no scope for accepting a lamp that may comply with MEPS in its country of origin (eg in the EU) unless it also complies with Australian MEPS levels. The GATT does not prevent countries from setting MEPS levels according to their own requirements, costs and benefits.

In summary, the proposed regulations are fully consistent with the GATT Technical Barriers to Trade Agreement, and follow international standards where possible.

Trans-Tasman Mutual Recognition Agreement

Another trade issue is the Trans-Tasman Mutual Recognition Agreement (TTMRA). This states that any product that can be lawfully manufactured in, or imported into, either Australia or New Zealand may be lawfully sold in the other jurisdiction. The New Zealand government is currently regulating MEPS for lamps (NZNZHB 4782.2 : 2001). New Zealand MEPS levels for linear fluorescent lamps are described in Table 11.

Table 11: Performance of Electrical Lighting Equipment - Tubular Fluorescent Lamps - MEPS (NZ)

Class	Nominal Lamp Length (mm):	550-600	850-900	1150-1200	1450-1500
Q	Initial Efficacy (F_{100})	≥ 70.0	≥ 74.0	≥ 85.0	≥ 85.0
R	Initial Efficacy (F_{100})	< 70	< 74	< 85	< 85
	Maintained Efficacy (F_M)*	≥ 57.5	≥ 61.0	≥ 70.0	≥ 70.0

Note: Fm = 70% of the lamp rated life.

New Zealand MEPS states that each tubular fluorescent lamp shall meet the requirements for class 'Q' or Class 'R' (see table below).

The standards committee EL-41-8 has drafted a new joint standard AS/NZS 4782.2 which contains the MEPS requirements outlined in Table 12. The New Zealand Government has agreed that this will replace the existing New Zealand regulation NZNZHB 4782.2:2001 confirmed].

Table 12 – Draft Joint MEPS Australia / New Zealand

Lamp nominal length (mm) (mandatory):	550 ≤ l < 700	700 ≤ l < 1150	1150 ≤ l < 1350	1350 ≤ l ≥ 1500
Lamp typical power (watts) (informative):	16 – 24	17 – 40	28 – 5	35 – 80
Initial efficacy:	$F_{100} \geq 66.0$	$F_{100} \geq 74.0$	$F_{100} \geq 80.0$	$F_{100} \geq 85.0$
	and	and	and	and
Maintained efficacy:	$F_M \geq 57.5$	$F_M \geq 61.0$	$F_M \geq 70.0$	$F_M \geq 70.0$

4.3 Benefits and Costs of Other Options

The alternative options put forward (voluntary MEPS, mandatory labelling and levy programs) all seek to accelerate the transition from halophosphate lamps to triphosphor lamps. The key variable is the rate at which halophosphate lamps are replaced with triphosphor lamps, or simply the rate of decrease in halophosphate stocks. Mandatory MEPS would effectively remove halophosphate lamps from the Australian stock within a few years. The other options put forward would remove halophosphate stocks at varying rates and with varying program costs.

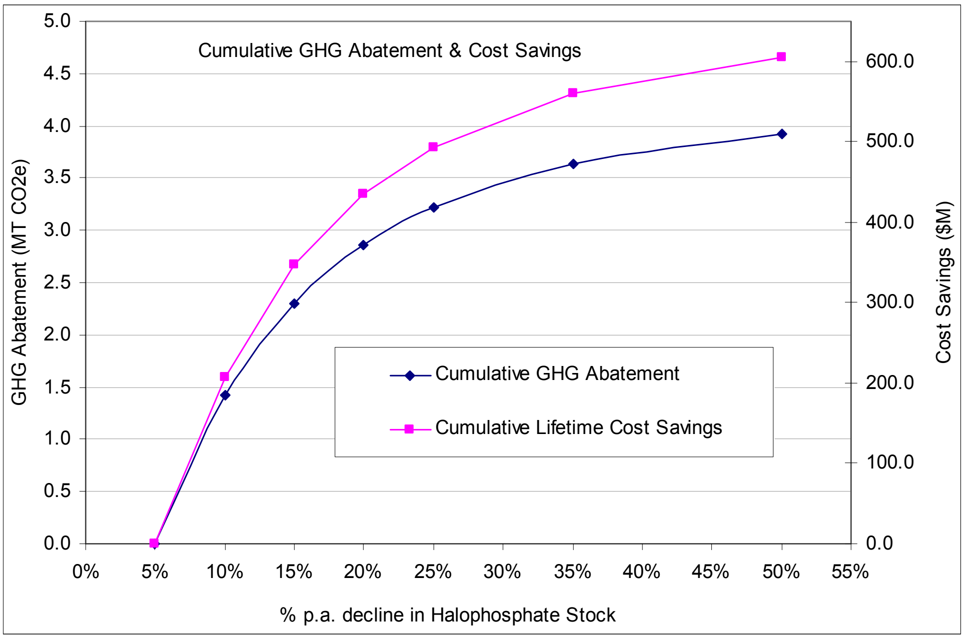
Mandatory MEPS is the only option that would prohibit the sale of halophosphate lamps (as their efficacy is largely unchangeable). The other options all rely on voluntary means of reducing sales of halophosphate lamps (including mandatory labelling, which requires a mandatory label but does not remove the voluntary choice of lamp from the consumer as mandatory MEPS does). Experience with voluntary programs worldwide shows that It is unlikely that any voluntary program could totally eliminate the sale of halophosphate lamps, if given a realistic program budget. Estimated program costs for all options are presented in Table 13.

Table 13 – Estimated Program Costs

Option	Industry Costs p.a.	Government Costs p.a.			Total Costs p.a.
		Salaries & Overheads	Check Testing	Printing & Promotional	
Status Quo	$0	$0	$0	$0	**$0**
Voluntary MEPS	$0	$150k	$25k	$100k	**$225k**
Levies	$0	$250k	$0	$150k	**$400k**
Mandatory Labelling	$500k	$150k	$75k	$250k	**$975k**
Mandatory MEPS	$0	$50k	$75k	$25k	**$150k**

The effect of the rate of removal of halophosphate lamps on greenhouse gas abatement and lifecycle costs is illustrated in Figure 23, which depicts the relationships between the decline in halophosphate stock from year to year (as a percentage of the previous year's stock) against the level of cumulative greenhouse gas abatement as well as lifecycle costs. Figure 23 assumes that the BaU rate of decline is 5% p.a. (ie the same as BaU scenario B1).

Figure 23 – Relationship between decline in halophosphate stock and greenhouse gas abatement & Lifecycle Cost Savings



From Figure 23 it is evident that, as long as the rate of decline of halophosphate stock is greater than 5% (i.e. BaU), greenhouse gas abatement and lifecycle cost savings will occur. The greater the rate of decline of halophosphate stock, the greater the benefits. This is due to the fact that T8 triphosphor lamps are more efficient and more cost effective, per unit of light output, than halophosphate lamps.

The alternatives presented here involve greater program costs than mandatory MEPS, and would not remove halophosphate lamps from the market as quickly as mandatory MEPS. Hence mandatory MEPS is considered to be the most effective option for achieving this aim, and for achieving the primary objective of the proposed regulation, that is to bring about a reduction in greenhouse gas emissions from the use of linear fluorescent lamps.

5 CONSULTATION

5.1 Consultations

5.2 Comments

5.2.1 Comments Received Prior to Publication of Draft RIS

In 2002 NAEEEC published a proposal for the regulation of lamps, in the form of a 'product profile', based on the original study undertaken by MEA in 2001. In June 2002, the AGO published an addendum to the MEA report to bring it up to date. Copies of these reports and recommendations have been circulated to the lighting industry and other stakeholders during 2002, and written comments were received from:

> The Sustainable Energy Industry Association (SEIA).
> Rexel Lighting.
> NSW Department of Public Works and Services.
> AEEMA.

The following is a summary of responses to the NAEEEC Proposal, together with recommendations for appropriate actions.

SEIA

Response: Peter Szental supports the Energetics proposal, on behalf of SEIA (Sustainable Energy Industry Association, now part of the Business Council for Sustainable Energy). In addition, SEIA notes the need for government intervention to address the institutional barriers to cost-effective energy efficiency, which SEIA claim would result in over 10Mt of abatement and $1b annual energy savings in the built environment sector.

Recommendation: The issue raised is beyond the scope of MEPS, however they could be partially addressed by a Best Practice Program, and specific projects funded by GGAP.

Rexel Lighting

Response: On behalf of Rexel Lighting, Ed Buckett points out that the Energetics MEPS proposal appears to be inconsistent with the New Zealand standard (NZHB 4782.2: 2001).

Rexel's interpretation is that the Energetics proposal (table on page 7 of proposal) specifies MEPS for fluorescent lamps based on dual requirements for minimum Initial Efficacy (F_{100}) and for minimum Maintained Efficacy (F_M).

If this interpretation of the table is correct, that is both the F_{100} and F_M requirements need to be satisfied (rather than one or the other), then this proposal is not harmonised with New Zealand requirements.

However, if columns 3 and 4 of the table represent an 'either/or' criteria, then the table would appear to mimic the approach of the New Zealand standard.

The New Zealand standard requires that lamps meet either class Q or class R requirements, as outlined in the following table.

Class	Nominal Lamp Length (mm):	550-600	850-900	1150-1200	1450-1500
Q	Initial Efficacy (F_{100})	≥ 70.0	≥ 74.0	≥ 85.0	≥ 85.0
R	Initial Efficacy (F_{100})	< 70	< 74	< 85	< 85
	Maintained Efficacy (F_M)	≥ 57.5	≥ 61.0	≥ 70.0	≥ 70.0

The requirement for Class Q lamps is that the Initial Efficacy is greater than a specified minimum level. Class R lamps do not meet the minimum Initial Efficacy requirement of Class Q, but display a Maintained Efficacy greater than a specified minimum level.

In order to meet the New Zealand standard, lamps must be either Class Q or Class R. Put simply, complying lamps must either display a minimum specified Initial Efficacy or a minimum specified Maintained Efficacy.

If the Energetics proposal requires compliance with both the F_{100} and F_M minima, then certain lamps which are acceptable to New Zealand would be ruled out of the Australian market.

In addition, Rexel point out that lamp measurements made in accordance with IEC 60081 should incorporate an exemption that tests on T5 lamps may be made at an ambient temperature of 35°C rather than 25°C.

Recommendation: Australian and New Zealand MEPS are being harmonised (see section 4.2) and it is likely that the requirement will be for lamps to meet both the initial and maintained efficacy requirements.

NSW Department of Public Works and Services

Response: On behalf of the NSW Department of Public Works and Services, Don Eadie highlights the issue of existing luminaires that will not operate with any of the T8 triphosphor lamps currently available.

In particular, a proportion of the luminaires installed in NSW Government schools were designed for T12 halophosphor lamps, and are not compatible with currently available T8 lamps. It appears that local suppliers may offer a suitable 1200mm triphosphor equivalent, however it is unknown whether a suitable 1500mm replacement will become available.

Recommendation: The aim of MEPS is to see less efficient products phased out, and this will mean that some existing luminaires will need to be changed. In this case, if replacement lamps do not become available, the existing luminaires will need to be replaced with T5 or T8 compatible luminaires, or converted to electronic switch-start in order to be compatible with T8 triphosphor lamps.

It is possible that new products will emerge on the market to meet this particular demand. It implications of replacement lamps, starters and fittings (if required) will be analysed at the regulatory impact assessment stage. Analysed in section 4.1.4 of this RIS.

AEEMA

Response: On behalf of AEEMA, Kristen Egan makes several comments in response to the NAEEEC proposal.

1. AEEMA note that almost all T8 emergency lighting products have been tested and approved using halophosphate lamps. The differences between halophosphate and triphosphor lamps may mean that these units have to be re-tested and re-qualified.

2. AEEMA state that the majority of installed T8 emergency lighting products have been designed to work exclusively with halophosphate lamps, and that using triphosphor lamps in these products may result in increased battery drain and failure of emergency inverters.

3. AEEMA also note that many specialised lighting fittings use halophosphate lamps to achieve a specialised lighting effect.

Recommendation: 1. & 2. It is recommended that these technical issues be fully assessed during the Australian Standard drafting process and that due consideration be given to methods for dealing with any technical issues arising.

3. The Energetics proposal (page 8) suggests that Australian MEPS should incorporate a set of exclusions that allows specific applications to be exempted from MEPS, in line with the New Zealand Standard. It is recommended that Australian MEPS be harmonised with the exemptions in the New Zealand standard.

Lighting Centre of Excellence

Response: On behalf of the Lighting Centre of Excellence, Neil Wills states that the Centre generally agrees with most of the recommendations of the Energetics proposal.

The Centre states that the assumption that improved light output from triphosphor lamps will allow a reduction in the number of lamps may be too simplistic.

The Centre also notes that energy consumption (by lighting and HVAC equipment) would be further reduced if T5 lamps and electronic control gear were mandated to replace conventional T8 lamps and ballasts.

Recommendation: It is recommended that the cost-effectiveness of triphosphor lamps (including any impact on required numbers of lamps) be fully assessed at the regulatory impact assessment stage.

Fluorescent ballasts will be mandated from 1 March 2003 and further revisions of MEPS for lamps will consider increasing the stringency of the requirements to a level which effective mandates T5 lamps.

5.2.2 Comments on Draft RIS

6 EVALUATION AND RECOMMENDATIONS

COAG Guidelines:

> Evaluation: there should be an evaluation of the relative impacts of the proposal and any alternatives, to show that the desired policy objective cannot be achieved at a lower cost to business and the community at large.

6.1 Assessment

This section contains a summary assessment of the alternatives considered in this RIS against the objectives of the mandatory MEPS option.

Reduce Greenhouse Gas Emissions Below Business as Usual

From the time of its implementation, mandatory MEPS will immediately remove halophosphate lamps from sale. Based on an average life of 4 years, the majority of halophosphate lamps will therefore be removed from the Australian stock within 8 years. Hence mandatory MEPS will cause halophosphate stocks to effectively decrease to zero in approximately a linear fashion.

It is expected that, due to their voluntary nature, the other options will not reduce halophosphate stocks to zero in a linear fashion. This is because the other options do not have the ability to cease sales of halophosphate lamps immediately. Rather sales will most likely decrease each year by a proportion of the previous year's sales, as the program gathers momentum. The result is that stocks will also decrease over time in this exponential fashion.

Table 14 contains estimates of the cumulative greenhouse gas emissions reductions (2005-2020) for mandatory MEPS (based on a linear decrease in stock) and for the other options (based on an exponential decrease in stock).

Table 14 – Greenhouse Gas Emissions Reductions from MEPS and Other Options

		Cumulative Greenhouse Gas Emissions Reductions (MT CO2e)		
		Versus BaU1	**Versus BaU2**	**Versus BaU3**
Mandatory MEPS:		3.1	0.5	3.1
Other Options (with varying year-on-year % decrease in stock):	10% p.a. decrease	0.12	N/A	0.12
	15% p.a. decrease	0.17	N/A	0.17
	20% p.a. decrease	0.19	0.01	0.19
	25% p.a. decrease	0.20	0.02	0.20
	30% p.a. decrease	0.20	0.02	0.20
	40% p.a. decrease	0.20	0.02	0.20
	50% p.a. decrease	0.20	0.02	0.20

Due to its non-voluntary nature, mandatory MEPS option has the highest probability of reducing greenhouse gas emissions below business as usual.

Address Market Failures

By requiring the removal of halophosphate lamps from the market, mandatory MEPS will most effectively address market failures, so that the average lifetime costs of linear fluorescent lamps are reduced. All other options rely on voluntary mechanisms and therefore cannot as effectively require that average lifetime costs are taken into account (i.e. by mandating lamps with lowest lifetime costs).

The average annual cost per lumen for linear fluorescent lamps (from section 1.5.2) is reproduced in Table 15. These include capital, energy and replacement costs.

Table 15 - Average Lamp Characteristics

Weighted Average	T12 Halo	T8 Halo	T8 Tri	T5 Tri
Total annual cost per lumen (enduser) (cents p.a.):	0.93	0.77	0.75	0.99

As can be seen in Table 15, there is currently only a marginal difference between T8 halophosphate and T8 triphosphor lamp costs, although it is likely that triphosphor lamps will continue to decrease in price which will improve their cost effectiveness. It should also be noted that the cost modeling does not include any environmental externalities such as greenhouse gas emissions.

Address Information Failures

Mandatory MEPS will not effectively provide buyers with improved access to product performance information, nor will any of the other options, with the exception of labelling. However by requiring the purchase of efficient lamps, mandatory MEPS essentially makes this requirement redundant.

Minimise the Risk of Negative Impact on Product Quality and Function

All options are thought to increase product quality and function, as triphosphor lamps are accepted as being superior in quality and function to halophosphate lamps.

Minimise the Risk of Negative Impacts on Suppliers

The mandatory MEPS option would clearly require lamp suppliers to change their import patterns to remove non-complying products. This is not thought to involve negative impacts on suppliers as the volume of sales would not be substantially affected. There may be an additional benefit in that the range of products they would be required to support would decrease rather than increase. The other options would have similar negligible impacts on suppliers, with the exception of mandatory labelling which would involve significant labelling costs.

Benefits Versus Costs, in Light of any Potential Restriction in Competition

As discussed in section 4.2, mandatory MEPS is unlikely to restrict competition between lighting suppliers, as it is understood that all major lamp suppliers in Australia supply approximately equal proportions of halophosphate and triphosphor lamps. However any potential for restriction of competition must be viewed in light of the net positive financial benefit of MEPS and the resultant greenhouse gas abatement.

Restriction of Competition no More than Necessary in the Public Interest

As discussed in section 4.2, mandatory MEPS is unlikely to restrict competition between lighting suppliers. However any potential for restriction of competition must be viewed in light of the public interest in net positive financial benefits and greenhouse gas abatement that MEPS will create.

Conclusions

After consideration of the mandatory MEPS option and the provisions of the Standard in this RIS, it is concluded that:

> The mandatory MEPS option is likely to be effective in meeting all the stated objectives.

> None of the non-MEPS alternatives examined appear as effective in meeting all objectives. Some would be completely ineffective with regard to some objectives and some appear to be considerably more difficult or costly to implement.

> Given that the proposal for MEPS has been in the public domain since June 1997, and is to be issued for public comment as a draft standard in August 2003, the program could be implemented as early as October 2004.

6.2 Recommendations

It is recommended that:

> States and Territories implement mandatory minimum energy performance standards for linear fluorescent lamps.

> The mode of implementation be through amendment of the existing regulations governing appliance energy labelling and MEPS in each State and Territory, to add fluorescent lamps to the schedule of products for which minimum energy performance standards are required.

> The regulations refer to the forthcoming Australian and New Zealand Standard 4782.2 Double Capped Fluorescent Lamps.

> The amendments take effect on 1st October 2004.

> State and Territory governments should require registration of lamp models, so invoking Part 2 of the proposed Standard.

> Governments re-examine, no later than 2007, the costs and benefits of revising the MEPS levels and other options for further increasing the energy efficiency of linear fluorescent lamps.

7 REVIEW

Lamp MEPS would be implemented under the same State and Territory regulations as household appliance labelling and MEPS, and so subject to the same sunset provisions, if any. Victoria and South Australia have general sunset provisions applying to their labelling/MEPS regulations as a whole, while NSW has sunset provisions applying to the inclusion of some (but not all) items scheduled.

Once the States and Territories agree to mandatory requirements, their removal in any one jurisdiction would undermine the effect in all other jurisdictions, because of the Mutual Recognition agreements between the States and Territories. Under the co-operative arrangements for the management of the National Appliance and Equipment Energy Efficiency Program, States advise and consult when the sunset of any of the provisions is impending. This gives the opportunity for revised cost-benefit analyses to be undertaken.

The Australian Standards called up in State and Territory labelling MEPS regulations are also subject to regular review. The arrangements between the Commonwealth, State and Territory governments and Standards Australia provide that the revision of any Standards called up in energy labelling and MEPS regulations are subject to the approval of the governments.

Therefore any proposal to make lamp MEPS in an Australian standard either more or less stringent would need the cooperation of both the standards bodies and of the regulators.

NAEEEC has adopted the principles that there should be a MEPS 'stability period' of at least 4 years, and that a cost-benefit analysis would be undertaken before any revisions are proposed. The earliest possible timing of any change to the MEPS regulations discussed in this RIS would therefore depend on date of their implementation. If they are implemented in October 2004, the earliest possible revision would be October 2008. However, it would be necessary to carry out a study well in advance of that time, so that adequate notice could be given to industry in the event that a change were justified.

8 MEPS – IMPACTS ON NEW ZEALAND

8.1 Current New Zealand MEPS

The New Zealand government has been regulating MEPS for lamps (New Zealand Handbook 4782.2: 2001) from 1 July 2002. The current New Zealand MEPS levels for linear fluorescent lamps are described in Table 16.

Table 16: Performance of Electrical Lighting Equipment - Tubular Fluorescent Lamps - MEPS (NZ)

Class	Nominal Lamp Length (mm):	550-600	850-900	1150-1200	1450-1500
Q	Initial Efficacy (F_{100})	≥ 70.0	≥ 74.0	≥ 85.0	≥ 85.0
R	Initial Efficacy (F_{100})	< 70	< 74	< 85	< 85
	Maintained Efficacy (F_M)*	≥ 57.5	≥ 61.0	≥ 70.0	≥ 70.0

Note: Fm = 70% of the lamp rated life.

New Zealand MEPS requires that each tubular fluorescent lamp meets the requirements for either class 'Q' or class 'R'. This means that lamps must meet either the minimum initial efficacy requirement or the minimum maintained efficacy requirement. The maintained efficacy is defined at lamp life of 70% of the rated lifetime of the lamp.

8.2 Proposed Australia / New Zealand MEPS

The standards committee EL-41-8 has drafted a new joint standard AS/NZS 4782.2 which contains the MEPS requirements outlined in Table 12. The New Zealand Government has agreed that this will replace the existing New Zealand regulation NZNZHB 4782.2: 2001 confirmed].

Table 17 – Draft Joint MEPS Australia / New Zealand

Lamp nominal length (mm) (mandatory):	**550 ≤ l < 700**	**700 ≤ l < 1150**	**1150 ≤ l < 1350**	**1350 ≤ l ≥ 1500**
Lamp typical power (watts) (informative):	16 – 24	17 – 40	28 – 5	35 – 80
Initial efficacy: Maintained efficacy:	$F_{100} \geq 66.0$ And $F_M \geq 57.5$	$F_{100} \geq 74.0$ and $F_M \geq 61.0$	$F_{100} \geq 80.0$ and $F_M \geq 70.0$	$F_{100} \geq 85.0$ And $F_M \geq 70.0$

The maintained efficacy is defined at lamp life of 5000 hrs. The initial efficacy level will be used for testing purposes. Check tests will not be based on maintained efficacy levels, as it is considered impractical to test lamps for 5000 hours prior to taking enforcement action. Figure 24 to Figure 27show the current New Zealand and proposed Australia / NZ MEPS levels as well as actual lamp data for the four proposed lamp length categories.

Figure 24 – MEPS levels & lamp data for lamps 550-700mm

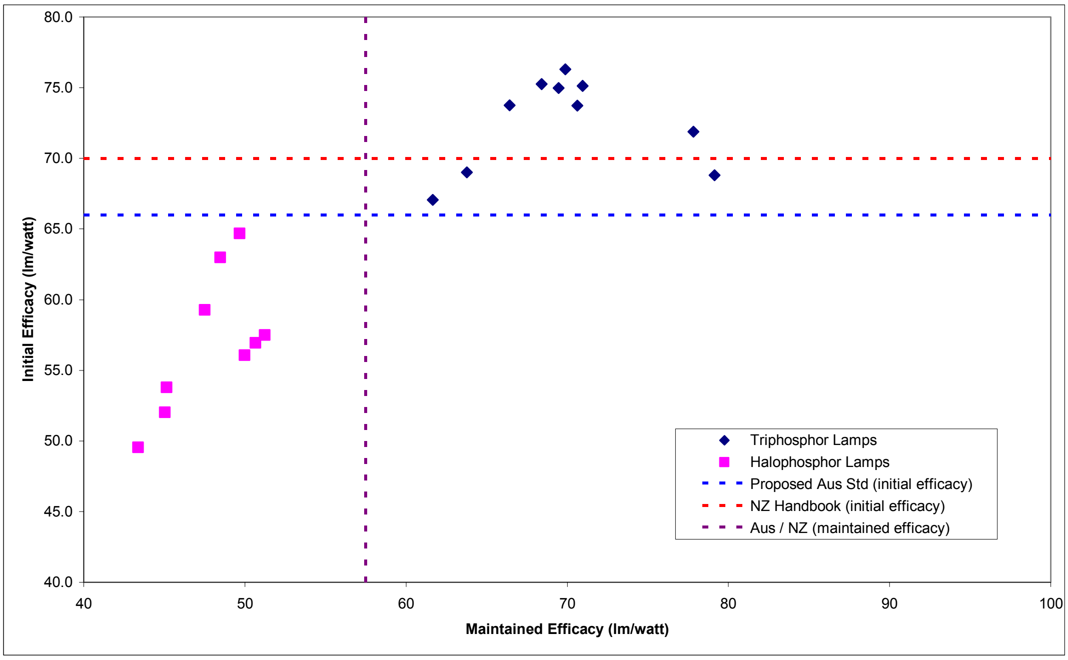


Figure 25 – MEPS levels & lamp data for lamps 700-1150mm

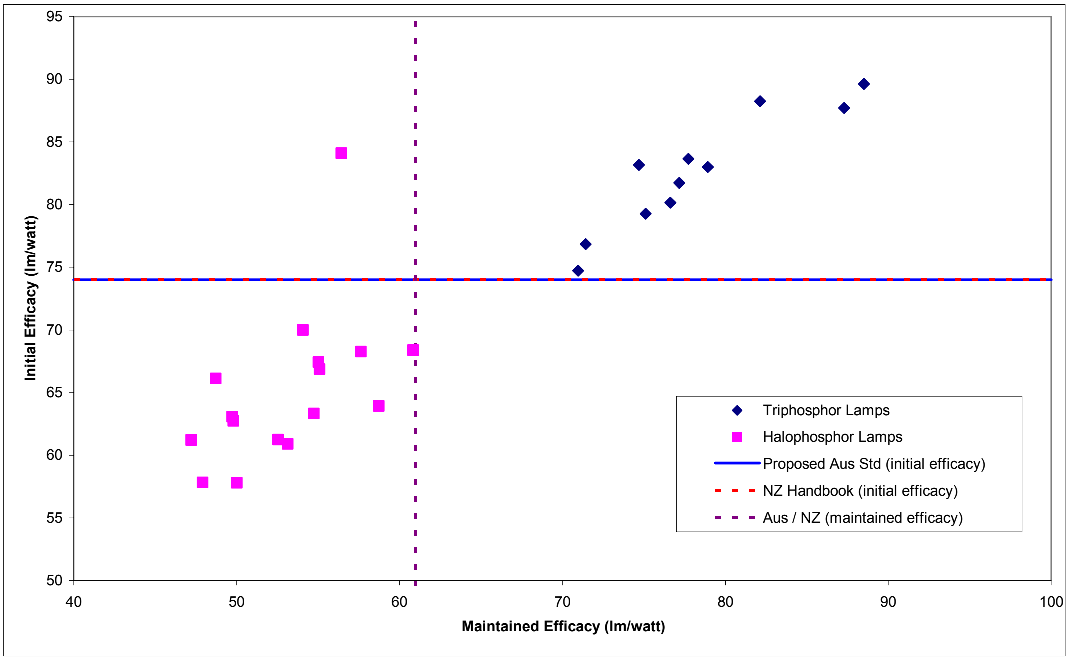


Figure 26 – MEPS levels & lamp data for lamps 1150-1350mm

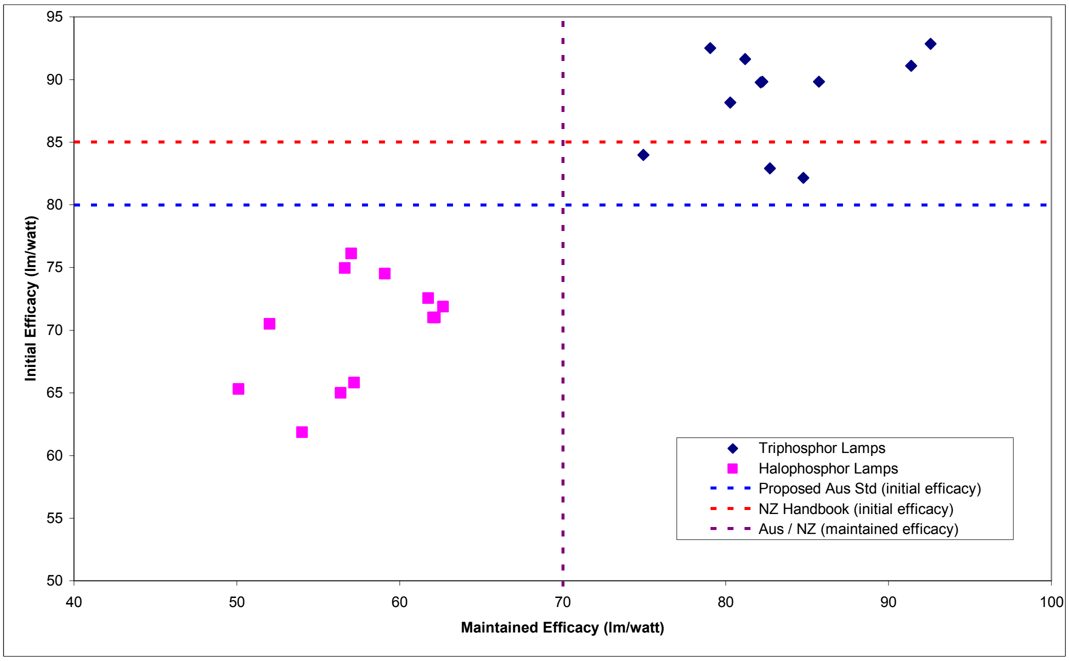
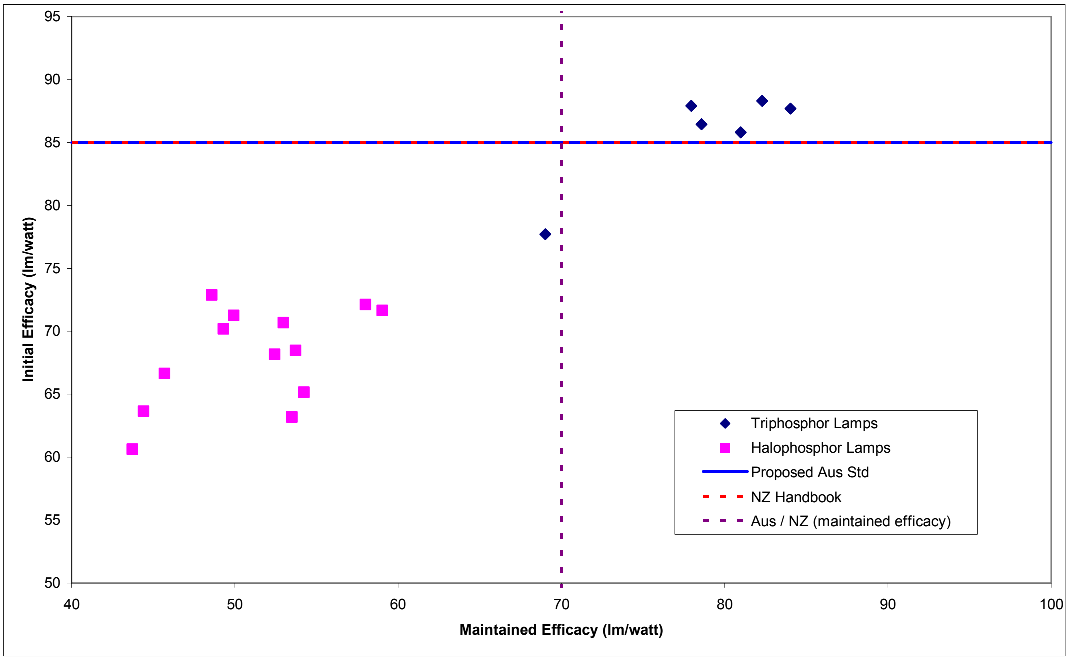


Figure 27 – MEPS levels & lamp data for lamps 1350-1500mm



Under this MEPS regime, the allowable lamps in Figure 24 to Figure 27are those in the top right hand segment, with initial and maintained efficacies greater than the horizontal and vertical MEPS lines respectively. From these figures it is evident that six triphosphor lamps, currently not allowed under New Zealand MEPS, would be allowed under the proposed Australia / NZ MEPS regime.

8.3 Impacts of Proposed MEPS on New Zealand

Adoption of the proposed harmonised MEPS for Australia and New Zealand would impose minor changes to the current New Zealand MEPS for linear fluorescent lamps. The differences between the two MEPS regimes and the estimated impacts on the New Zealand market are summarised in the following sections.

8.3.1 Definition of Maintained Efficacy

In the current New Zealand MEPS, 'maintained efficacy' is defined as the lamp efficacy after 70% of the rated lamp lifetime has expired. The proposed Australia / NZ MEPS defines maintained efficacy as the efficacy after 5000 hours of lamp operation.

Data for the efficacy of lamps at 70% of lamp life (NZ definition) was not available. However data for maintained efficacy at 5000 hours is available. Charts from E-Source 1997 show that for halophosphate lamps the efficacy at 70% of rated lamp life (around 8000 hours for the average halophosphate lamp) is around 2% lower than at 5000 hours. For triphosphor lamps, the difference in efficacy at 70% of rated lamp life (around 14000 hours for the average triphosphor lamp) is similarly around 2% lower than at 5000 hours.

The horizontal axes of Figure 24 to Figure 27show the proposed MEPS requirement for maintained efficacy at 5000 hours, as well as actual lamp data for maintained efficacy at 5000 hours. If the lamp efficacies at 70% of lamp life were plotted on these figures, the data points would shift to the left by around 2%. It does not appear that this would cause any data points to cross the (vertical) maintained efficacy MEPS line. Hence, changing the definition of maintained efficacy from 70% of lamp life to 5000 hours does not appear to have any effect on lamp eligibility. Hence this change is not likely to have an impact on the New Zealand lamp market.

8.3.2 Initial and Maintained Efficacy Tests

New Zealand MEPS currently require that lamps pass either a minimum initial efficacy test or a minimum maintained efficacy test. The proposed Australia / NZ MEPS requires that lamps pass both these tests. From inspection of Figure 24 to Figure 27 it is apparent that all lamps which pass the initial efficacy test also pass the maintained efficacy test (and vice versa), with the exception of one halophosphate lamp. This lamp (in the 700-1150mm category) passes the initial efficacy test (and is therefore permissible under existing NZ MEPS), but does not pass the maintained efficacy test. Under the proposed joint MEPS regime it would subsequently be excluded.

The exclusion of this one halophosphate lamp is similar to the original New Zealand justification for MEPS, which was based on excluding halophosphate lamps in favour of triphosphor. Hence the proposed change to is not thought to have a significant effect on the previously-justified case for MEPS in New Zealand.

8.3.3 Lamp Lengths

According to data supplied by the Australian lighting industry, the lamp length categories used in the NZ Handbook do not cover all the linear fluorescent lamps currently manufactured. Halophosphate lamps manufactured in lengths 720mm, 756mm and 970mm are outside the MEPS lamp length categories described in the New Zealand handbook and would therefore not be subject to MEPS. There is no apparent reason why these lamps, or any new products which also might fall outside the NZ lamp length categories, should be excluded from regulation. As a result, the draft Australian standard has altered the length categories so that they run continuously from 550 mm to 1500 mm, as shown in Table 12.

The apparent impact of this would be to exclude 720mm, 756mm and 970mm halophosphate lamps. However it is not known what the actual availability and market penetration of these lamps is in New Zealand. No halophosphate lamps of these lengths are listed in the current Australian price lists for Sylvania, Osram or Philips (Sylvania 2003b, Osram 2003, Philips 2003b). This would suggest that the popularity of these lamps lengths is extremely low or zero. If this is the case in New Zealand, then the effect of excluding these lamps is nil.

In the unlikely scenario that these halophosphate lamps are currently sold in significant quantities in New Zealand, then their exclusion is similar to the original New Zealand justification for MEPS, which was based on excluding halophosphate lamps in favour of triphosphor. Hence the proposed change to is not thought to have a significant effect on the previously-justified case for MEPS in New Zealand.

8.3.4 Initial Efficacy Requirements

There are two proposed changes to the initial efficacy MEPS levels. The required minimum initial efficacy of lamps with length 550-700mm would be reduced from 70 to 66 lm/watt, and the minimum initial efficacy of lamps with length 1150-1350mm would be reduced from 85 to 80 lm/watt. In each case, the reduction is necessary to incorporate three triphosphor lamps that otherwise would not meet MEPS. In New Zealand this will have the effect of including six additional triphosphor lamps that currently do not achieve MEPS (assuming that these six lamps are, or will at some stage be, available in New Zealand).

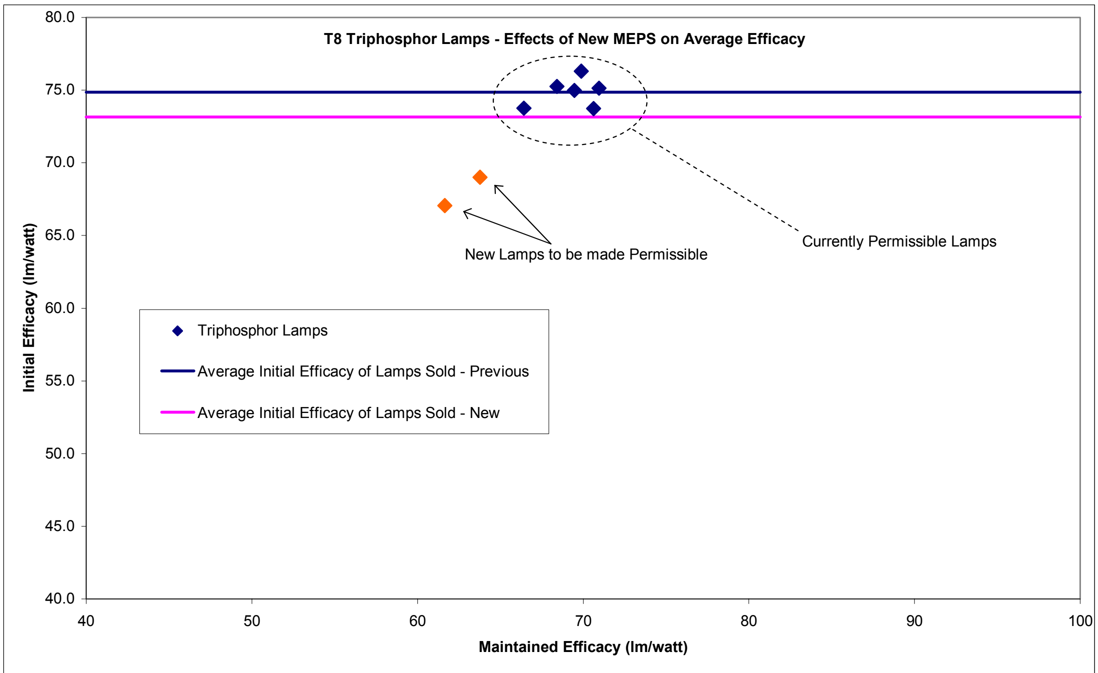
From analysis of lamp data provided by manufacturers, this would have the effect of allowing an additional six triphosphor lamps to be sold in the New Zealand market, in addition to the triphosphor lamps currently permissible. The characteristics of these six lamps are listed in Table 18.

Table 18 – Additional Lamps to be Included

Ref No.	Type	Length (mm)	100 Hours Power (watt)	100 Hours Lumens	100 Hours Efficacy (lm/w)	5000 Hours Power (watt)	5000 Hours Lumens	5000 Hours Efficacy (lm/w)
A	T8	590	17.5	1208	69.0	1117	17.5	63.8
B	T8	590	17.6	1182	67.0	1087	17.6	61.6
C	T5	550	22.9	1578	68.8	1820	23.0	79.1
D	T8	1199	36.9	3102	84.0	2763	36.9	74.9
E	T5	1150	52.6	4317	82.1	4503	53.1	84.8
F	T5	1150	52.6	4359	82.9	4365	52.8	82.7

Lamps A and B are 590mm T8 triphosphor lamps. They represent two of the eight available T8 triphosphor lamps in this length category. Assuming that each of these eight lamp types are sold in equal volumes, inclusion of the two additional lamps would cause the average initial efficacy of T8 triphosphor lamps currently sold to decrease from 74.9 to 73.1 lm/watt (a 2.3% reduction in average efficacy). This reduction is due to the fact that the two additional lamps have lower efficacies than the currently permissible lamps. Hence the average efficacy of permissible lamps would reduce, as illustrated in Figure 28.

Figure 28 – Effects of New MEPS on Average Efficacy of T8 Triphosphor Lamps



Similarly the average maintained efficacy (5000 hours) will reduce from 69.3 to 67.7 lm/watt, or a 2.4% reduction in efficacy. The methodology has been applied to all six lamp types (lamps A to F in Table 18) and the calculated results are listed in Table 19.

Table 19 – Average Efficacy Calculations

	Average Efficacy (lumens / watt)							
	T8 600mm		T5 600mm		T8 1200mm		T5 1200mm	
	100hrs	5000hrs	100hrs	5000hrs	100hrs	5000hrs	100hrs	5000hrs
Existing NZ MEPS	74.9	69.3	71.9	77.8	90.3	81.8	92.0	92.0
Proposes MEPS	73.1	67.7	70.3	78.5	89.4	80.8	87.3	87.9
% Reduction	-2.3%	-2.4%	-2.1%	0.8%	-1.0%	-1.2%	-5.1%	-4.5%
Average % Reduction in Efficacy (100 hrs)	-2.3%		-0.6%		-1.1%		-4.8%	

In Table 19 the maintained efficacy (5000 hours) has been chosen and used in calculations as it represents the worst case reduction in average lamp efficacy.

A weighted average efficacy reduction was calculated across the entire linear fluorescent lamp market, as a result of the introduction of these six lamp types. The following sales weightings were used in this calculation and applied to the reductions in Table 19 for each lamp type (assumed to be the same as Australian sales):

- T8 600mm: 13.9%
- T5 600mm: 0.3%
- T8 1200mm: 24.5%
- T5 1200mm: 0.5%

The result of applying these weightings was a reduction in overall efficacy of linear fluorescent lamps sold in New Zealand of 0.6%. This means that the estimated effect of introducing the additional six triphosphor lamps into the New Zealand market, would be to reduce the overall efficacy of lamps currently sold by 0.6%.

The previously stated assumption, that each of the lamp models within each category occupies an equal market share, can be altered to test its effect on this result. The worst case is assumed to involve the newly included triphosphor lamps occupying three times their initially assumed market share. This would result in the overall weighted average lamp efficacy reducing by 1.8% from the status quo. This translates to a 1.8% reduction in the energy saving benefits arising from the current New Zealand MEPS scheme, under a worst case scenario.

8.4 Conclusions

8.4.1 Summary of Impacts

The impacts of changing MEPS can be summarised as follows:

1. Changes to the definition of maintained efficacy are not likely to exclude or include any lamps, and therefore would not have an effect on the New Zealand market.
2. Changes to the requirement to pass both initial and maintained efficacy tests would serve to exclude one currently-available halophosphate lamp. This is not likely to have a significant effect on the previously-justified case for MEPS in New Zealand, which is based on excluding halophosphate lamps.
3. Changes to the lamp length categories would exclude three halophosphate lamp lengths, which are not thought to currently be popular in New Zealand. Even if their popularity is significant, the proposed change to is not thought to have a significant effect on the previously-justified case for MEPS in New Zealand, which is based on excluding halophosphate lamps.
4. Changes to the initial efficacy MEPS levels would have the effect of including an additional six triphosphor lamps in the New Zealand market. These lamps have a lower efficacy than the currently permissible lamps and this impact is discussed in the following section.

8.4.2 Benefits and Costs

The most significant effect of altering New Zealand MEPS is thought to result from point 4 in section 8.4.1, that is the inclusion of six additional triphosphor lamps in the New Zealand market. This is not likely to increase the cost of supplying and purchasing fluorescent lamps because the supply and purchase of the additional lamps will not be compulsory and hence only likely to occur if cost effective for the parties involved. This is also balanced by the effect of the proposed MEPS of excluding up to several lamps.

It is also unlikely that there will be any significant additional costs in administering the proposed New Zealand MEPS scheme due to the inclusion of six additional lamp types. Again, this is balanced by the effect of the proposed MEPS in excluding up to several lamps.

As discussed in section 8.3.4, the inclusion of six additional triphosphor lamps would result in a reduction in the benefits of the previously justified MEPS regime by up to 1.8%. As there are not expected to be any significant cost impacts, the overall effect is a reduction in the previously calculated benefit-cost ratio of up to 1.8%.

Table 20 contains the results of the benefit-cost analysis previously undertaken in support of the current New Zealand MEPS scheme for linear fluorescent lamps. Note that this does not include internalisation of greenhouse gas emissions costs.

Table 20 – Previous Benefits and Costs of New Zealand MEPS

PV costs $m	8.4
PV benefits $m	11.0
NPV net benefits $m	2.6
Benefit : cost ratio	132%

The estimated worst case impact of altering MEPS in New Zealand is to reduce the benefit-cost ratio of MEPS by 1.8%. This would have the effect of reducing the cost-benefit ratio of MEPS from 132% to 130%. Hence it is concluded that the proposed Australian / New Zealand MEPS does not have a significant impact upon the previously-justified case for fluorescent lamp MEPS.

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APPENDIX A: OVERSEAS MEPS

Canada

The Energy Efficiency Act passed in 1992 provides the federal government with the authority to make and enforce regulations concerning minimum energy performance standards (MEPS) for energy-using products, as well as requirements for labelling of energy-using products and the collection of data. The first Energy Efficiency Regulations under the Act came into effect in 1995, following extensive consultations with the provincial governments, affected industries, utilities, environmental groups and others. All products covered by these regulations are required pass a cost benefit analysis.

Purpose and scope

Canada's National Standard CAN/CSA-C819-95 specifies minimum colour rendition index and minimum average lamp efficacy for a range of general service fluorescent lamp types. The standard applies to the following types of fluorescent lamps:

- a rapid-start straight-shaped fluorescent lamp with a nominal overall length of 1200mm (48 inches), a medium bi-pin base a nominal power of not less than 28 W;
- a rapid-start straight-shaped fluorescent lamp with a nominal overall length of 2400mm (96 inches), a recessed double contact base, a nominal power of not less than 95 W and a nominal current of 0.8 A;
- a rapid-start U-shaped fluorescent lamp with a nominal overall length of not less than 560mm (22 inches), and not more than 635mm (25 inches), a medium bi-pin base and a normal power of not less than 52 W; and
- an instant-start straight-shaped fluorescent lamp with a nominal overall length of 2400mm (96 inches), a single pin base and a nominal power of not less than 52 W; and
- any fluorescent lamp that is a physical and electrical equivalent of a lamp described in paragraph (a), (b), (c), or (d).
- But does not include
    - a fluorescent lamp that is specifically marked and marketed for plant growth use;
    - a cold temperature fluorescent lamp;
    - a coloured fluorescent lamp;
    - a fluorescent lamp designed to be impact-resistant;
    - a reflectorized or aperture fluorescent lamp;
    - a fluorescent lamp designed for use in reprographic equipment;
    - a fluorescent lamp primarily designed to produce ultraviolet radiation; or
    - a fluorescent lamp with a colour rendering index of 82 or greater.

Efficiency Levels

The minimum efficiency levels specified in the Standard are the same as referenced in Schedule 1 of the Energy Efficiency Regulations as amended 07 November 1995. These requirements came into effect from 1/2/1996.

The minimum efficiency levels are as follows:

Lamp Type	Nominal Lamp Wattage	Minimum Average CRI	Minimum Average Lamp Efficacy (lm/W)
1200 mm (48 in.), medium bi-pin base	>35 W less than or equal to 35 W	69 45	75.0 75.0
560 to 635 mm (22 to 25 in.), U-shaped	>35 W less than or equal to 35 W	69 45	68.0 64.0
2400 mm (96 in.) high output, recessed double contact base	>100 W less than or equal to 100 W	69 45	80.0 80.0
2400 mm (96 in.) slimline, single pin base	>65 W less than or equal to 65 W	69 45	80.0 80.0

Where CRI = colour rendering index; lm/W = lumens per watt

Test Procedure

Test procedures are included in CAN/CSA-C819-95. Reference is made to the following Standards and publications:

- American National Standards Institute (ANSI)
  - ANSI C78.1,
  - ANSI 78.3
  - ANSI C78.375
  - ANSI C82.3
- International Commission in Illumination (CIE)
  - No. 13.3-1995: Method of Measuring and Specifying Colour-Rendering Properties of Light Source.
- Illuminating Engineering Society of North America (IES or IESNA)
  - LM-9-1988: Approved method for Electrical and Photometric Measurements for Fluorescent Lamps
  - LM-16-1984: Colorimetry of Light Sources
  - LM-58-1983: Spectroradiometric Measurements

United States

The cost of lighting energy in the US was estimated in 1995 as $36 billion per year. It is further estimated that 50% to 80% of this could be saved through the adoption of more efficient technologies.

Government efficiency standards in the US include:

> The adoption in some states (e.g. California) of voluntary or mandatory lighting efficiency codes for new buildings;

> The implementation by some cities of building codes that require existing buildings to be upgraded with certain energy efficiency measures whenever they are sold, remodelled or refinanced;

> The efficiency of fluorescent ballasts has been regulated in the US since 1990, a measure estimated to have led to approximately 10% energy savings over standard ballasts;

> The Energy Policy Act of 1992 is a major piece of national legislation regulating lighting products. Further detail is provided below

The Energy Policy (EP) Act covers the following lighting products:

> Incandescent non-reflector lamps, rated between 30W and 199W, and between 115V and 130V, with a E26 medium screw base.

> Incandescent reflector lamps, with an R bulb shape, a PAR bulb shape similar to R or PAR that is neither ER nor BR, as described in ANSI C79.1; rated between 40W and 205 W, and between 115 volts and 130 volts with a E26 medium-screw base; with a diameter greater than 2.75 inches (70 mm). Note that the regulations do *not* apply to coloured, vibration- or impact-resistant or certain other special purpose lamps.

> Fluorescent lamps, including the four main categories of general service fluorescent lamps (4' and 2' U-tube, 8' slimline and 8' high output), excluding coloured, cold-temperature, reprographic and certain other special purpose lamps.

> Compact fluorescent lamps (CFLs), medium base compact fluorescent lamps, which are integrally ballasted fluorescent lamp with a medium screw base and a rated input voltage of 115 to 130 volts and which is designed as a direct replacement for a general service incandescent lamp.

The EP Act sets energy performance standards for incandescent reflector lamps and fluorescent lamps (Part 430), and labelling requirements for all the above products (Part 305). It also prescribes performance testing methodologies. The Act was required to demonstrate that regulation provided a cost benefit to the nation before coming into force.

Efficiency Levels Fluorescent Lamps

The standard cover 4' and 2' U-tube, 8' slimline and 8' high output fluorescent lamps manufactured after the effective dates specified in the following table. The standard specifies CRI and efficacy, and took effect in 1994 and 1995.

In effect, this rules out standard 38mm (40W) lamps, requiring 34W lamps with higher efficacy as a minimum.

MEPS for General Service Fluorescent Lamps, USA

Lamp type	Nominal lamp wattage	Minimum CRI	Minimum average lamp efficacy	Effective date
4' medium bi-pin	>35W	69	75.0	01 Nov 1995
	<=35W	45	75.0	01 Nov 1995
2' U-tube	>35W	69	68.0	01 Nov 1995
	<=35W	45	64.0	01 Nov 1995
8' slimline	>65W	69	80.0	01 May 1994
	<=65W	45	80.0	01 May 1994
8' high output	>100W	69	80.0	01 May 1994

The test procedures are in American National Standards Institute (ANSI) standards ANSI C78.1, 78.3, C78.385, International Commission in Illumination (CIE) standard CIE 13.3, and Illuminating Engineering Society of North America (IES) standards IES LM9, LM16 and LM58.

US Federal Energy Management Program (FEMP)

The FEMP recommends efficiency levels for lamps purchased by US federal government agencies. Energy efficiency recommendations are made for several lighting technologies, as summarised below.

Recommended Minimum Efficacy, Fluorescent Tubes, FEMP

Lamp type	Length	Recommended minimum lumen/W	Best available lumen/W
T8, 32W	4'	87.5	93.8
T12, 34W	4'	82.3	85.3
T8, 59W	8'	96.6	100.8
T12, 60W	8'	93.3	100.0
T8/U, 31-32W	U-tube	82.5	90.5
T12/U, 34W	U-tube	79.4	81.1

China

Under the Chinese Green Lights program, a standard for double capped fluorescent tubes (GB /T 19043—2003) come in force in June 2003. The standard sets two thresholds:

- **Minimum Efficiency Standards** – The standard that all products must achieve to go on sale;
- **Certification Standards** – An optional efficiency level for premium products.

The standard for double capped fluorescent lamps also provides advance warning to manufacturers that the "Certification Standard" thresholds will become the "Minimum Efficiency Standards" in August 2005 (this is often referred to as the "Reach Standard"). The requirements under this standard are shown in the following table.

Energy Efficiency Thresholds for Double-Capped Fluorescent Lamps

Rating (W)	Initial Luminous Efficacy (lm/W)					
	Energy efficiency grades (Colour temperature: RR, RZ)		Energy efficiency grades (Colour temperature: RL, RB)		Energy efficiency grades (Colour temperature: RN, RD)	
	Certification	Minimum	Certification	Minimum	Certification	Minimum
14~21	53	44	62	51	64	53
22~35	57	53	68	62	70	64
36~65	67	55	74	60	77	63

Hong Kong

The Energy Efficiency Office of the Electrical and Mechanical Services Department of Hong Kong has published a 'Code of Practice for Energy Efficiency of Lighting Installations' (1998 edition) which covers all types of lamps. The minimum allowable efficacy levels are shown in the following table:

Minimum Allowable Efficacy Levels, Hong Kong

Lamp type	Nominal lamp power (W)	Minimum allowable efficacy (lm/W)
Tubular fluorescent	<18	40
	18 – 40	50
	>40	60

Japan

The Law Concerning the Rational Use of Energy – Effectively Mandatory Minimum Energy Efficiency Standards (1994), has set target efficiency (lamp efficacy) to be achieved by 2000 as follows:

Target Efficacy Targets for Fluorescent Lamps, Japan

Application	Target Efficacy (lumen/W)
Commercial and Public Lighting	75
Residential Lighting	65

Source: Egan and du Pont 1998, quoted by EES et al (1999a).

New criteria and energy efficiency standard levels were announced by MITI under the "Top Runner" program during 1999.

By 2005 all manufacturers of luminaries will be required to have a sales weighted average for each type of product sold which is greater than the Top Runner target. Manufacturers have to report shipments and efficiency levels to MITI. Manufacturers are also required to mark overall luminaire efficacy on their product literature from 2000.

Top Runner targets are included in Table F2. Note that the target value is weighted mean value of products shipped April 2005 to March 2006.

Top Runner Target Values for 2005 - lamp + ballast, Japan

Fixture Type for Fluorescent Lamps	Lumens/Watt
1. Straight 110W rapid start	79.0
2. Straight 40W HF operation	86.5
3. Straight 40W rapid start	71.0
4. Straight 40W starter type	60.5
5. Straight 20W starter type, electronic ballast	77.0
6. Straight 20W starter type, magnetic ballast	49.0
7. Circular type, total lamp wattage >72W	81.0
8. Circular type, 62W< total lamp wattage≤72W	82.0
9. Circular type, total lamp wattage <62W, electronic	75.5
10. Circular type, total lamp wattage <62W, magnetic	59.0
11. Table light with CFL	62.5
12. Table light with straight FL	61.5

Korea

Fluorescent lamps

In 1992 the Ministry of Commerce, Industry and Energy (MOCIE) is authorised by the Act to set MEPS levels on the basis of analyses carried out by agencies such as the Korean Institute of Energy Research (KIER). MOCIE establishes effective dates, specifies the energy test procedures and sets the rules for energy labelling.

The comparative label rates the product on one of 5 efficiency levels, and also provides energy consumption and other key data. A public agency, the Korean Energy Management Corporation (KEMCO), enforces these rules, supervises implementation and monitors the programs.

MEPS levels and other aspects of the program are reviewed every three years and changed if necessary. In March 1999 the MOCIE mandated updated MEPS levels for fluorescent lamps and ballasts, and introduced MEPS for screw base compact fluorescent lamps.

Relationship between MEPS levels and Energy Ratings

The Korean government publishes two energy efficiency levels or formulae for each product. The less stringent value defines the MEPS level – no product less efficient than this may be sold after the date the levels take effect. The more stringent value is the "target".

The energy ratings for the comparative energy labels are defined in relation to the "target" values (which may be expressed in terms of kWh/month, EER or other units depending in the product). For example, a product that consumes 80% of the energy of its target value (assuming this is expressed in kWh/yr) will get a higher energy rating than a product which consumes 110% of its target value energy. (Note that "1" is the highest, most energy-efficient grade and "5" is the lowest).

When the MEPS levels are made more stringent (about every 3 years) the target levels are also made more stringent. Since the energy rating scales refer to the target values, products must be more efficient to obtain the same energy rating after the revision of the target levels (ie the rating categories are being made more stringent on a regular basis). The new MEPS level is not raised all the way to the old target value, but sometimes to somewhere between the old MEPS level and the old target level.

Fluorescent Lamps

MEPS and target values are published for linear tubular and circular lamps in the range 20W to 40W. Both T10 (32mm) and T8 (26mm) tubes are covered. The minimum and target values, expressed in terms of lumens/watt, are given in the table below.

MEPS Levels for Fluorescent Lamps, Korea

Lamp type		Lamp wattage	Minimum lumen/W (a)	Target lumen/W (b)
Tubular (i.e. linear)	T10	20	55.0	76.0
		40	66.0	98.0
	T8	32	73.0	95.0
Circular		32	52.8	68.0
		40	58.0	76.0

Source: Lee (1999) Effective date July 1, 1999 (a) As of January 1, 2000 (b) By end of June 30, 2002

The test standard is KS C 7601-97, based on JIS C 7601. The lumen/W values are calculated taking into account the power consumption of the circuit, including a reference ballast.

Thailand

In 1992, the Royal Thai Government issued the Energy Conservation Promotion Act B.E. 2535 (1992). The Act provides the main framework and support for energy efficiency activities in Thailand. It mandates energy efficiency measures in large buildings and factories, promotes rural and renewable energy projects, research and development, and energy policy projects. These projects are financed through one of the largest energy conservation funds in the world: Thailand's Energy Conservation Promotion Fund.

National Energy Policy Office (NEPO) has commissioned a major study, to be completed in mid-1999, which will make recommendations to the government for a comprehensive set of minimum efficiency performance standards (MEPS) for appliances and electrical equipment.. The study is likely to consider and recommend MEPS for the following products:

- refrigerators,
- air conditioners,
- electric motors,
- compact and regular fluorescent lamps, and
- ballasts for fluorescent lamps.

Thailand's DSM Program

In 1991, the Royal Thai Government approved a five-year master plan for demand-side management (DSM) in the power sector, updated and revised in 1992.

Among the DSM programs, the most effective and successful programs have been the High-Efficiency Fluorescent Tube or the "Thin-Tube" program, the Energy-Efficient Refrigerator (labelling) program, and Energy-Efficient Air Conditioner (labelling) program.

Fluorescent Lamps

High-Efficiency Fluorescent Tube (*Voluntary* Market Transformation) Program (1993) has been completed. All production is now T8 (36W and 18W) thin tubes, and T12 tubes (40W and 20W) have been eliminated from market. 394 MW and 1,433 GWh savings achieved through 9/98 (far exceeding the program target).

In exchange for EGAT's advertising expenses, lamp manufacturers/distributors in Thailand agreed to switch all production, import, and sales from T12 lamps to T8 lamps.

Minimum Energy Performance Standards are being considered to cover all T8 36W (4 foot), 18W (2-foot) fluorescent lamps and 32W circular ("circline") lamps.

Products will be required to exceed the minimum energy efficiency level to allow sale in the market. The minimum efficiency level has not been determined but will most probably be based on the following parameters:

- Efficacy (Lumens/watt)
- Lamp Life
- Lamp Lumen Depreciation

It may be proposed that the minimum level standards for these parameters will be based on a good quality, thin-tube (T8), halophosphate (e.g. cool white) fluorescent lamp.