

**FINAL**

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**National Appliance and Equipment Energy Efficiency  
Program (NAEEEP) -**

**Coverage of the Residential, Commercial and  
Manufacturing Sectors**

**Prepared for the**

**Australian Greenhouse Office**

**by**

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## Summary

The National Appliance and Equipment Energy Efficiency Program (NAEEEP) comprises a number of mandatory measures, including energy labelling and Minimum Energy Performance Standards (MEPS), and voluntary measures such as the Energy Star label for standby power and the Top Energy Saver Award Winner (TESAW) label.

Over the years the NAEEEP's impact has increased through three separate mechanisms:

- **extent:** the Program has become more extensive as it has embraced more products or more areas of energy consumption;
- **intensity:** the Program has become more intensive as it has applied more measures to the same products or areas of use, eg by transition from voluntary to mandatory labelling, by implementing MEPS as well as labelling for the same products, or by addressing the performance of components – eg electric motors – as well as of entire assemblies – eg air conditioners;
- **stringency:** the Program has become more stringent as the criteria have become more demanding (eg by rising MEPS levels).

One of the key indicators of the Program is the extent of its coverage of the sectors it targets. This paper quantifies the NAEEEP's coverage of the three main sectors of non-transport energy use: the Residential, Commercial and Manufacturing sectors.

In order to reflect the range of different and sometimes overlapping ways in which NAEEEP measures impact on energy use, the modes of coverage have been classified as 'mandatory', 'voluntary', 'under consideration' (ie the subject of research) or 'strategic' (targeting key areas of energy use, extending across energy forms and/or technology types, rather than specific products).

There are differences in the monetary and environmental benefits of saving different forms of end use energy – electricity, natural gas, LPG or biomass – so it would be an over-simplification to quantify coverage solely in terms of delivered energy, which would give equal weight to electricity and wood. While it is common practice to weight and combine different forms of energy based on their price or greenhouse gas emissions, this analysis uses Fossil Fuel Primary Energy instead. This makes the analysis consistent with the approach in the National Framework for Energy Efficiency.

The NAEEEP coverage of the stationary energy sectors is summarised in Tables S1 and S2 and illustrated in Figures S3 and S4. In general NAEEEP coverage of energy use is higher in the Residential sector and Commercial sectors, and lower in the Manufacturing sector. This reflects the good fit between the focus of the NAEEEP – the energy-efficiency of new, mass-produced products – and the largely standardised equipment installed in the Residential and Commercial sectors.

The NAEEEP covers a somewhat lower ratio of Manufacturing sector energy use, partly because the Program's focus on this sector is more recent, and partly because a high ratio of the sector's energy is used in unique, purpose-engineered equipment rather than

in mass-produced products. However, the NAEEEP does cover electric motors, which are key components of most manufacturing equipment and account for a significant share of the sectors' electricity use. An investigation of the scope for covering packaged oil and gas boilers is in the work program. As more data become available on the pattern of equipment purchase and energy use in various industries, it is possible that more products will prove suitable for NAEEEP coverage, most likely as part of wider energy efficiency strategies rather than as stand-alone measures. Indeed, the prospect of MEPS for certain types of equipment may prompt some industries to implement other, and perhaps more effective approaches to energy efficiency.

Active NAEEEP measures (mandatory, voluntary or strategic) cover 67% of primary energy use in the Residential sector, 43% in the Commercial sector and 21% in the Manufacturing sector. Products for which research is under way or planned for the next three years cover over half of Commercial sector primary energy use, indicating that there is considerable scope for expansion of NAEEEP coverage.

Although the Manufacturing and Agricultural sectors have the lowest proportion of energy covered by active NAEEEP programs (MEPS for electric motors) the amount of fossil fuel primary energy covered by this one measure (306 PJ) is in fact greater than that for all currently active programs in the Commercial sector.

**Table S1 Coverage of Sectoral Energy Use by NAEEEP  
(by PJ Fossil Fuel Primary Energy)**

	Mandatory coverage	Voluntary coverage	Research coverage	No active coverage	Hot water strategy	Total active (a)	Total
Residential	277.9	42.7	129.2	98.9	133.1	453.8	681.8
Commercial	182.7	34.0	258.1	24.4		216.7	499.3
Manufacturing (c)	305.7		54.7	1063.0		305.7	1423.3
All sectors	766.4	76.7	442.0	1186.2	133.1	976.2	2604.4

(a) Sum of Mandatory, Voluntary and Special Strategies (b) Coverage of wood-fired heaters, which represent 81.4 PJ of non-fossil primary energy, is additional (c) ANZSIC Division C

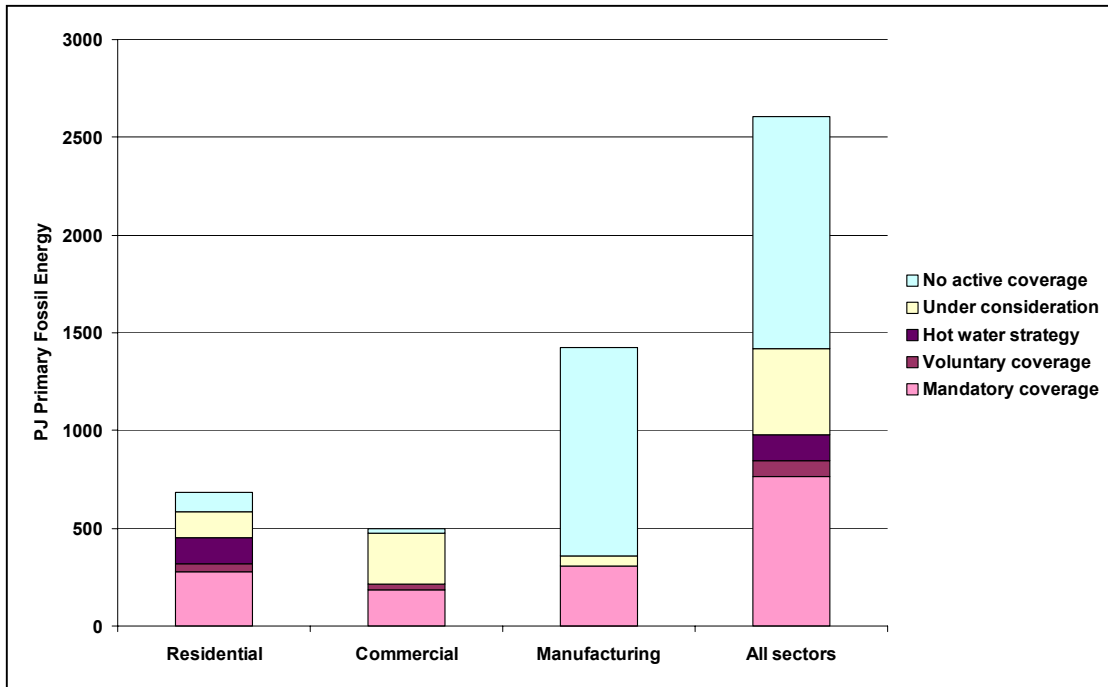
**Table S2 Coverage of Sectoral Energy Use by NAEEEP  
(by % Fossil Fuel Primary Energy)**

	Mandatory coverage	Voluntary coverage	Research coverage	No active coverage	Hot water strategy	Total active (a)	Total
Residential	41%	6%	19%(b)	14%	20%	67%	100%
Commercial	37%	7%	52%	5%		43%	100%
Manufacturing (c)	21%		4%	75%		21%	100%
All sectors	29%	3%	17%	46%	5%	37%	100%

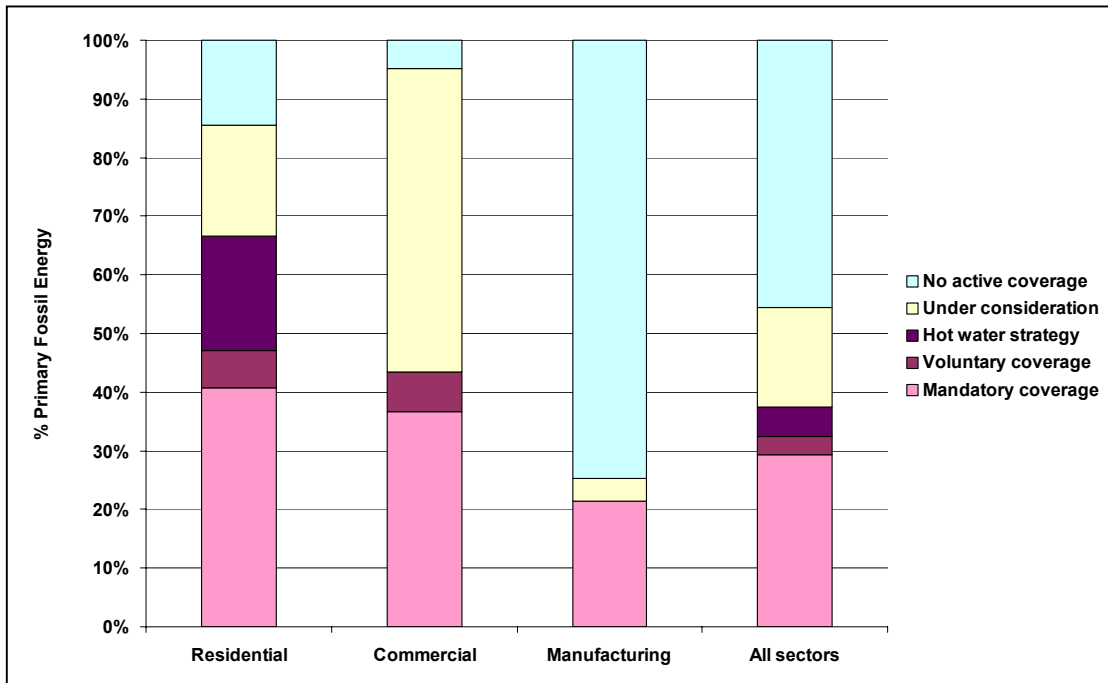
(a) Sum of Mandatory, Voluntary and Special Strategies (b) Coverage of wood-fired heaters, which represent 81.4 PJ of non-fossil primary energy, is additional (c) ANZSIC Division C

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**Figure S1 Coverage of Stationary Sector Energy Use by NAEEEP  
(by PJ Fossil Fuel Primary Energy)**



**Figure S2 Coverage of Stationary Sector Energy Use by NAEEEP  
(by % of Fossil Fuel Primary Energy)**



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## **Background**

### **Determining the NAEEEP's Coverage**

The National Appliance and Equipment Energy Efficiency Program (NAEEEP) comprises a number of mandatory measures, including energy labelling, Minimum Energy Performance Standards (MEPS) and voluntary measures, such as the Energy Star label for standby power and the Top Energy Saver Award Winner (TESAW) label.

Since its formal inception as a national program in the early 1990s, building on State activities begun in the mid 1980s, the NAEEEP has grown to cover a large number of products, which together account for a large proportion of the energy used in the residential, commercial and manufacturing sectors.

One of the key indicators of the Program is the extent of its coverage of the sectors it targets. 'Coverage' can be expressed both in terms of the products that come within the NAEEEP's ambit and the energy used by those products. This is not the same as the Program's 'impact', which is the amount of energy, money and greenhouse gas emissions it has saved, or is projected to save. An energy efficiency program can have high coverage but low impact, and vice versa.

This paper quantifies the NAEEEP's coverage of the three main sectors of non-transport energy use: the Residential, Commercial and Manufacturing sectors. It also makes some observations about impact, although it does not attempt to project this in the same detail as the triennial impact studies, the next one of which is due in late 2004.

### ***Defining Coverage***

It is assumed that the NAEEEP covers a product if:

- (a) At least one of the NAEEEP range of measures already applies to that product, or there is a commitment to apply at least one of the measures; or
- (b) The merits of including that product have been analysed in a published *Product Plan*, leading to a decision not to implement any measures for the time being; or
- (c) The merits of including that product in the program are currently being considered or will be considered in the NAEEEP near-term work program (2005-07); or
- (d) It is covered by one of the Strategic Measures which target key areas of energy use, extending across energy forms and/or technology types (eg water heating, lighting).

In June 2004 the Standing Committee of Officials (SCO) gave in-principle support for the objective of establishing a national gas appliance and equipment energy efficiency program (GAEEEP) as part of the NAEEEP. It has been assumed that the present MEPS and labelling requirements for gas products, enforced via gas safety regulations, will become NAEEEP mandatory requirements by the end of 2007.

For the purposes of the present exercise, NAEEEP coverage has been classified as:

- Mandatory: covered by MEPS, mandatory star rating labelling or both;
- Voluntary: covered by TESAW endorsement labelling, Energy Star endorsement labelling, optional comparative labelling, the Standby Power Consumption Strategy (NAEEEP 2002b), or more than one of these measures;
- Under Consideration; the subject of a published *Product Plan*, or a *Product Plan* to be completed by the end of 2007 (ie meeting conditions (b) or (c) above);
- Hot water strategy; within the scope of the Hot Water Strategy which, according to the (draft) 2005-07 NAEEEP work program, is to be released in 2005.

It is necessary to assign each product to a unique category so that its energy use is not double counted. Where products are covered by more than one measure, the coverage is classified according to the most stringent – for example, if a product is subject to both mandatory and voluntary measures the coverage is categorised as ‘mandatory’.

The Hot Water Strategy will extend the coverage of the NAEEEP by directly addressing the efficiency of all hot water use. MEPS for electric storage water heaters has successfully targeted their standing heat loss but the only direct impact on the efficiency of hot water use has been via the energy labelling of clothes washers and dishwashers, which together use only a small proportion of the water heated by water heaters.

A key element of the Hot Water Strategy is already in place. The mandatory water efficiency labelling (WEL) of showers, taps, clothes washers and dishwashers is expected to begin in 2005 (legislation is before the Commonwealth Parliament at the time of writing). Although the program will be managed by the Department of Environment and Heritage rather than NAEEEC there are many points of interaction with the NAEEEP, such as the use of common appliance tests and common label formats.

The draft NAEEEP work program includes the development of three other Strategies over the coming triennium: ‘Motor Systems (Fans & Pumps)’, ‘Industrial Measurement and Data Collection’ and ‘Building Heating, Ventilation and Airconditioning’ (HVAC). The NAEEEP already covers electric motors and packaged air conditioners, and drives, fans and non-packaged HVAC equipment are included in the draft work program, so the three proposed Strategies would not significantly extend the NAEEEP’s coverage in terms of energy use, but they should increase its impact.

The present study is based on the latest draft of the NAEEEP *Joint Management Plan* (NAEEEP 2004a) and on the New Zealand *Appliance and Equipment Energy Efficiency Forward Programme 2004-05* (EECA 2004). There is a high degree consistency and cross-reference between the two documents. One minor variation, however, is that the NZ *Forward Programme* proposes a number of additional products for attention (see Table 1) that do not, as yet, appear in the *Joint Management Plan*.

The AGO, EECA and the New Zealand Department of Environment have ‘have entered into an Arrangement to co-operate on developing work programmes for MEPS and energy labelling.’ (EECA 2004). This raises the question of the criteria for inclusion of

new products in the NAEEEP, and how products of interest to one country but not necessarily the other should be treated. In order to estimate the Program's coverage by 2007 it has been necessary to hypothesise some boundary criteria (see the next section) and make some assumptions about whether the products in Table 1 meet these criteria.<sup>1</sup>

**Table 1 Additional Products recommended for inclusion in New Zealand Appliance and Equipment Energy Efficiency Forward Programme 2004-05**

Product	Measure to be investigated	Assumption for this study
Water heater cylinder wraps	MEPS and/or labelling	Beyond scope of NAEEEP
Solid fuel heaters	MEPS and/or labelling	Included in coverage estimates
Solar water heaters	MEPS for storage tank; labelling for whole system	Included in coverage estimates
Building insulation	MEPS and/or labelling	Beyond scope of NAEEEP
Windows	MEPS and/or labelling	Beyond scope of NAEEEP
Motor rewinds	Quality controls	Beyond scope of NAEEEP
Two-stroke engines	Public education, emission controls, MEPS and/or labelling	Included in coverage estimates

Source: EECA (2004) Table 6.2; list is additional to products already included in the (draft) NAEEEP *Joint Management Plan* (NAEEEP 2004a)

### ***Program boundaries***

The NAEEEP is probably the most effective and cost-effective energy efficiency program in Australia. Its success is largely due to the fact that it has focussed on one main objective: influencing the supply and purchase of new energy-using appliances and equipment in order to increase their energy efficiency.

The Program cannot and should not try to address every product, or every conceivable aspect of product purchase, use and resale. Some of the ever-growing list of products and measures proposed in the NAEEEP (draft) *Joint Management Plan* and in the EECA *Forward Programme* may not be consistent with the central focus of the NAEEEP, although some may merit inclusion in other energy efficiency programs (eg for building products or building codes) or as stand-alone programs in their own right.

It is timely to consider some of the boundary issues for the NAEEEP, and to propose some criteria to guide what should be considered for coverage and what should not.

At present the NAEEEP only covers new mass-produced products, where the energy performance of each unit sold can be determined with reasonable confidence on the basis of repeatable and verifiable type tests and random sample tests specified in published standards and carried out in qualified laboratories. The costs of establishing standards, regulations and testing capabilities are fixed, as are testing costs per model. This means that the NAEEEP is not suited to coverage of products manufactured or sold in small numbers, since program costs per unit are high, unless the average energy use of each unit is so high that the potential for savings balances the cost.

Market preference signals from buyers of new products are the primary commercial influences on suppliers. It has been argued that labelling or other information measures

<sup>1</sup> Note that NZ proposals for extending coverage to dairy water heaters, incandescent lamps and dehumidifiers are already incorporated in the draft *Joint Management Plan* and so are included in the coverage estimates.

to differentiate the energy efficiency of second hand products may ultimately offer some minor reinforcement of the original market signals (eg by slightly increasing the resale value of models that were more efficient when new), and could assist lower income consumers, who purchase second hand, to reduce the lifetime costs of their purchases.

All second hand products start off new, so the more effective the NAEEEP the more energy-efficient the pool of appliances available down the track to *all* second hand purchasers, including those who are not concerned with energy efficiency, or not able to exercise their concern because they are constrained by limited search time and by what is offered in a particular locality (as is more likely to be the case for used than for new product purchases).

It is also likely that the performance of products will deteriorate over time even in normal use, and there is no reliable way of knowing (without a very extensive testing program) whether the rate of deterioration varies for different models or different brands. An added uncertainty is the random effect of damage, misuse or modification on particular units.

The NAEEEP is not equipped to collect or disseminate information on used or modified products. However, it may be worth retaining information on superseded new models for longer (eg in an archived section of the energyrating website), and for making the information more useable to second-hand buyers through linking to the compliance plate codes. However this introduces a new range of trade practices issues, so it should only be contemplated on a voluntary basis, with the agreement of the manufacturer.

The principle of restricting the NAEEEP to new products would exclude measures that seek to control the quality of or rate the effectiveness of after-market modifications such as motor rewinds. This is not to say that the EECA proposal for a program to address motor rewinding does not have merit, just that it does not fit within the NAEEEP.

Another clear distinction is between products that actually consume or convert energy (electricity, gas, petroleum fuels and wood) and those that impact on the demand for energy but do not use energy themselves, eg products that affect the thermal performance of buildings. Measures that deal with the performance of insulating materials (including water heater insulating blankets) or building components such as windows fit with housing energy efficiency programs or building codes, but not with the NAEEEP.

While some proposals in the *Joint Management Plan* and the *Forward Programme* appear to be inconsistent with the NAEEEP, the following proposals do fit well with the core objectives, even though they take the Program into new energy forms, product groups and aspects of performance (and have been included in the coverage estimates):

1. Recognising peak electricity demand aspects of the energy use of appliances covered on the NAEEEP (principally household and commercial air conditioners) and incorporating measures such as demand response into the testing and communications elements of the Program where appropriate. (This has no quantitative impact on the coverage estimates in the present study, which are based on energy consumption).

2. Extending coverage to wood-fired heaters. Although this is not a greenhouse issue if the fuel is renewable (ie harvested in a sustainable manner), wood smoke has become a winter pollution problem in some cities in New Zealand (eg Christchurch) and Australia (eg Launceston). There are strong links between fuel-efficiency and pollution, and as commercial wood prices rise, running cost is also becoming a major factor in wood heater purchase. Therefore inclusion in the NAEEEP is appropriate. Household wood consumption in Australia is estimated at about 81 PJ per annum.
3. Extending coverage to two-stroke motors. This is recommended in the NZ *Forward Programme*, which states that:

“Conventional two-stroke motors (in boats, lawn mowers etc) are less efficient than the equivalent four-stroke motor, and produce more emissions. Encouraging the use of the most appropriate technology for the job would improve both energy efficiency and emissions. This could involve providing information to the public through education, labelling, or by setting emissions standards... either an emissions or efficiency level is the best way to set this performance standard, so that advanced two-strokes as well as advanced fourstroke engines are promoted.”

Although the energy consumption of most items of garden care equipment is likely to be low due to infrequent usage (except for units purchased by professional garden-care businesses), there are issues of local pollution as well as petroleum-dependence. Therefore inclusion in the NAEEEP is appropriate. The energy consumed in Australia by garden care equipment (but not boats) is estimated at about 5.1 PJ per annum.

### ***Changes over time***

This paper is a simplified snap-shot of the extent of the NAEEEP’s coverage, taking into account its present scope and the work program for the next triennium (2005 to 2007 inclusive).

This does not fully capture all the ways in which coverage can change over time. Essentially, coverage can increase (or decrease) in three ways:

- Through extent: the Program becomes more extensive if it embraces more products or more areas of energy consumption;
- Through intensity: the Program becomes more intensive as it applies more measures to the same products or areas of use, eg by transition from voluntary to mandatory labelling, by implementing MEPS as well as labelling for the same products, or by addressing the performance of components – eg electric motors – as well as of entire assemblies – eg fans and pumps.
- Through stringency: the Program become more stringent as the criteria become more demanding (eg by raising MEPS levels, regrading label scales or raising the criteria for TESA W or for ‘high efficiency’ designation).

There have been steady increases in extent, intensity and stringency throughout NAEEEP's history. For example, while the extent of household refrigeration coverage has been 100% since the introduction of mandatory labelling in the mid 1980s, intensity increased with the addition of voluntary endorsement labels (Galaxy, and later TESAW), and with the implementation of MEPS in 1999. Stringency has also increased, with the regrading of label scales in 2000, and will increase again with the adoption of higher MEPS levels in 2005.

According to the mode of classification used in the present analysis, 100% of household refrigeration energy was already covered at the highest ('mandatory') level in 1986, and the subsequent increases in intensity and stringency would not change this coverage estimate. Therefore a more complex analysis would be necessary to fully reflect changes in the NAEEEP's impact over time.

It would be possible to gain a picture of the evolution of the NAEEEP by charting, year by year for each product, the specific measures applying (indicating intensity) and noting changes in MEPS levels or label scales (indicating stringency). However, this would be a qualitative indication only, and would not track the combined effect of all these changes on the overall coverage and impact of the Program as a whole. The best way to do that is to calculate the projected impacts of the program from time to time, ensuring that the calculations are done on a consistent basis. This is discussed further in the later section, Coverage by projected savings.

## Quantifying coverage

### *Coverage by energy use*

This paper estimates the amount of Australia's non-transport energy use covered by the NAEEEP, in a way that is consistent with the approach in the National Framework for Energy Efficiency (NLEE). Estimates of New Zealand energy end use disaggregated to the same level of detail as for Australia were not available at the time of preparing this study, so energy coverage has been quantified for Australia only.

In order to carry out the analysis it is necessary to estimate the electricity, natural gas, LPG, other petroleum products, coal or wood used by the products covered by the NAEEEP. The cost of using (and the benefit of saving) a PJ of electricity is clearly higher, in both monetary and environmental terms, than that of a PJ of natural gas. By the same token the value of using or saving a PJ of fossil fuel such as natural gas is higher than that of a PJ of renewable fuel such as biomass.

Energy prices and greenhouse gas emission and have generally been used as the means to normalise the financial and environmental impacts of different energy forms (GWA 1998, NAEEEP 2003). In the present analysis the main basis of comparison is Fossil Fuel Primary Energy (FFPE): the amount of primary energy required to supply the delivered energy for each identified end use. If the NAEEEP succeeds in, say, reducing delivered electricity to a sector by 25%, then all else being equal the primary energy requirement would also fall by about 25%, but the quantity of FFPE saved would be over three times as great as the delivered energy saving.

The higher the FFPE ratio, the more primary energy used in producing and transmitting a PJ to the point of final energy use. The calculated FFPE ratios for each major fossil energy form are summarised in Table 2. Each PJ of end use electricity is equivalent to 3.12 PJ FFPE (taking into account that about 5.25% of the primary energy use in electricity generation is renewable, mainly hydro). Each PJ of natural gas supplied via the low pressure network is equivalent to 1.13 PJ FFPE. As wood is not a fossil fuel, and there are no reliable data on fossil fuel use in fuelwood production and transport, the primary energy covered by the NAEEEP's proposed wood heater measures is estimated simply as the total energy consumed by wood heaters in Australia.

**Table 2 Fossil Fuel Primary Energy (FFPE) Ratios**

		PJ	FFPE (PJ/PJ)
Electricity	Fossil fuel primary energy used in generation	2141.8	
	Renewable primary energy used in generation	118.7	
	Total primary energy used in generation	2260.4	
	Electricity consumed	687.0	
	FFPE (PJ/PJ)		<b>3.12 (a)</b>
Natural gas	Low pressure supply		<b>1.13 (b)</b>
	High pressure supply		<b>1.11 (b)</b>
Petroleum fuels	LPG and all petroleum products		<b>1.06 (b)</b>
Coal	Non-generation black coal		<b>1.01 (b)</b>

(a) Calculated by author from 2001-02 Table A, ABARE (2003). (b) GWA and ES (2002).

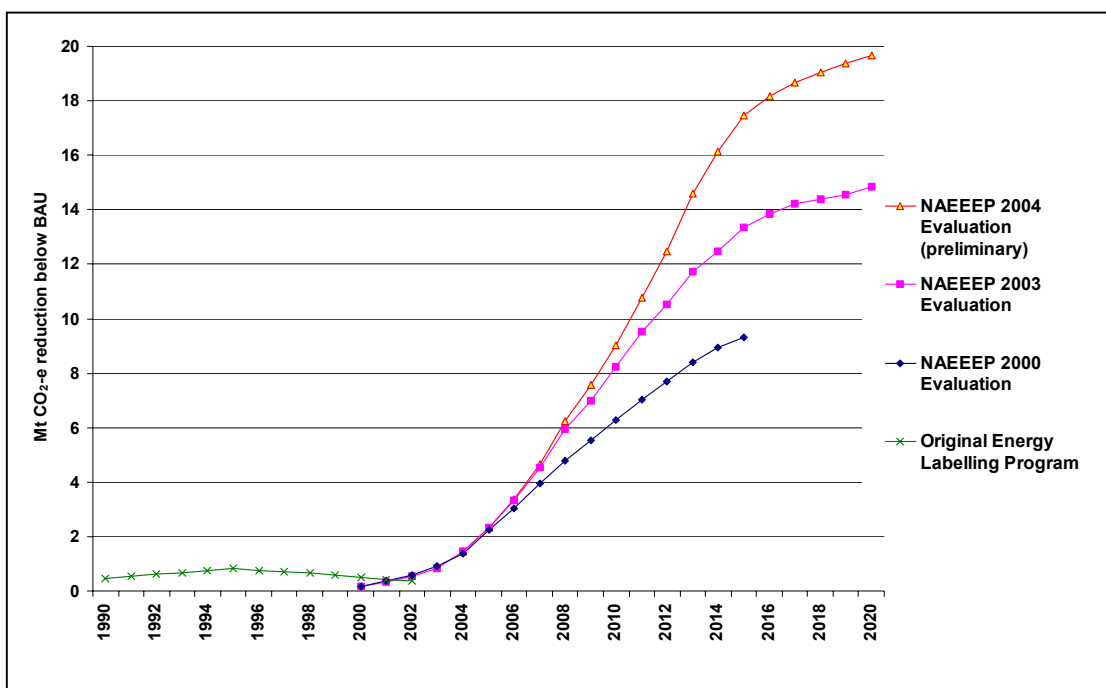
### Coverage by projected savings

The most robust way to integrate the effect of different NAEEEP elements is to combine projections of savings from detailed product use studies, using common time scales, greenhouse gas coefficients, energy prices and discount rates. This method was used in NAEEEP (2000) and NAEEEP (2003). It is planned to use the same approach to project the impacts of the measures to be implemented in the next triennium, once detailed studies on each individual measure become available in late 2004.

In the meantime, a preliminary estimate has been made of the potential impacts of new NAEEEP measures, which will target additional appliances and standby power consumption in the residential sector, HVAC cooling towers, fans and pumps in the commercial sector and small boilers (including dairy water heaters) in the industrial and agricultural sector. The impact of gas appliance measures has also been included.

It is estimated that the total greenhouse gas emissions (in Australia) associated with the products listed above is about 13.0 Mt CO<sub>2</sub>-e annually, and that this will increase at about 2.0% per annum. It is assumed that NAEEEP measures (still to be developed and implemented) first impact on this group in 2008, and gradually increase in effectiveness so that by 2020 the total emissions of the group are 20% below BAU. Under these assumptions, the total greenhouse savings from the NAEEEP would increase as projected in Figure 1. The impact has been expressed on terms of greenhouse gas emissions rather than energy, for consistency with previous analyses. The impact of measures targeting wood heaters is not captured by this approach, since the greenhouse benefit of wood fuel savings is very low. (Delivered and Primary Energy impacts will be separately modelled and reported in the next complete impact analysis).

**Figure 1 Projected greenhouse gas reductions from NAEEEP measures (with preliminary estimate of impacts of new measures)**



## Residential Sector

The residential sector has the longest history of NAEEEP measures (since 1986, when energy labelling first became mandatory), the widest range of measures in use and the most reliable data on energy use. Appendix 1 summarises energy use by product type in the residential sector in Australia.<sup>2</sup> For some products energy use is further disaggregated by purpose and by energy form, since different NAEEEP measures target different aspects of product energy use. For example, energy use by gas hot water heaters is disaggregated into three components:

- The component of gas consumption that is equivalent to the energy in the hot water drawn off: this will be impacted by measures that reduce the consumption of hot water, so is allocated to the 'hot water coverage' category;
- The component of gas consumption that exceeds the energy content of the delivered hot water. This energy is lost in combustion products or as standing heat from the water heater and is impacted by the energy labelling and MEPS programs which target the efficiency of water heaters themselves. As those measures are effectively mandatory, the energy is allocated to the 'mandatory coverage' category;
- For gas instantaneous water heaters, there is a third component: the electricity used in controls, in ignition and in the operation of fans during combustion. This element is targeted as part of the 'Standby' strategy of the NAEEEP, which is voluntary at present, so the energy is allocated to the 'voluntary coverage' category.

The results of the analysis are illustrated in Figure 2 (as PJ FFPE and Wood Use covered) and Figure 3 (as % of FFPE covered).

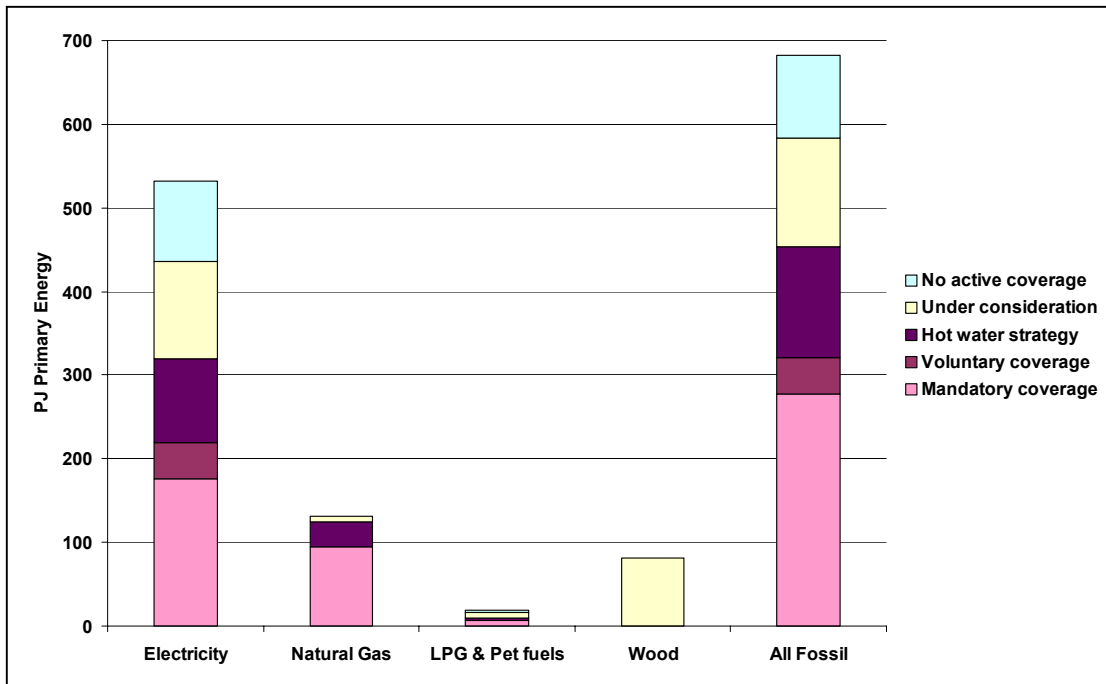
The largest parts of the 'mandatory coverage' category are the electricity use of refrigerators and freezers (about 80 PJ), the gas use of space heaters (77 PJ) and the heat losses of electric water heaters (45 PJ). The largest part of the 'voluntary coverage' category by far is standby electricity (26 PJ). The largest parts of the 'under consideration' category are wood heating (81 PJ), non-fluorescent lighting (49 PJ), electric cooking (26 PJ) and the operating energy of pool equipment (about 16 PJ – preliminary estimate only).

A large part of the 'no active coverage' category is electric resistance heating (17 PJ), which is already at the limit of its technical efficiency, and is being targeted by programs that reduce the demand for space heating, which all outside the NAEEEP. The great majority of 'no active coverage' (88 PJ) is the operating energy of the myriad small household electric appliances (from toasters and irons to power tools and clocks) that individually use very little energy.

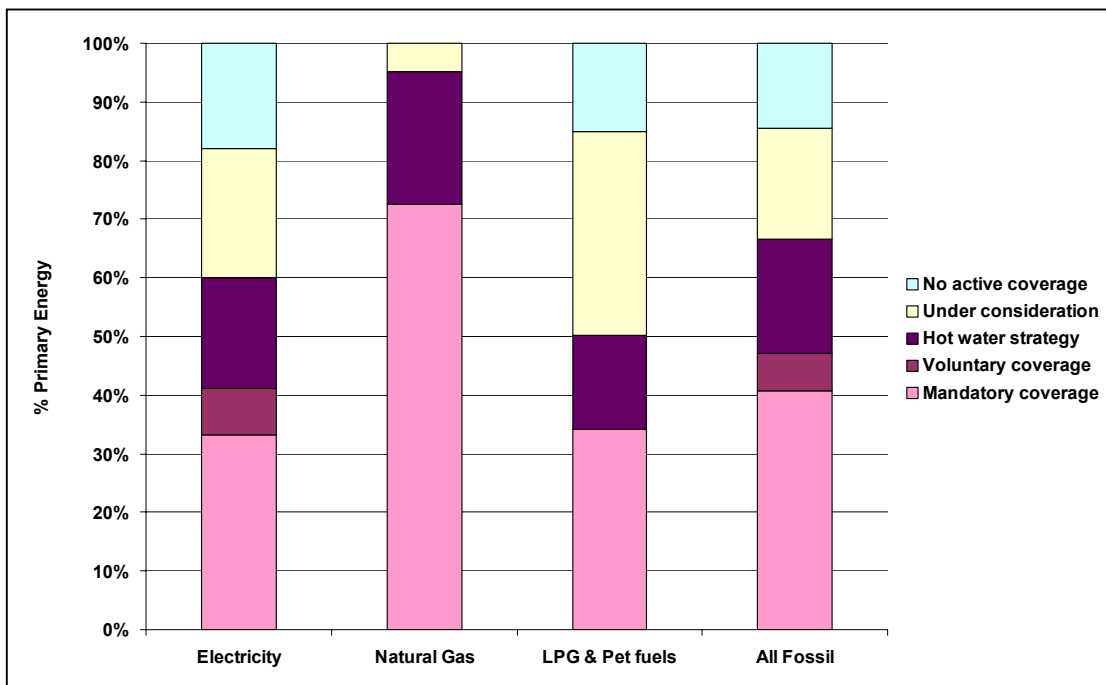
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<sup>2</sup> All values in this paper are based on energy use in 1999, the latest data year available at the time the analysis in GWA & ES (2002) was carried out. The main intent of this paper is to indicate NAEEEP coverage within sectors and to compare coverage between sectors, so the fact that energy use has increased somewhat in the 5 years since is only a factor to the extent that some sectors of end use may have grown at different rates.

**Figure 2 Coverage of Residential Sector Energy Use by NAEEEP  
(by PJ Fossil Fuel Primary Energy and PJ Wood Use)**



**Figure 3 Coverage of Residential Sector Energy Use by NAEEEP  
(by % of Fossil Fuel Primary Energy)**



## Commercial Sector

The main NAEEEP measures already implemented for the commercial sector target fluorescent lighting, packaged air conditioners and commercial refrigeration. The energy use of products ‘under consideration’ accounts for nearly 52% of the total Fossil Fuel Primary Energy of the commercial sector, compared with about 17% for the residential sector. This reflects the fact that the NAEEEP is highly engaged with the commercial sector, but that engagement is somewhat more recent.

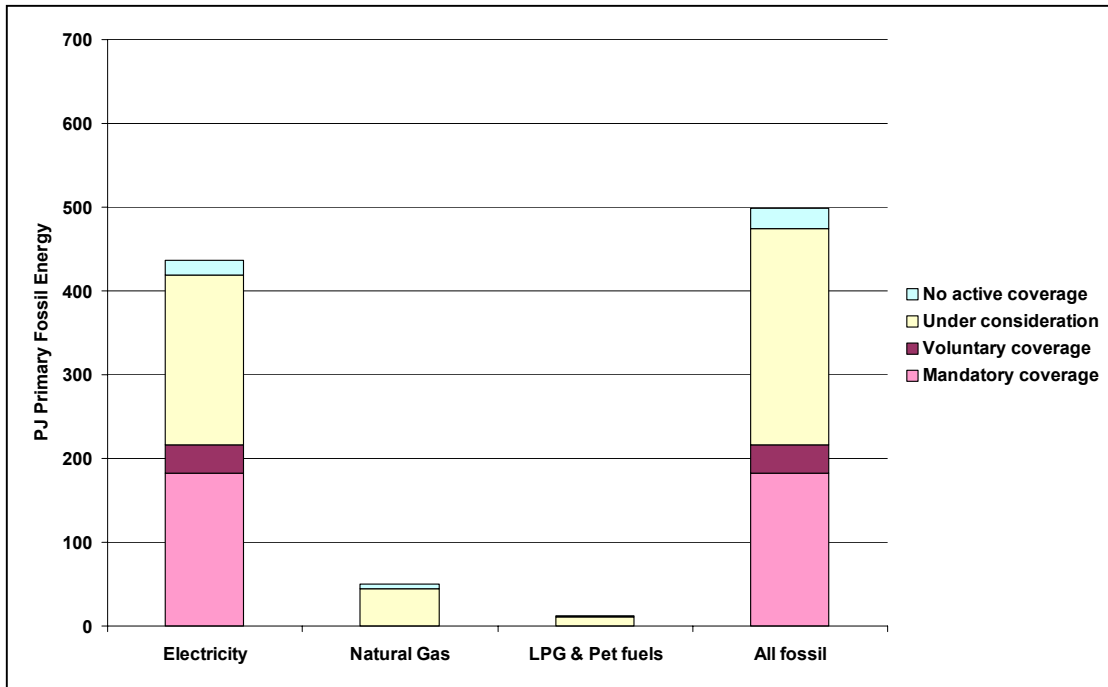
The results of the analysis are illustrated in Figure 4 (as PJ FFPE) and Figure 5 (as % of FFPE covered). The largest parts of the ‘mandatory coverage’ category by far is the electricity use of fluorescent lamps and ballasts (nearly 100 PJ), followed by commercial refrigeration (52 PJ) and the energy use for cooling by packaged air conditioners (31 PJ). All of these are, or will be subject to MEPS, and suppliers may also choose to energy label the cooling efficiency of packaged air conditioners and refrigeration equipment.

The ‘voluntary coverage’ category comprises office equipment, which is covered by Energy Star (22 PJ) and the optional energy labelling of the heating performance of packaged air conditioners (12 PJ), which is not at present subject to MEPS.

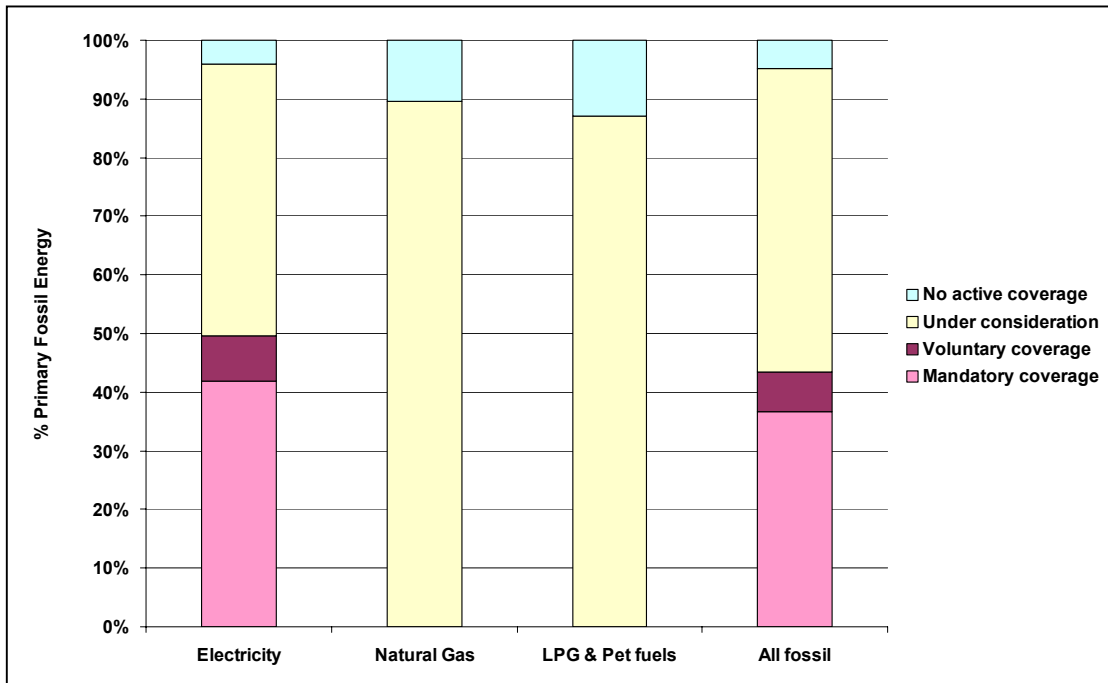
The largest parts of the ‘under consideration’ category are fans and drives for air handling (90 PJ), the energy use of large chillers and cooling towers (76 PJ), gas boilers (45 PJ) and fluid pumps and drives for air conditioning and heating (16 PJ). Actually, this understates the degree of coverage, since MEPS for electric motors – the main NAEEEP measure targeting the industrial sector – also has an influence on the energy consumption of fans and drives used in the commercial sector.

The ‘no active coverage’ category represents only 5% of commercial sector energy use.

**Figure 4 Coverage of Commercial Sector Use by NAEEEP  
(by PJ Fossil Fuel Primary Energy)**



**Figure 5 Coverage of Commercial Sector Energy Use by NAEEEP  
(by % of Fossil Fuel Primary Energy)**



## Manufacturing and Agriculture

The Manufacturing sector has a lower level of NAEEEP coverage than other sectors. At present the only mandatory measure impacting on manufacturing is MEPS and optional ‘High Efficiency’ labelling for electric motors, although these measures alone cover over 21% of the sector’s total Fossil Fuel Primary Energy (see Figure 6 and Figure 7).

The NAEEEP’s lower coverage ratio of Manufacturing sector energy use is partly because the Program’s focus on this sector is more recent, and partly because a high ratio of the sector’s energy is used in unique, purpose-engineered equipment rather than in mass-produced products (see Table 3 – most of the biomass use in cogeneration and dryers is bagasse used in the sugar industry). However, apart from the electric motor measures, an investigation of the scope for covering packaged oil and gas boilers is in the work program. As more data become available on the pattern of equipment purchase and energy use in various industries, it is possible that more products will prove suitable for NAEEEP coverage, most likely as part of wider energy efficiency strategies rather than as stand-alone measures. Indeed, the prospect of MEPS for certain types of equipment may prompt some industries to implement other, and perhaps more effective approaches to energy efficiency.

The ‘buildings’ end use within manufacturing represents the energy – mainly electricity - used to light, heat and cool factories, office blocks and amenities blocks and provide hot water and other services analogous to those in the commercial and residential sector. As the NAEEEP measures targeting residential and commercial sector equipment will have some impact on the manufacturing sector also, the coverage has been classified as ‘under consideration’ pending further analysis.

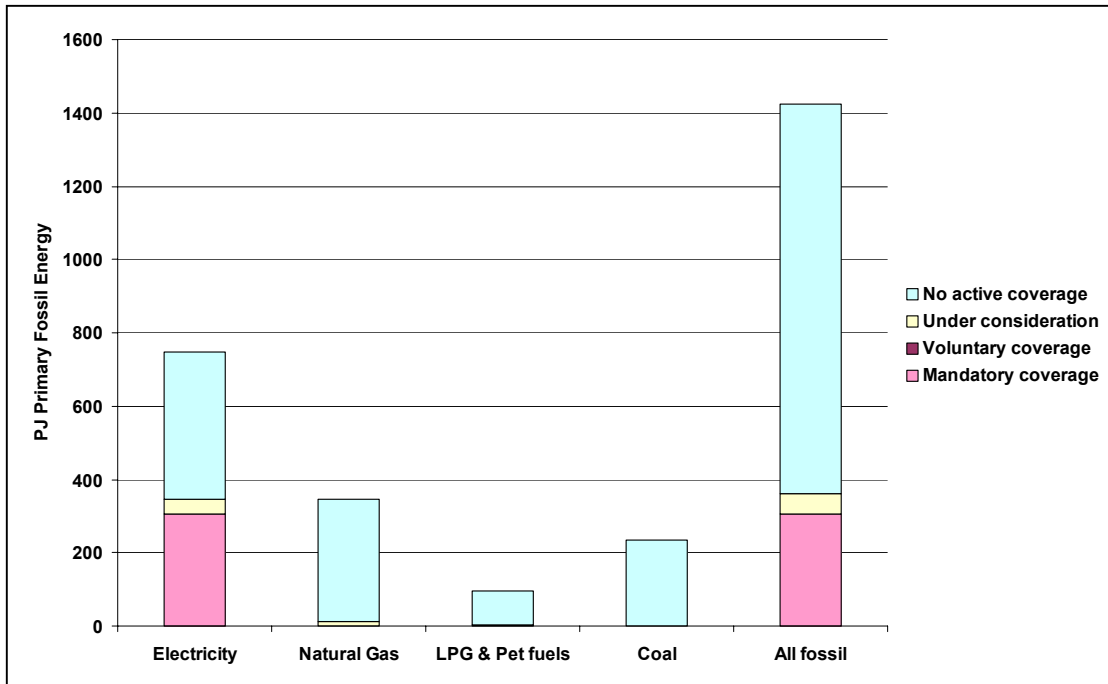
**Table 3 Main classes of stationary end uses in the Manufacturing Sector**

End use	Delivered PJ	FFPE PJ	Biomass PJ	% FFPE
Cogeneration equipment	290.5	188.9	112.2	13.3%
Kilns	186.8	202.9	0.0	14.3%
Dryers	122.7	112.0	20.8	7.9%
Boilers	17.8	18.5	0.7	1.3%
Metallurgical equipment	161.6	188.5	NA	13.2%
Electrolytic equipment	95.3	296.9	NA	20.9%
Motors	98.1	305.7	NA	21.5%
Buildings, etc	12.7	39.5	NA	2.8%
Other uses	22.6	70.4	NA	4.9%
<b>Total</b>	<b>1008.0</b>	<b>1423.3</b>	<b>133.8</b>	<b>100.0%</b>

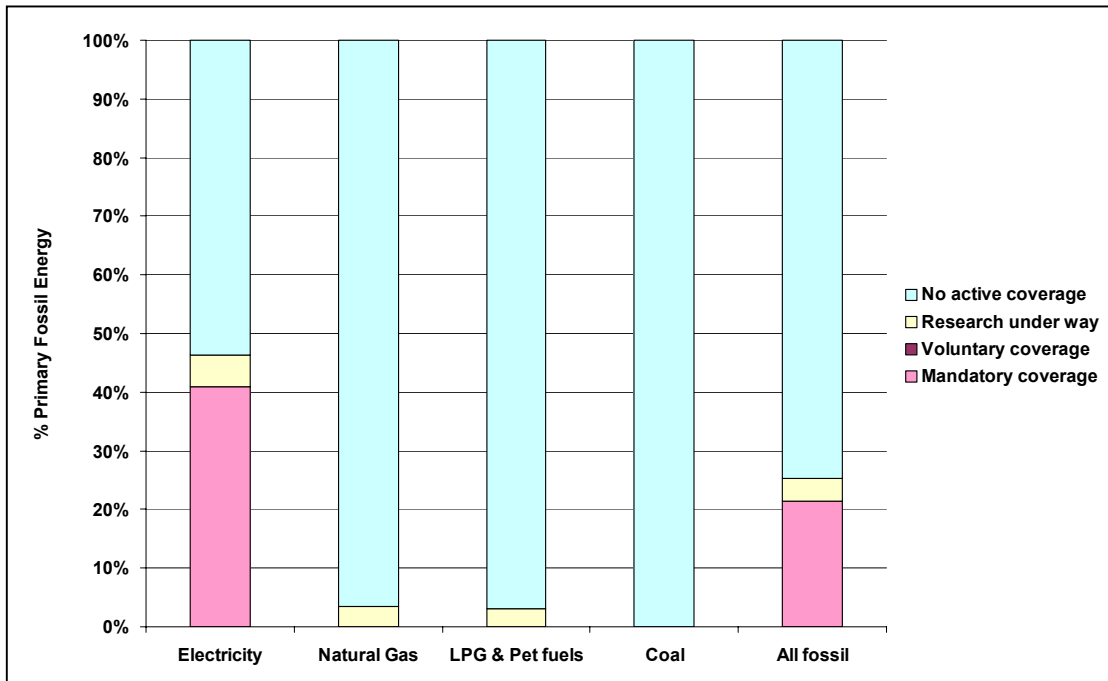
Source: Appendix 3. Excludes mobile equipment (eg forklifts)

The NAEEEP coverage of the Agriculture, Forestry and Fishing sector is even lower than for the Manufacturing sector. Mobile sources (eg tractors, harvesters, logging equipment, boats) account for the great majority of energy use in this sector. Stationary end uses amount to only 11 PJ delivered energy, or 44 PJ FFPE. A high proportion of the stationary energy use is electric, made up of end uses such as dairy equipment (in agriculture), sawmilling (in forestry) and shore-based refrigeration (in fishing). These will be impacted to some extent by the NAEEEP motors, boilers and commercial refrigeration programs.

**Figure 6 Coverage of Manufacturing Sector Energy Use by NAEEEP  
(by PJ Fossil Fuel Primary Energy)**



**Figure 7 Coverage of Manufacturing Sector Use by NAEEEP  
(by % of Fossil Fuel Primary Energy)**



## All Stationary Energy Sectors

### Coverage by sector

The NAEEEP coverage of the stationary energy sectors is summarised in Table 4 and Table 5 and illustrated in Figure 8 and Figure 9. In general, the coverage of the NAEEEP is higher in the Residential sector and Commercial sectors, and relatively low in the Manufacturing sector. This reflects the good fit between the focus of the NAEEEP – the energy-efficiency of new, mass-produced products – and the largely standardised equipment installed in the Residential and Commercial sectors.

Manufacturing sector energy use is dominated by specialised applications of energy, often in unique, purpose-engineered equipment, which lie beyond the scope of the NAEEEP – except for motors and packaged boilers of various types, which are, or will be covered.

Active NAEEEP measures (mandatory, voluntary or strategic) cover 67% of primary energy use in the Residential sector, 43% in the Commercial sector and 21% in the Manufacturing sector. Products for which research is under way or planned for the next three years cover over half of Commercial sector primary energy use, indicating that there is considerable scope for expansion of NAEEEP coverage.

Although the Manufacturing sector has the lowest proportion of its energy covered by active NAEEEP programs (MEPS for electric motors), the amount of fossil fuel primary energy covered (306 PJ) is in fact greater than for all currently active programs in the Commercial sector.

**Table 4 Coverage of Sectoral Energy Use by NAEEEP  
(by PJ Fossil Fuel Primary Energy)**

	Mandatory coverage	Voluntary coverage	Research coverage	No active coverage	Hot water strategy	Total active (a)	Total
Residential	277.9	42.7	129.2	98.9	133.1	453.8	681.8
Commercial	182.7	34.0	258.1	24.4		216.7	499.3
Manufacturing (c)	305.7		54.7	1063.0		305.7	1423.3
All sectors	766.4	76.7	442.0	1186.2	133.1	976.2	2604.4

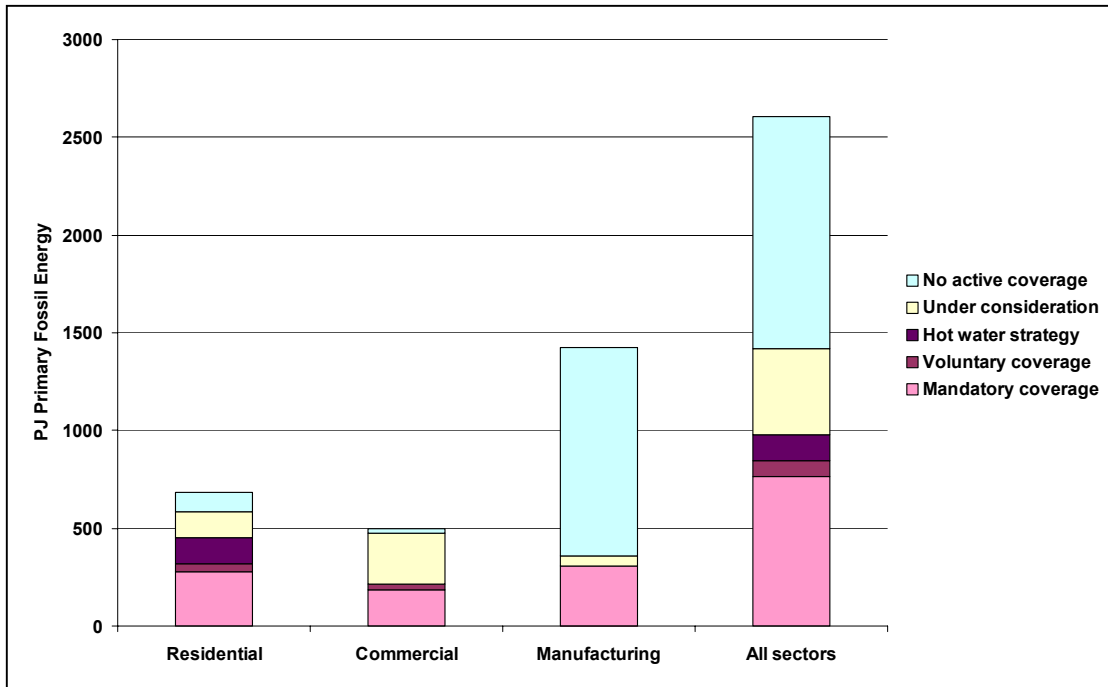
(a) Sum of Mandatory, Voluntary and Special Strategies (b) Coverage of wood-fired heaters, which represent 81.4 PJ of non-fossil primary energy, is additional (c) ANZSIC Division C

**Table 5 Coverage of Sectoral Energy Use by NAEEEP  
(by % Fossil Fuel Primary Energy)**

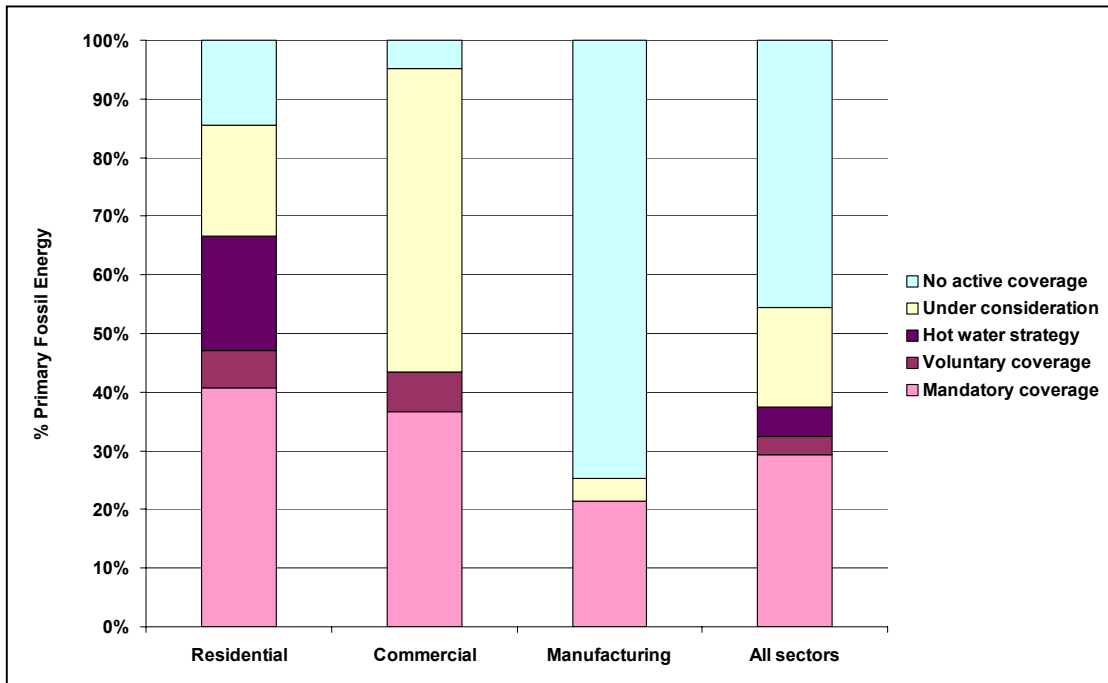
	Mandatory coverage	Voluntary coverage	Research coverage	No active coverage	Hot water strategy	Total active (a)	Total
Residential	41%	6%	19%(b)	14%	20%	67%	100%
Commercial	37%	7%	52%	5%		43%	100%
Manufacturing (c)	21%		4%	75%		21%	100%
All sectors	29%	3%	17%	46%	5%	37%	100%

(a) Sum of Mandatory, Voluntary and Special Strategies (b) Coverage of wood-fired heaters, which represent 81.4 PJ of non-fossil primary energy, is additional (c) ANZSIC Division C

**Figure 8 Coverage of Stationary Sector Energy Use by NAEEEP  
(by PJ Fossil Fuel Primary Energy)**



**Figure 9 Coverage of Stationary Sector Energy Use by NAEEEP  
(by % of Fossil Fuel Primary Energy)**



## Coverage by energy form

NAEEEP coverage can also be summarised by the forms of delivered energy covered. Table 6 and Figure 10 indicate the primary energy embodied in the electricity, natural gas, LPG and petroleum fuels used in the product for which NAEEEP coverage is mandatory, voluntary etc. (Note the addition of Distribution Transformers, which are covered by MEPS. Transformer losses amount to about 3.3% of the electricity delivered to users in Australia (GWA 2002), but as it is very difficult to allocate this to end use sectors it is not shown in the preceding sectoral tables).

As Table 7 and Figure 11 indicate, active NAEEEP measures (mandatory, voluntary or strategic) cover 51% electricity use in the Residential, Commercial and Manufacturing sectors combined, 24% of natural gas use, 8% of LPG and petroleum product use and none of the coal use (most of which is used in cogeneration equipment, kilns or dryers).

**Table 6 NAEEEP coverage of stationary energy use by energy form  
(by PJ Fossil Fuel Primary Energy)**

	Mandatory coverage	Voluntary coverage	Research coverage	No active coverage	Hot water strategy	Trans-formers	Total active (a)	Total
Electricity	664.8	76.7	358.2	514.4	100.6	56.6	898.6	1771.2
Natural Gas	95.0		63.8	340.6	29.5		124.5	528.8
LPG & Pet fuels	6.6		20.0	97.7	3.1		9.6	127.3
Coal				233.6				233.6
All fossil (b)	766.4	76.7	442.0	1186.2	133.1	56.6	1032.7	2660.9

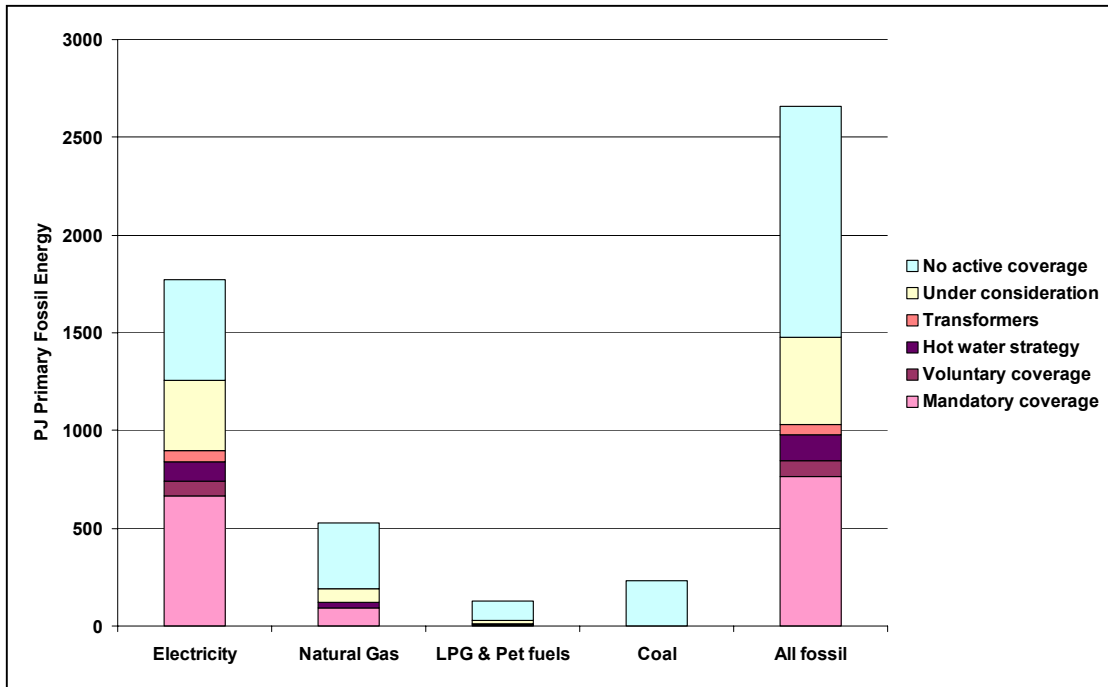
(a) Sum of Mandatory, Voluntary and Special Strategies, including Transformer MEPS (b) Coverage of wood-fired heaters, which represent 81.4 PJ of non-fossil primary energy, is additional

**Table 7 NAEEEP Coverage of stationary energy use by energy form  
(by % Fossil Fuel Primary Energy)**

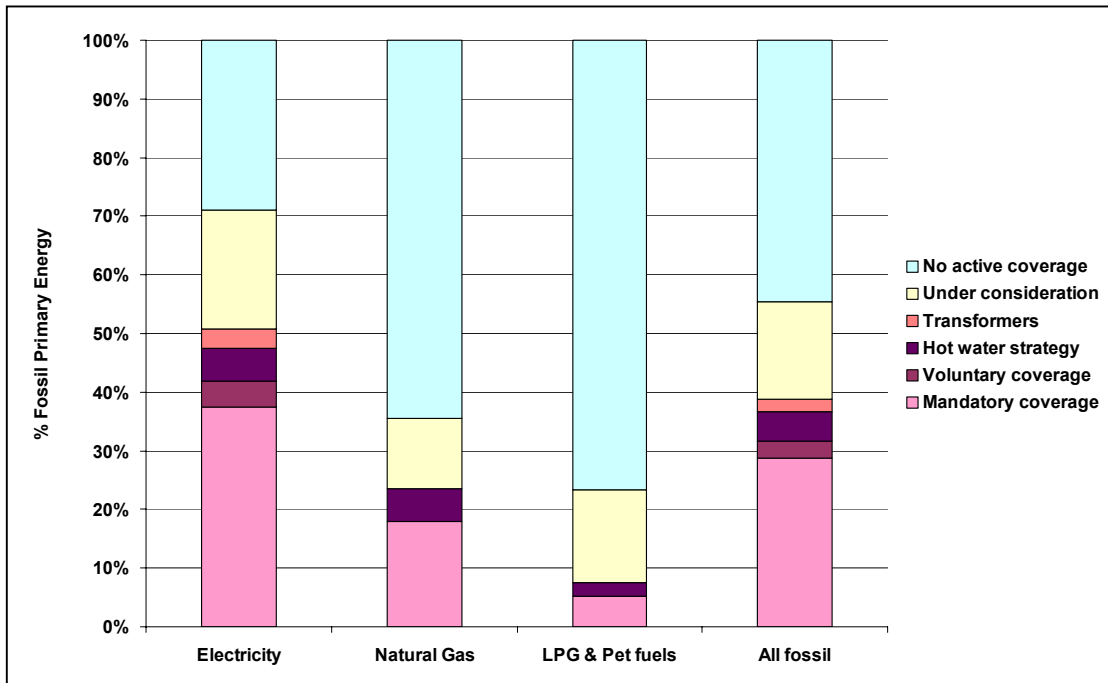
	Mandatory coverage	Voluntary coverage	Research coverage	No active coverage	Hot water strategy	Trans-formers	Total active (a)	Total
Electricity	38%	4%	20%	29%	6%	3%	51%	100%
Natural Gas	18%		12%	64%	6%		24%	100%
LPG & Pet fuels	5%		16%	77%	2%		8%	100%
All sectors (b)	29%	3%	17%	45%	5%	2%	39%	100%

(a) Sum of Mandatory, Voluntary and Special Strategies, including Transformer MEPS (b) Coverage of wood-fired heaters, which represent 81.4 PJ of non-fossil primary energy, is additional

**Figure 10 NAEERP coverage of stationary energy use by energy form (by PJ Fossil Fuel Primary Energy)**



**Figure 11 NAEERP Coverage of stationary energy use by energy form (by % Fossil Fuel Primary Energy)**



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## Appendix 1 Residential sector end use and coverage

Appliance/End Use		Energy form	Delivered PJ	FFPE PJ	MEPS	Mandatory label	Voluntary label	Standby	Research done	Mode of Coverage
Airconditioners	Cooling	Elec	5.8	18.1	1	1	1			M
	Heating	Elec	1.1	3.4		1	1			M
	Standby	Elec	0.3	1.1				1		V
Electric resistance	Heating	Elec	5.5	17.1						NA
	Standby/fan	Elec	0.1	0.4				1		V
Gas heater	Heating	Gas	68.3	77.1	1	1				M
	Standby/fan	Elec	0.7	2.3				1		V
LPG heater	Heating	LPG	4.2	4.4	1	1				M
	Standby/fan	Elec	0.0	0.1				1		V
Other petroleum fuel	Heating	Oil	2.7	2.9						NA
Coal	Heating	Coal	0.1	0.1						NA
Wood	Heating	Biomass	81.4	NA					1	V
Electric water heater	Losses	Elec	14.4	45.0	1					M
	UE	Elec	30.8	95.9						HW
Solar-electric	Boosting	Elec	1.5	4.7						HW
	Solar gain	Solar	2.4	NA						
	Losses	Solar	1.3	NA						
	UE	Solar	2.6	NA						
Gas-storage	Losses	Gas	12.6	14.2	1	1				M
	UE	Gas	20.1	22.7						HW
Gas-instantaneous	Losses	Gas	3.2	3.7	1	1				M
	UE	Gas	6.0	6.8						HW
	Standby	Elec	0.2	0.5				1		V
LPG water heater	Losses	LPG	2.0	2.1	1	1				M
	UE	LPG	2.9	3.1						HW
	Standby	Elec	0.0	0.1				1		V
Cookers		Elec	8.4	26.2					1	UC
		Gas	5.7	6.4					1	UC
		LPG	1.2	1.2					1	UC
Refrigerator	Operating	Elec	22.3	69.5	1	1	1			M
Freezer	Operating	Elec	6.4	20.1	1	1	1			M
Clothes washer	Operating	Elec	1.2	3.9		1	1			M
	Standby	Elec	0.7	2.1		1				M
Clothes dryer	Operating	Elec	1.5	4.6		1	1			M
	Standby	Elec	0.3	1.0		1				M
Dishwasher	Operating	Elec	1.5	4.8		1	1			M
	Standby	Elec	0.2	0.8		1				M
TV	Operating	Elec	3.4	10.6					1	UC
	Standby	Elec	1.0	3.0				1		V
VCR	Operating	Elec	0.1	0.2					1	UC
	Standby	Elec	1.5	4.7				1		V
Computers	Operating	Elec	1.6	5.1					1	UC
	Standby	Elec	0.5	1.6			1	1		V
Other uses - covered	Operating	Elec	5.0	15.6					1	UC
	Standby	Elec	1.0	3.1				1		V
Other uses - balance	Operating	Elec	28.3	88.2						NA
	Standby	Elec	8.3	25.9				1		V
Lighting	Fluoro	Elec	0.8	2.4	1					M
	Ballast	Elec	0.2	0.7	1					M
	Non-fluoro	Elec	15.7	49.0					1	UC
Garden & lawn equpt	Motors	Oil	5.1	5.4					1	UC
Source: GWA & ES (2002)			386.1	681.9						

## Appendix 2 Commercial sector end use and coverage

Appliance/End Use	Energy form	Delivered PJ	FFPE PJ	MEPS	Mandatory label	Voluntary label	Standby	Research done	Mode of Coverage
Air Handling	Fans	Elec	29.0	90.4				1	UC
Cooling	Towers	Elec	24.3	75.6				1	UC
	Packaged	Elec	10.0	31.2	1	1			M
Fluid pumping	Pumps	Elec	5.2	16.2				1	UC
Heating (heat pump)	Packaged	Elec	3.8	11.8		1			V
Heating (thermal)	Resistance	Elec	1.6	5.1					NA
	Boiler	Gas	40.7	45.2				1	UC
	Boiler	LPG/Oil	9.7	10.4				1	UC
	Boiler	Coal	1.4	1.4					NA
	Boiler	Biomass	0.8	NA					NA
Lighting	Fluoro	Elec	25.3	78.9	1				M
	Ballast	Elec	6.6	20.6	1				M
	Non-fluoro	Elec	3.4	10.7				1	UC
Cooking		Elec	0.6	1.9					NA
		Gas	1.9	2.1					NA
Water heating	Storage	Elec	1.2	3.9					NA
	Storage/Inst	Gas	2.9	3.2					NA
	Storage/Inst	LPG/Oil	1.4	1.5					NA
	Boiler	Coal	0.5	0.5					NA
Water boiling		Elec	3.1	9.6				1	UC
Office equipment		Elec	7.1	22.1		1	1		V
Lifts, etc		Elec	1.5	4.8					NA
Refrigeration - unitary		Elec	5.6	17.3	1				M
Refrigeration - split		Elec	11.1	34.7	1				M
Other		Elec	0.6	1.9					NA
Source: GWA & ES (2002)			199.5	501.2					

### Appendix 3 Manufacturing sector end use and coverage

Appliance/End Use	Energy form	Delivered PJ	FFPE PJ	MEPS	Mandatory label	Voluntary label	Standby	Research done	Mode of Coverage
Cogeneration equipment	Gas	75.6	83.9						NA
	LPG/Oil	23.8	25.3						NA
	Coal	78.8	79.6						NA
	Biomass	112.2	NA						
Kilns	Elec	0.2	0.7						NA
	Gas	112.6	124.9						NA
	LPG/Oil	48.3	51.4						NA
	Coal	25.6	25.9						NA
Dryers	Elec	1.0	3.0						NA
	Gas	68.0	75.4						NA
	LPG/Oil	5.8	6.2						NA
	Coal	27.2	27.5						NA
	Biomass	20.8	NA						
Boilers	Gas	11.0	12.2					1	UC
	LPG/Oil	2.8	3.0					1	UC
	Coal	3.3	3.3						NA
	Biomass	0.7	NA						
Metallurgical equipment	Elec	9.6	29.8						NA
	Gas	46.0	51.1						NA
	LPG/Oil	9.8	10.4						NA
	Coal	96.3	97.2						NA
Electrolytic equipment	Elec	95.3	296.9						NA
Motors	Elec	98.1	305.7	1		1			M
Buildings, etc	Elec	12.7	39.5					1	UC
Other uses	Elec	22.6	70.4						NA
Source: GWA & ES (2002)		1008.0	1423.3						