

PRODUCT PROFILE



MODEMS

AUSTRALIA'S STANDBY POWER STRATEGY 2002 - 2012

AN INITIATIVE OF THE MINISTERIAL
COUNCIL ON ENERGY FORMING
PART OF THE NATIONAL
GREENHOUSE STRATEGY

The National Appliance and Equipment Energy Efficiency Committee seeks comment on this proposal from any interested person or organisation.

Please email comments to:

energy.rating@deh.gov.au

Alternatively, hard copy comments can be mailed to:

Equipment & Appliances Team
Australian Greenhouse Office
Department of Environment and Heritage
GPO Box 787
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Comments received by 28 February 2005 will assist in determining the final form of the policy proposals taken to government.

An electronic version of this Standby Product Profile and other Profiles released for public discussion can be obtained from www.energyrating.gov.au

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PRODUCT DESCRIPTION

Modems were first developed in the 1950s for the US defence force, to transfer data across existing phone lines. The first commercial modem, introduced in 1962, was the Bell 101 which used 'frequency shift keying' technology to transmit data at up to 300 bits per second (bps). By the early 1990s modems were operating at speeds of 14.4 kilobits per second (kbps). Since then modem technology has continued to extend the perceived limits of phone line transmission, with 56 kbps dialup modems now commonplace along with broadband modems capable of speed in excess of 1500 kbps.

For the purpose of this product profile, a modem is defined as an end-user device used to receive and transmit data between a personal computer and the internet, over a telephone line or through the pay television cable network. The modems considered here are external, self-powered modems, which use dialup, ADSL or cable technology. They may include a firewall, router or network hub function, and may have wireless connectivity to the computer or other devices.

Most Australian users connect to the internet using either a dialup or broadband (cable or ADSL) modem. The following types of modems are not included in this profile:

- Internal modems, such as those incorporated into many laptop and desktop computers, and card modems inserted into computers. These are not self powered. They are powered by the computer itself and thus fall under the computer's power consumption regime.
- External modems which are powered via the computer's USB (universal serial bus). These are also not self-powered.
- Modems incorporated into other equipment, such as EFTPOS terminals, remote meter-reading equipment and rack-mounted industrial modems. Their power consumption is typically considerably smaller than the power consumed by other elements of the incorporated equipment.
- ISDN (integrated services digital network) modems and SHDL (symmetric high-bitrate digital subscriber line) modems. These currently occupy a small market share, primarily in the business sector.
- Satellite modems, cellular telephone modems and wireless modems (modems which connect to the ISP without phone lines or cables). These have inherently different functionality and currently occupy a relatively small market share.

Items of 'central office' (CO) equipment which are connected at the other end of the phone line or cable, for

example an ADSL DSLAM (digital subscriber line access multiplexer) are not a focus of this profile, but are further discussed below.

DIALUP MODEMS

Dialup modems transmit and receive data over the telephone network at speeds of up to 56 kbps, using an audio carrier signal. While the majority of dialup modems are currently internal, external models are still sold in significant quantities.

ADSL MODEMS

DSL stands for digital subscriber line, and is the most common broadband technology in use. DSL allows continual use of a phone line without interrupting normal analogue phone traffic. Common DSL modems can receive data at speeds of 256 to 1500 kbps. In Australia, ADSL (asynchronous digital subscriber line) is the predominant DSL technology. It has an inherently higher receive rate for the end user, which suits the typical user's preference for downloading data rather than uploading.

The other type of DSL technology is symmetric DSL, otherwise known as SHDL (symmetric high-bitrate digital subscriber line). SHDL has equal upload and download speeds and currently occupies a small market share, primarily for businesses operating internet servers over the copper telephone network. Thus SHDSL technology is not covered by this profile.

CABLE MODEMS

Cable modems are a broadband technology and communicate over the hybrid co-axial/optical pay television network. Cable download speed is dependant on available bandwidth and can be very high if suitable bandwidth is available.

The majority of existing ADSL and cable modems are external to the computer, using a USB, ethernet or wireless connection to the computer. External models either have their own power supply or are powered by USB from the computer. USB-powered modems are not covered by this profile for reasons discussed previously.

INTEGRATED MODEMS

Modems, particularly ADSL and cable modems, can incorporate other hardware such as a firewall (used to protect from outside attack), a router (used to share the internet connection with multiple computers), a network hub (used to allow multiple computers to network with each other) or a printer server. These are known as integrated modems and are included in this profile. Some integrated modems also allow computers and other peripherals to be connected wirelessly to the modem.

CURRENT OWNERSHIP AND TRENDS

In September 2003 there were a total of 5.2 million internet subscribers in Australia [ABS 2004], and this is assumed to equal the number of modems in operation. Households comprise approximately 87% of this total [ABS 2004]. The major trend is towards broadband modems and away from dialup, which is illustrated in Figure 1.

Of the 4.5 million existing dialup modems, industry sources estimate that 20% are external to the computer. Of the current stock of approximately 900,000 external dialup modems, a proportion are USB-powered and therefore not included in this profile. Anecdotal evidence suggests that the majority of external modems are self-powered and therefore the stock of self-powered, external, dialup modems is estimated at 800,000.

Of the 840,000 broadband modems, ADSL represents 54% and cable represents 42% [ABS 2004], with the remainder being predominantly satellite connections (around 4%).

Currently, the vast majority of broadband modems in use are external, some of which are USB-powered. From the models sighted for testing, it is estimated that 80% are self-powered. Thus the current stock of self-powered, external, broadband modems is estimated at 700,000.

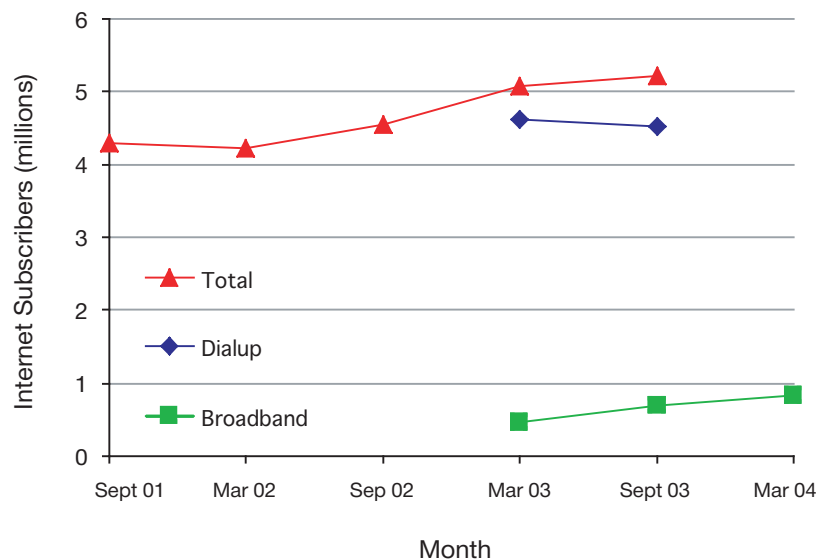
Hence the total stock of external, self-powered dialup and broadband modems is estimated at 1.5 million.

There are a number of trends for broadband modems, which will have varying effects on total modem standby energy consumption, as discussed below:

- > The market share of external broadband modems will continue to increase rapidly in the short term, which will tend to increase standby energy consumption. The introduction of voice over internet protocol (VOIP) telephony may further increase the popularity of broadband modems.
- > Internal broadband modems may become more common as the technology becomes mainstream. This will tend to reduce standby energy consumption.
- > Integrated broadband modems are predicted to become more widespread, and the ability to share modem connections between computers is likely to reduce sales of conventional modems.
- > As product functionality and speed improves, the energy efficiency of integrated circuit chips tends to increase in order to limit thermal, size and cost issues.

Despite the conflicting effects of these trends, and the rapid pace of technical development (making accurate predictions difficult), the overall standby energy consumption of self-powered modems is predicted to increase in the medium term.

FIGURE 1 INTERNET CONNECTIONS IN AUSTRALIA BY TYPE(ABS 2004)



SALES

Annual sales of modems in this profile are based on current stock levels and average lifespan. The AGO estimates that PCs are typically replaced approximately every 5 years [AGO 2003a]. It is reasonable to assume that modems are ordinarily replaced when personal computers are upgraded, thus modem lifespan is also estimated to be 5 years.

Given the estimated stock of 800,000 external dialup modems, and the recent decrease in stock, industry experts estimate current sales of external, self-powered, dialup modems to be 130,000 units p.a.

The stock of broadband modems increased by 370,000 in the twelve months to March 2004, and retirements of modems will not be significant given that this technology is so recent. Industry experts estimate that sales of external, self-powered broadband modems are 300,000 units p.a. These sales rates are likely to continue in the short to medium term, as customers convert to broadband internet connections and heated competition between internet service providers continues.

Therefore total sales of external, self-powered modems are currently estimated to be 430,000 units per annum.

RELEVANT MODES FOR THE ONE WATT POWER PLAN

Modems ordinarily have three operational modes: on, standby and off. On-mode occurs when the modem is actively connected to the ISP and is receiving or transmitting significant data. Consumption in this mode is generally not considered under the standby power plan.

Standby mode occurs while the modem is switched on and ready to communicate with the ISP, but is not receiving or transmitting significant amounts of data. In many modems, particularly broadband modems, this mode is not relevant or is indistinguishable from on-mode, as the modem will connect to the ISP with full communications ability whenever it is switched on. Some broadband modems also have a 'standby' button, which is typically designed to disconnect the modem from the computer for security purposes and does not significantly affect power consumption.

Off mode occurs when the modem is switched off by a button or switch on the unit. Some models have a 'soft' off switch and continue to consume power when switched off. Anecdotal evidence also suggests that many broadband modems either do not have an off switch, or are never switched off, and are therefore fully energised at all times.

Analysis suggests that both off and standby modes make a significant contribution to total greenhouse gas emissions in Australia. Total emissions from modems are likely to grow, as discussed below.

KNOWN STANDBY DATA FOR INSTALLED STOCK AND NEW PRODUCTS

Modem power consumption data presented here is sourced from the 2001 intrusive household survey [NAEEEC 2001] and measurements of modems undertaken for this product profile (69 models in total). Figure 2 graphs off mode and standby mode consumption readings for these modems.

As illustrated in Figure 2, modem standby/off mode consumption varies significantly, with measurements ranging from 0.6 W to more than 13 W.

It is also apparent that broadband modems generally have higher consumption than dialup modems. Contributing to this is the fact that many broadband modems do not have a standby mode distinguishable from on mode, nor do they have an off switch. Thus they essentially use full power at all times, unless physically disconnected from the mains supply.

In the broadband modems analysed, the losses within the broadband modems (as opposed to the power supply) typically consume around 5 W at all times. This is in contrast to USB-powered broadband modems which consume 2.5 W or less, which is the USB power limit. Internal PCI modems also tend to draw less power.

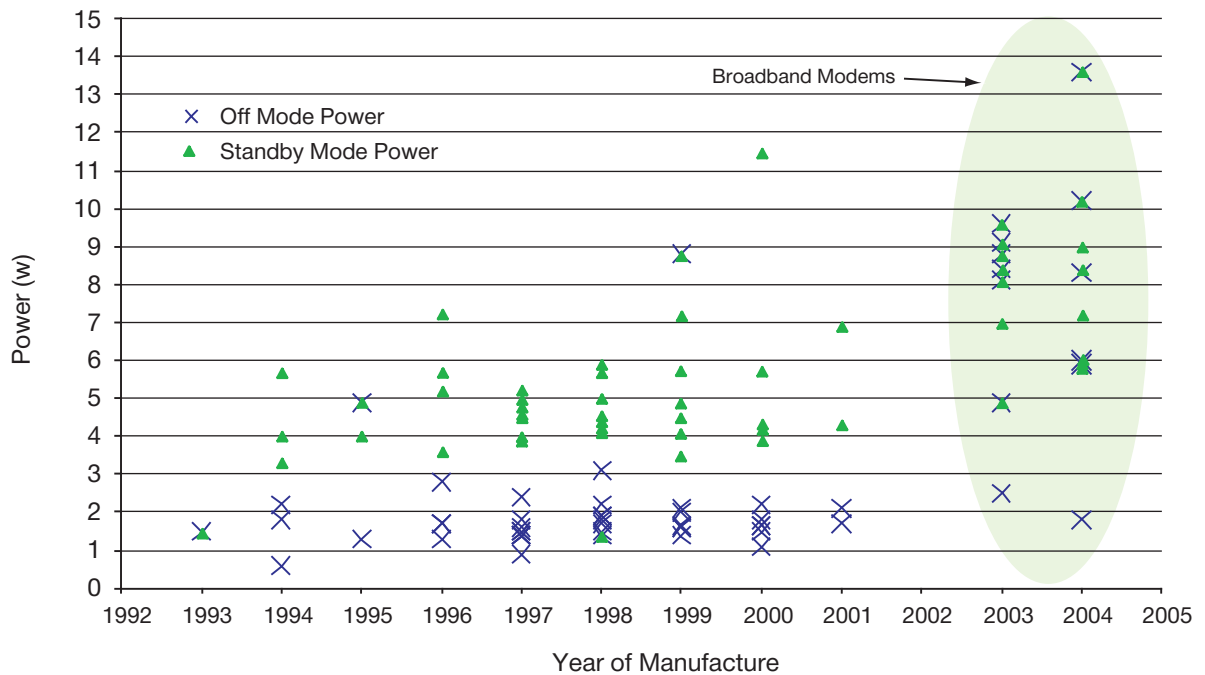
Furthermore there is a trend for USB and internal broadband modems to use the computer motherboard for some of the digital signal processing required, which in turn reduces chipset costs and power draw.

CONCLUSIONS

For self-powered dialup modems, the range of power levels illustrated in Figure 2 suggests that there is significant scope to reduce the off and standby power consumption of these modems.

All self-powered broadband modems tested had relatively high power consumption (the minimum was 5 W). This does not indicate immediate scope for standby power reduction in broadband modems using existing technologies. However, as discussed further below, there is potential to reduce broadband modem consumption in the next few years, following improvements in external power supply design and the ability of some broadband modems to enter into low power modes.

FIGURE 2 MODEM POWER CONSUMPTION DATA – IN OFF AND STANDBY MODES



GREENHOUSE EMISSIONS

For the purpose of estimating ‘business-as-usual’ (BaU) greenhouse gas emissions, average power consumption figures from the test measurements were used, as shown in Table 1. These were assumed to remain constant for the BaU case.

For all modem stocks, the following average daily operating patterns were used:

- > On mode: 3 hours per day;
- > Standby mode: 19 hours per day;
- > Off mode: 1 hour per day;
- > Disconnected from mains supply: 1 hour per day.

As discussed previously, it is difficult to predict trends in the stocks of external, self-powered broadband modems because the technology is relatively new, and the marketplace is changing rapidly (e.g. to include functions such as networking and wireless connectivity). However, for the purpose of predicting greenhouse gas emissions, it was assumed that stocks of external, self-powered broadband modems would increase at the current rapid rate for several years, before levelling off. Stocks of external, self-powered dialup modems were assumed to decrease at a continuous steady pace. These estimates are shown in Figure 3 overleaf.

TABLE 1 – CURRENT MODEM CONSUMPTION LEVELS*

Type	Standby (W)	Off (W)
Dialup, external modem, self-powered	5.5	2.6
Broadband, external modem, self-powered	8.2	7.5
Broadband external modem, self-powered with network hub and/or wireless connectivity to the PC	13.0	13.0

* note that these figures include consumption of the external power supply if present

FIGURE 3 ESTIMATED AUSTRALIAN STOCKS OF EXTERNAL, SELF-POWERED MODEMS

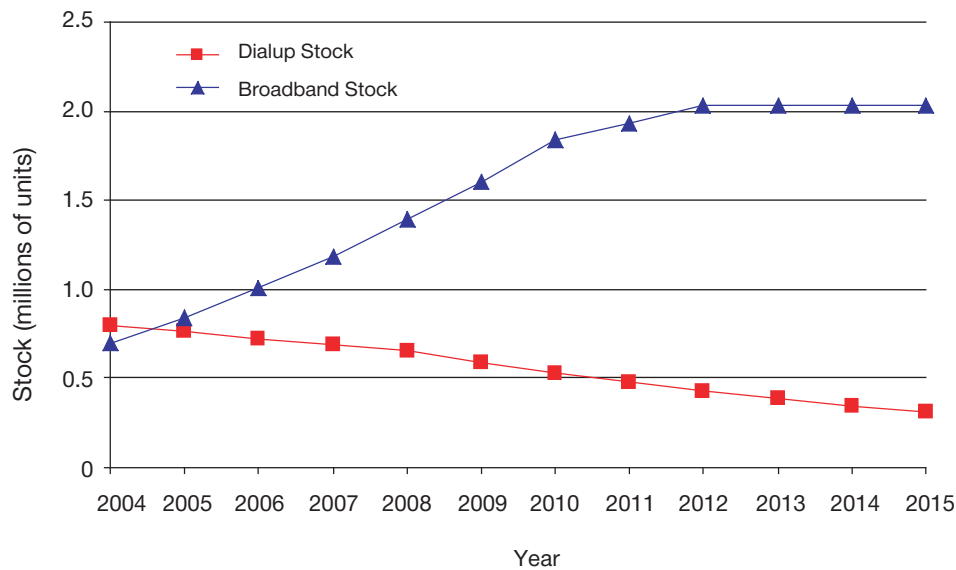
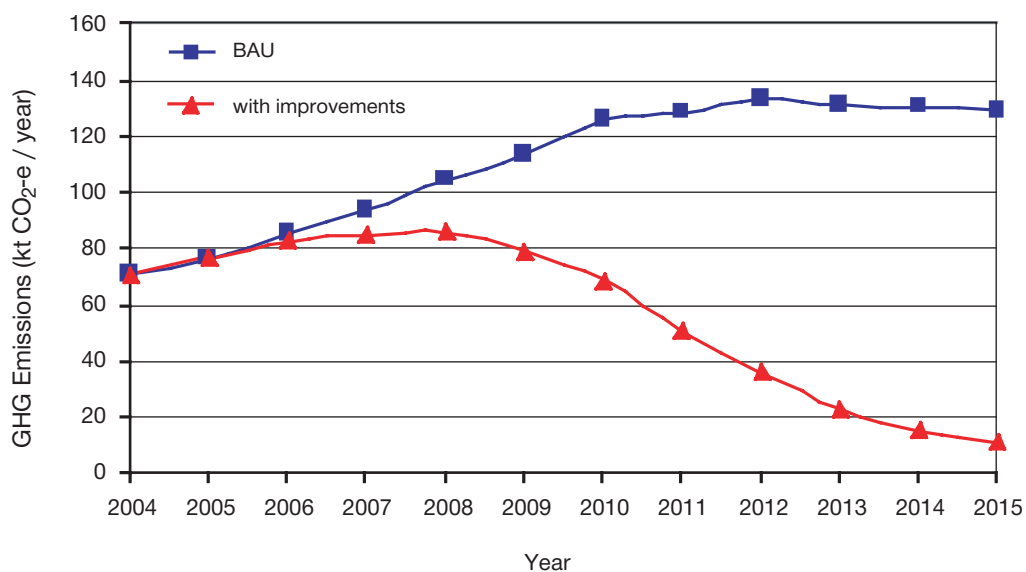


FIGURE 4 – GREENHOUSE GAS EMISSIONS FROM SELF-POWERED MODEMS (IN OFF AND STANDBY MODES)



The BaU greenhouse emissions from standby energy consumption of modems in Australia is estimated at 70,000 tonnes CO₂-e per annum in 2004 and predicted to rise, as shown in Figure 4 (BaU curve).

It is expected that the following consumption limits could be achieved with some care in design, including the incorporation of automatic standby modes and an off switch.

TABLE 2 FUTURE CONSUMPTION LIMITS FOR MODEMS

Modem Type	Standby (W)	Off (W)
External, self-powered modems	0.75	0.5

These consumption limits are based on the following developments for modems:

- > MEPS for external power supplies: The majority of dialup and ADSL modems tested incorporated an external power supply. The cable modems tested had a mixture of external and internal power supplies. External power supplies will be subject to Minimum Energy Performance Standards (MEPS) in 2006, and power consumption of a large number of modems in all modes will therefore be reduced.
- > Next generation broadband modems: Current generation ADSL modems operate in full-power mode at all times, even when not in use. The ADSL2 protocol includes power management facilities that help reduce overall power consumption while maintaining 'always-on' functionality. The ADSL2 low power mode enables overall power savings, at both the end-user modem and at the central office, by entering into sleep mode when the connection is not being used for extended periods of time [Aware 2004]. This is likely to result in significant power savings. At this time, similar developments for cable modems have not been proposed, although the 'with improvements' greenhouse emissions curve assumes that future developments in cable modems will reduce power consumption in the same manner as ADSL2.

Assuming the modem consumption limits (Table 2) are met by 2012 for all new product sales, estimated greenhouse gas savings are significant, as illustrated in Figure 4 (the 'with Improvements' curve). Savings are estimated to be around 50kt CO₂-e p.a. by 2010 and 110kt CO₂-e p.a. by 2015. Cumulative greenhouse savings to 2015 are estimated at 600kt CO₂-e.

CURRENT OVERSEAS POLICIES AND TRENDS

EUROPEAN CODE OF CONDUCT FOR BROADBAND EQUIPMENT

The European Union is currently drafting a Code of Conduct for Broadband Equipment (<http://energyefficiency.jrc.cec.eu.int>). The draft criteria for broadband modem maximum power levels (in on mode) are as follows:

- > DSL / cable modem for USB port or PCMCIA port: 2 W or less.
- > DSL / cable modem with external power supply: 2.8 W or less from the mains supply. Modem should have power management to follow PC mode.
- > Modems with ethernet hub or wireless access point: 6.6 W or less from the mains supply. Modem should have power management responding to data traffic.

US PROGRAMS

The US Energy Star program (www.energystar.gov) does not currently cover modems. The US Government's Federal Environment Management Program (FEMP - www.eere.energy.gov/femp/) provides efficiency recommendations for a range of products, and Federal Government agencies are required to purchase only products which meet these criteria. Modems are currently under consideration by FEMP.

OVERSEAS PROGRAMS FOR EXTERNAL POWER SUPPLIES

A number of countries are currently in the process of adopting mandatory efficiency requirements for external power supplies. Details of these programs are included in a report on external power supplies available from the energy rating website (www.energyrating.gov.au).

GOVERNMENT TARGET

EXTERNAL POWER SUPPLIES

In view of the significant losses from external power supplies, and the large number of modems using external power supplies, NAEDEC intends to partly focus on external power supplies as a means of reducing modem energy consumption. Regardless of any specific recommendations for modems, all external power supplies will be required to meet MEPS requirements described in Table 3 and Table 4.

MODEMS

As discussed previously, the modem itself is also responsible for significant losses in addition to its power supply. Given the expected future developments discussed previously (e.g. ADSL2), it is also considered feasible to reduce this consumption.

Access to low power modes (such as defined in the ADSL2 protocol) is clearly important in reducing overall energy

consumption for modems. It should be noted however that for ADSL2 to be effective, both the modem and the central office (CO) equipment need to be ADSL2 compliant. Thus initiatives will require the co-operation of a number of Australian Telcos to be effective.

For cable modems however, it does not appear that the DOCSIS cable modem protocol currently allows for low power modes.

Dialup modems are not 'always on' modems, and hence do not represent such a large standby energy consumption problem. They too however should be optimised to allow low standby consumption when not connected.

For modems types where a low-power mode does not yet exist (cable modems) or is not practical (dialup modems), a maximum power level for on mode is recommended, similar to the levels proposed by the European Union. This would also assist where, for example, an ADSL2 modem is connected to ADSL central office equipment and therefore cannot take advantage of the low power ADSL2 modes.

TABLE 3 RECOMMENDED NO-LOAD REQUIREMENTS FOR EXTERNAL POWER SUPPLIES

Nameplate Output Power (P _{no})	Australian MEPS Proposal Phase (1): April 2006	Australian MEPS Proposal Phase (2): April 2008
0 to < 10 watts	≤ 0.5 watts	≤ 0.5 watts
≥ 10 to ≤ 250 watts	≤ 0.75 watts	≤ 0.5 watts

TABLE 4 RECOMMENDED REQUIREMENTS FOR AVERAGE EFFICIENCY FOR EXTERNAL POWER SUPPLIES

Nameplate Output Power (P _{no})	Australian MEPS Proposal Phase (1): April 2006	Nameplate Output Power (P _{no})	Australian MEPS Proposal Phase (2): April 2008
0 to ≤ 1 watt	≥ 0.49 * P _{no}	0 to ≤ 1 watt	≥ 0.5 * P _{no}
> 1 to ≤ 49 watts	≥ [0.09 * Ln (P _{no})] + 0.49	1 to ≤ 51 watts	≥ [0.09* Ln (P _{no})] + 0.5
> 49 watts	≥ 0.84	> 51 watts	≥ 0.85

GOVERNMENT TARGETS

In accordance with the National Standby Strategy, NAEEEC intends to recommend to the Ministerial Council on Energy that an 'interim' target for modems be adopted, to provide Governments with confidence that Australian products will meet the ultimate target in 2012. If the interim target is not met in the specified year, Government will commence dialogue with industry to explore other options, including the possibility of moving to Stage Two mandatory measures.

It is considered that the proposed targets are likely to be technically achievable with minimal cost and changes to product design. Standby targets for each product have been developed in the context of what is achievable. It should be noted that these products are projected to be present in large numbers in Australian homes and businesses, so even modest reductions in per unit energy consumption will result in significant national energy and greenhouse savings.

1. INTERIM TARGET - 2008

Modem Type	On Mode (W)
Dialup, external modem, self-powered	< 2.8
Broadband, external modem, self-powered	< 2.8
External modem, self-powered with network hub and/or wireless connectivity to the PC	< 6.6

This target will apply to all external, self-powered modems sold in Australia in that year. NAEEEC proposes to monitor the sale of these products in that year and to move toward regulation should the interim target not be met by a significant number of products.

The following targets also apply:

- > All modems should have a standby and/or hard off switch.
- > ADSL modems should allow automatic low power modes (i.e. ADSL2 or similar). Target power levels for these modes may be set once sufficient models become available.
- > Cable modems should have automatic low power modes, where the protocol allows. If feasible, the Australian Government will act to facilitate the development of such a protocol.
- > The Australian Government will work with Telcos and appropriate bodies to encourage the installation of efficient central office equipment, in order to facilitate modem low power modes and reduced energy consumption of the central office equipment.

2. NATIONAL STANDBY STRATEGY TARGET – 2012

Modem Type	Standby Mode (W)	Off Mode (W)
External, self-powered modems	0.75	0.5

The following additional targets also apply:

- > All modems should have a standby and/or hard off switch.
- > All modems should allow automatic low power modes.

This target should apply to all external, self powered modems, and may be inserted into the relevant Australian Standard depending on future compliance requirements.

GOVERNMENT PROPOSALS TO MEET THIS TARGET

Government agencies intend to take the following actions to assist industry meet the standby targets for modems.

Voluntary Tool Available	Action / Rationale	Date
Government procurement list	<ul style="list-style-type: none"> MCE are considering a policy of preferencing the purchase of low standby external, self powered modems where available and fit for purpose. Qualifying products to be included on the government Energy Allstars procurement database. 	2005/6
Australian Standard	<ul style="list-style-type: none"> To communicate government expectations in a new part of AS/NZS 62301. 	From 2005
Annual survey	<ul style="list-style-type: none"> To collect data on new external, self powered modems and analyse trends. This data will be published annually. 	ongoing

Government will announce whether this product should be targeted for stage two intervention under the National Standby Power Strategy (involving possible regulatory intervention) or whether the abovementioned actions together with industry intervention have been successful in meeting the target at the NAEEEC Forum in the year:

2009

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