Report No: 2004/11

NATIONAL APPLIANCE AND EQUIPMENT ENERGY EFFICIENCY PROGRAM

Minimum Energy Performance Standards

REFRIGERATED BEVERAGE VENDING MACHINES

AN INITIATIVE OF THE MINISTERIAL COUNCIL ON ENERGY FORMING PART OF THE NATIONAL FRAMEWORK FOR ENERGY EFFICIENCY AND NEW ZEALAND ENERGY EFFICIENCY AND CONSERVATION STRATEGY

Minimum Energy Performance Standards - Refrigerated Beverage Vending Machines

Refrigerated beverage vending machines (RBVM) have been deployed in Australia for many decades, in areas of high public traffic, such as, commercial and institutional buildings, and railway stations. Use in other areas, such as staff lunch rooms has increased over the years, often replacing the traditional manned staff canteen.

In their simplest form, they vend a limited range of chilled cans and bottles of carbonated beverages. More recent models provide a wider range (up to 45 choices) of beverages, including bottled water, energy drinks and juices. These are not expected to displace the traditional vending machines in the near term.

Typically, RBVM spend considerable time in a maintenance mode - keeping beverages at the desired temperature, irrespective of demand. Substantial energy is wasted overnight and at weekends when there is low or no vending requirement, and in having lights on unnecessarily.

There are an estimated 110,000 RBVM in use in Australia today, which consumed approximately 520MWh of electricity in 2004. This equates to an estimated 500 ktCO_2-e of greenhouse gas emissions.

Since the market for RBVM is steadily increasing, annual energy consumption by RBVM is projected to reach 716MWh by 2020 without intervention.

RBVM in Australia do not incorporate relatively low cost energy efficiency measures already implemented overseas, particularly in the United States, which is the dominant source of RBVM for the Australian market. The use of more efficient motors, lighting and fans, together with facilities to automatically 'power down' machines when not in regular use, are capable of reducing energy consumption reduction by nearly 50%. Although these technologies are available in commercially produced RBVM in the United States, they have not been introduced into the Australian market.

Given no obvious uptake of available improved technologies and the growth rate predicted for RBVM in Australia, NAEEEC considers the introduction of efficiency standards for RBVM a priority.

INTERNATIONAL HARMONISATION

In keeping with Australia's policy of matching world's best regulatory practice, NAEEEC plans to introduce energy performance requirements in RBVM standards which are equivalent to the levels used in the United States, the source of the majority of RVBM used in Australia. NAEEEC has examined the regulations in Canada, the proposed requirements from January 2006 in California, and the voluntary US ENERGY STAR program. Australia plans to adopt MEPS levels for RVBM

STAKEHOLDER COMMENT

NAEEEC invites comments from any interested person or organisation on the measures proposed in this study. Comments should be directed to energy.rating@greenhouse.gov.au by 30 June 2005. Information sessions for industry participants can be arranged during the comment period if requested.

Electronic copies of profiles and full reports released for public discussion can be obtained from www.energyrating.gov.au types matching those specified by the US Environment Protection Agency in the ENERGY STAR program since April 2004.

North America is currently the only region requiring energy performance declarations for vending machines, based on tests on ASNI/ASHRAE test method, and since the majority of RBVM in the Australian market are sourced from North America, Australia should also require performance declaration based on an identical test method. Australia therefore plans to introduce a test standard for measuring energy consumption based upon ANSI/ASHRAE 32.1 – 2004. This will be developed through a Standards Australia Working Group with industry participation.

NAEEEC PLAN

NAEEEC proposes to introduce efficiency regulations for RBVM, with key components as follows:

1. Minimum energy performance standards (MEPS) should be implemented for RBVM based on daily energy consumption, commencing not earlier than April 2007. In addition to meeting MEPS, all RBVM will be required to automatically access low power modes, and this facility shall be enabled when machines are shipped.

2. A specific test method should be developed by the Standards Australia Working Group under ME-008, based on ANSI/ASHRAE 32.1 – 2004. When tested for MEPS compliance, low power modes shall be disabled.

3. The proposed MEPS levels for RBVM shall be equivalent to the ENERGY STAR criteria as amended in December 2004.

   $Y = 0.55\ [8.66 + (0.009 \times C)]$

   Where: Y = 24 hr energy consumption (kWh/day) after the machine has stabilized

   C = vendible capacity of cans.

   For example: a 650-can capacity machine may consume no more than 7.9805, or 7.98 kWh/day (rounded).

4. A category of 'high efficiency' products shall be established in the relevant Standard, such that only products which meet these specified performance standards can be promoted as 'high efficiency' products. The following performance levels for this higher efficiency category are equivalent to ENERGY STAR requirements from January 2007, and will be adopted as MEPS in Australia not earlier that 2010.

   $Y = 0.45\ [8.66 + (0.009 \times C)]$

   Where: Y = 24 hr energy consumption (kWh/day) after the machine has stabilized

   C = vendible capacity of cans.

IMPACT OF MEPS

With adoption of the proposed measures 1,2 and 3, it is estimated that annual energy consumption in 2020 should be reduced by 302GWh, with a corresponding reduction in annual greenhouse emissions in 2020 of 290ktCO_2-e. The total cumulative savings in greenhouse gas emissions from 2007 – 2020 is estimated to be 2.57MtCO_2-e.

Similarly, should the levels in point 4 be implemented as the new MEPS levels from 2009, then it is estimated that annual energy consumption in 2020 should be reduced by 380GWh, with a corresponding reduction in annual greenhouse emissions in 2020 of 360ktCO_2-e. The total cumulative savings in greenhouse gas emissions from 2007 – 2020 is estimated to be 3.09MtCO_2-e.

NAEEEC MEMBERS

The Commonwealth, New Zealand, and each state and territory are represented on NAEEEC and participate in its deliberations. Representatives are officials within government departments, agencies and statutory authorities or people appointed to represent those bodies. Representatives are usually a senior officer directly responsible for energy efficiency. The membership is currently under review and may expand to include other agencies working in these fields.

The Australian Greenhouse Office (AGO) is part of the Australian Government Department of the Environment and Heritage. The AGO is responsible for monitoring the National Greenhouse Strategy in cooperation with states and territories and with the input of local government, industry and the community. An AGO officer is the chair of NAEEEC and others provide support for its activities.

The NSW Department of Energy, Utilities and Sustainability provides policy advice to the NSW Government and operates a regulatory framework aimed at facilitating environmentally responsible appliance and equipment energy use.

The Office of the Chief Electrical Inspector is the Victorian technical regulator responsible for electrical safety and equipment efficiency. Its mission is to ensure the safety of electricity supply and use throughout the state and its corporate vision is to demonstrate national leadership in electrical safety matters and to improve the superior electrical safety record in Victoria. The office's strategic focus is to ensure a high level of compliance is sustained by industry with equipment efficiency labelling and associated regulations.

The Sustainable Energy Authority was established in 2000 by the Victorian Government to provide a focus for sustainable energy in Victoria. The authority's objective is to accelerate progress towards a sustainable energy future by bringing together the best available knowledge and expertise to stimulate innovation and provide Victorians with greater choice in how they can take action to significantly improve energy sustainability.

The Electrical Safety Office, Department of Industrial Relations, is the Queensland technical regulator responsible for electrical safety and appliance and equipment energy efficiency. The office ensures compliance with electrical safety and efficiency regulations throughout Queensland.

The Environmental Protection Agency, through its Sustainable Industries Division, is Queensland's lead agency in the promotion of energy efficiency, renewable power, and other initiatives that reduce greenhouse gas emissions throughout the state. Its key aim is to achieve increased investment in sustainable energy systems, technology and practice.

Energy Safety WA seeks to promote conditions that enable the Western Australian community's energy needs to be met safely, efficiently and economically.

The Western Australian Sustainable Energy Development Office promotes more efficient energy use and increased use of renewable energy to help reduce greenhouse gas emissions and increase jobs in related industries.

The Office of the Technical Regulator seeks to coordinate development and implementation of policies and regulatory responsibilities for the safe, efficient and responsible provision and use of energy for the benefit of the South Australian community.

The Tasmanian Government's interest is managed by the Department of Infrastructure, Energy and Resources' Office of Energy Planning and Conservation (OEPC). OPEC provides policy advice on energy related matters including energy efficiency.

Electricity Standards and Safety, Department of Infrastructure, Energy and Resources, is the technical regulator responsible for electrical safety throughout Tasmania. Regulatory responsibilities include electrical licensing, appliance approval and equipment energy efficiency.

The ACT Office of Sustainability was established in January 2002 to develop, facilitate and coordinate the implementation of policies and procedures related to sustainability. From the end of 2004, the Office has expanded to take on responsibility for energy and greenhouse policy, including energy efficiency issues. The ACT Planning and Land Authority is the ACT technical regulator responsible for electrical safety and equipment efficiency.

The Department of Employment, Education and Training is responsible for administering regulations in the Northern Territory on various aspects of safety, performance and licensing for goods and services including electrical appliances.

The Energy Efficiency and Conservation Authority (EECA) is the principal body responsible for delivering New Zealand's National Energy Efficiency and Conservation Strategy. EECA's function is to encourage, promote and support energy efficiency, energy conservation and the use of renewable energy sources.

The Ministry for Environment (MfE) is the lead department in New Zealand advising the Minister of Energy on the development of government policy advice on energy efficiency, conservation and the use of renewable sources of energy. It works with EECA and also monitors its performance under the Public Finance Act.

Analysis of the Potential for Minimum Energy Performance Standards

for

Refrigerated Beverage Vending Machines

Prepared for

The Australian Greenhouse Office and NAEEEC under the National Appliance & Equipment Energy Efficiency Program

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Draft Report

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1 Introduction

This report was commissioned by the National Appliance and Equipment Energy Efficiency Committee (NAEEEC) to explore the potential for energy and greenhouse savings through improvements to refrigerated beverage vending machines in Australia.

NAEEEC is the administering body for the National Appliance and Equipment Energy Efficiency Program (NAEEEP) which comprises representatives from the following government agencies:

- State and Territory regulatory agencies responsible for administering the mandatory energy efficiency labelling and performance standards called into legislation in their respective jurisdictions; and
- Commonwealth, State and New Zealand agencies with a mandate to encourage sustainable energy use and reduce greenhouse gas emissions.

NAEEEC reports to the Ministerial Council on Energy (MCE) through the Energy Efficiency and Greenhouse Gas Working Group. The NAEEEC is administered by the Australian Greenhouse Office.

The activities of NAEEEP flow from the requirement in the National Greenhouse Strategy (NGS 1998) to improve the energy efficiency of energy-consuming household appliances, and industrial and commercial equipment.

In 2001 the Australian Greenhouse Office flagged its intentions to introduce MEPS for commercial refrigeration equipment, with the publication of the following report:

- *Minimum Energy Performance Standards for Self-Contained Commercial Refrigeration,* the plan by the National Appliance and Equipment Energy Efficiency Committee, March 2001.

In December 2001, a discussion paper was published by Mark Ellis and Professor Eddie Leonardi:

- *Minimum Energy Performance Standards for Refrigerated Vending Machines - Self-Contained*

The purpose of the December 2001 discussion paper was to report on progress in the development of minimum energy performance standards (MEPS) for commercial refrigeration products, including refrigerated beverage vending machines. At that time, the best available efficiency levels for refrigerated beverage vending machines were set out in a Canadian standard. It was proposed that Australia match the MEPS levels contained in the Canadian standard for refrigerated beverage vending machines. However it was noted that most Australian models were likely to comfortably meet these MEPS levels and there could be a case for introducing more stringent MEPS.

Since publication of these two reports more stringent efficiency criteria (in the voluntary Energy Star program and the mandatory Californian standard) have been introduced in the USA. Canada has since proposed that it will harmonise with the Californian standard.

The objective of this document is to further advance the MEPS process for refrigerated beverage vending machines, and to facilitate informed decision-making by providing updated information about these products in Australia.

To assess the relative impact of refrigerated beverage vending machines on the overall refrigerated vending market, this report initially discusses all refrigerated vendors, including food and snack vendors and combined food/drink vendors.

From this initial assessment it is concluded that refrigerated beverage vending machines are responsible for approximately 75% of the greenhouse emissions produced by refrigerated food and/or beverage vending machines. Therefore detailed assessment focuses on refrigerated beverage vending machines, as the introduction of energy efficiency measures for these products will have greatest impact on managing greenhouse emissions.

Key information presented herein includes:

- current refrigerated vending machine types (food and/or beverage);
- current market and stock figures for beverage vending machines and other refrigerated vending machines, as well as an assessment of market trends;
- international standards applicable to refrigerated beverage vending machines;
- energy consumption figures for refrigerated beverage vending machines;

- analysis of the potential to reduce energy consumption and greenhouse emissions from these machines;
- recommendations for setting efficiency levels and test methods.

2 Product Description - Food and Beverage Vending Machines

2.1 General Description

Refrigerated vending machines are self-contained machines that accept payment prior to dispensing selected food or beverages stored in the machine to the consumer. Vending machines are typically placed in high-use public areas, either inside or outside buildings, to maximise product turnover. These machines plug into a conventional 240V power supply.

Broadly, vending machine types can be categorised as follows:

- Refrigerated machines for vending beverages;
- Refrigerated machines that heat food from cold or frozen, prior to vending;
- Refrigerated machines that vend frozen or chilled food;
- Refrigerated machines that vend both beverages and snacks;
- Non-refrigerated machines that vend snacks;
- Non-refrigerated machines that vend hot beverages; and
- Combination machines that vend hot and cold beverages and chilled snacks.

2.2 Applications and Machine Types

While most refrigerated vending machines fit within these major categories, there is some overlap in design between categories, as well as varying flexibility in products which can be vended. It should also be noted that there is an increasing trend away from the more traditional designs towards more flexible, multi-purpose designs.

2.2.1 Refrigerated machines for vending beverages

The most common beverage vending machine is the closed front machine, used to vend cans and/or bottles. With closed front machines, the product cannot be seen and the machine either has signage or a backlit panel on the front advertising the contents. The unlit machine (signage only) is typical of machines placed in an external location. Depending on the model, these machines can contain up to 800 cans and up to 12 varieties of beverages.

The other major type of beverage vendor is the glass fronted machine. This design allows the consumer to see the products inside the machine, with some models displaying as many as 45 different varieties of drinks. Product packaging is not limited to cans and bottles, and may also include cartons, tetra packs and non-standard bottle shapes. Glass fronted machines are typically placed inside a building or sheltered location. With the increasing market for non-carbonated soft drinks such as energy drinks, fruit juices and water (which come in a variety of packaging types and sizes) these machines provide much wider choice for the consumer.

2.2.2 Refrigerated machines that heat food from cold or frozen, prior to vending

These machines heat frozen food such as a pies and pasties for vending, and are of closed front design with signage advertising the contents to consumers. The food is generally heated in one minute using microwave technology.

One Australian manufactured unit has a capacity of 200 frozen goods and can vend up to 20 varieties of food, although these types of machines are more typically used for up to ten product varieties.

These vendors are placed in areas where hot food is not available, such as staff lunch rooms, railway stations or venues where alcohol is served and food has to be available.

2.2.3 Refrigerated machines that vend frozen or chilled food

These vending machines are glass fronted machines which vend frozen products such as icecreams and/or chilled products such as chocolates, cakes and other snacks. As with refrigerated beverage machines, they are capable of containing a variety of product types, up to 45 in some instances. Their design allows the consumer to see the range of products in the machine.

Such machines may include those:

- dedicated to frozen products;
- dedicated to chilled products;
- containing frozen and chilled foods in varying combinations.

These machines are typically placed inside a building or sheltered location.

2.2.4 Refrigerated machines that vend both beverages and snacks

These machines are designed to fit products with a range of packaging types, and have glass fronts allowing consumers to see the products inside. They vend refrigerated beverages as well as chilled snacks such as chocolates, cakes, chips and sweets.

There are two main design types:

- Vertically split chamber machines with snacks in one chamber at ambient temperature and beverages in another refrigerated chamber;
- Single chamber machines with beverages stocked in the lower section and snacks in the upper section. Refrigeration is concentrated on the beverages in the lower part of the chamber, with the rest of the chamber receiving some cooling effect.

Typical locations are offices, staff lunch rooms and bus and railway stations.

2.2.5 Non-refrigerated machines that vend snacks

These machines also are multi-package design with glass fronts allowing consumers to see the range of products inside. Contents are stored at ambient temperatures, and include snacks such as chips and sweets. Typical locations are offices, staff lunch rooms and bus and railway stations.

2.2.6 Non-refrigerated machines that vend hot beverages

These machines are primarily for vending coffee and tea, but may also stock other hot beverages such as hot chocolate and instant soups. There are three types of hot beverage machines:

- ’bean to cup‘ machines that grind stored coffee beans to make a cup of fresh espresso coffee. Some machines also include a frothing function to deliver coffee as though it was made in a café. Multiple soluble products such as sugar and milks are also included to allow the consumer to customise the coffee to personal taste. Typical locations are offices, staff lunch rooms and foyers of buildings;
- ‘instant’ hot beverage machines which vend hot drinks made by combining required soluble products (powders and granules) and water heated by the machine. A typical machine would have six powder compartments for products such as regular coffee, decaffeinated coffee, chocolate, soup, tea, sugar, milk etc. Typical locations are offices, staff lunch rooms, entertainment venues and public areas such as bus and railway stations with high volumes of people;
- units which are a combination of the above two types.

2.2.7 Combination machines that vend hot and cold beverages and chilled snacks

This is a recently released type of machine that vends ‘bean to cup’ coffee, instant hot beverages, cold beverages and snacks. The capacity of these machines to vend cold beverages and snacks is small (in terms of quantity and variety) in comparison to machines dedicated to those products, and hence the target market is expected to be offices and staff lunch rooms.

3 Market Profile

3.1 Industry Profile

Vending in Australia is dominated by the 'traditional' vendors: 'product to be vended' brand name companies with fleets of machines branded in their company livery, who also sell the vending products. These are major drink/snack companies which import machines and usually retain ownership of the machines. They provide total service vending (TSV) - installation, restocking and servicing.

These brand name vending machines are sourced primarily from the US and Europe, with the majority manufactured by several large vending companies. Some of the major vending manufacturers also have offices or distributors in Australia, and import their machines for sale within Australia. These companies are the main suppliers to the 'independent operators' market': smaller companies who own fleets of machines for on-site rental.

Therefore the majority of vending machines in Australia are owned by brand name companies or independent operators, rather than site owners. Table 1 provides a summary of the main vending manufacturers and their Australian importers/distributors.

Table 1: Major vending machine manufacturers and Australian importers/distributors

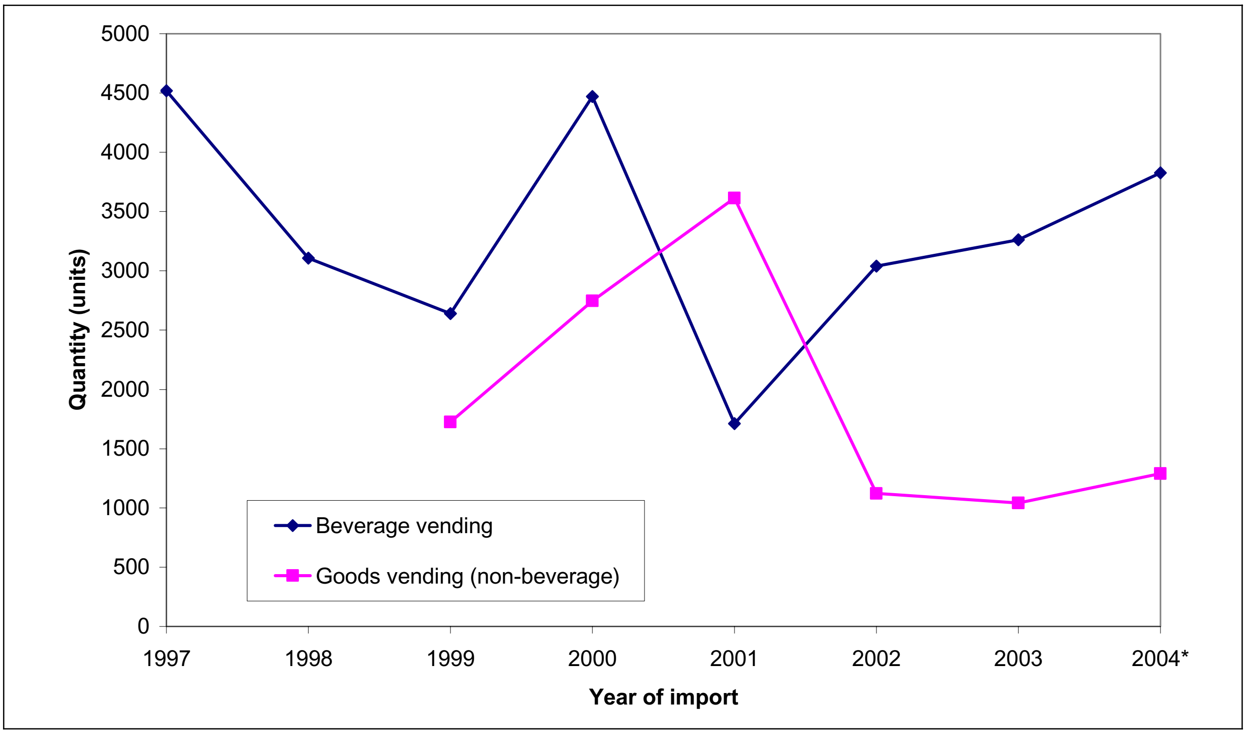
Brand	Importer / Distributor	Product type(s)
AMS	Quirks Refrigeration	snack; cold beverage
Automatic Products International	Professional Vending Services	cold/hot beverages; snack; cold/frozen food
Azkoyn	Professional Vending Services	cold beverage; snack; coffee and tobacco
Dixie-Narco	Brivend; Coca Cola Amatil; Cadbury Schweppes/Pepsi; Smiths Snack Vend	mainly cold beverage; some combination units
Hankers (Australian manufactured)	Professional Vending Services (Australian manufacturer)	heated frozen food
National Crane	Automatic Vending Specialists; Smiths Snack Vend	mainly snack; some combination units
Polyvend	Smiths Snack Vend	snack
Royal Vendors	Coinco/Royal Vendors; Coca Cola Amatil; Quirks Refrigeration	cold beverage
Vendo	Vendo (Sanden); Automatic Vending Specialists; Coca Cola Amatil; Cadbury Schweppes/Pepsi	mainly cold beverage; some combination units; coffee/food

3.2 Australian Bureau of Statistics Data

The great majority of refrigerated vending machines are imported, with only one manufacturer selling locally manufactured products. In general, the small size of the Australian market does not make local manufacturing viable except for more specialized vending applications. However many non-refrigerated vendors are at least partially manufactured and/or assembled in Australia.

Figure 1 shows the ABS import figures from 1997 – 2004 of refrigerated and/or heated beverage and food/snack vending machines, showing that beverage vending machine imports are generally higher than goods vending machines. It should be noted however that these ABS statistics do not discriminate between vending machines with refrigeration or heating, and therefore the numbers of refrigerated vending machines imported are less than shown in Figure 1.

Figure 1: Imports of refrigerated/heated automatic vending machines [ABS 2004]

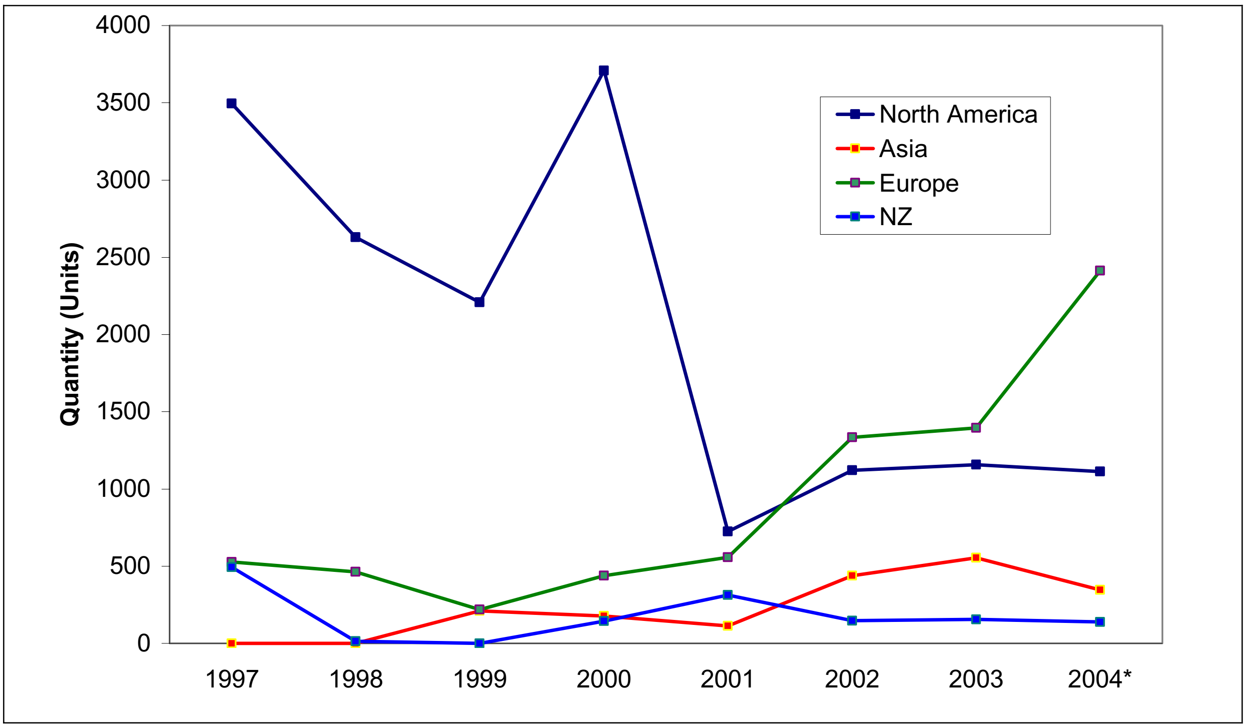


** 2004 data extrapolated from Oct 2004*

These figures confirm the wide market fluctuations indicated by industry sources, with a significant peak in vendor sales around the time of the Sydney 2000 Olympics.

The majority of beverage vending machines are imported from the USA and Europe, as shown in Figure 2.

Figure 2: Beverage vending machine Imports – source of origin ABS 2004



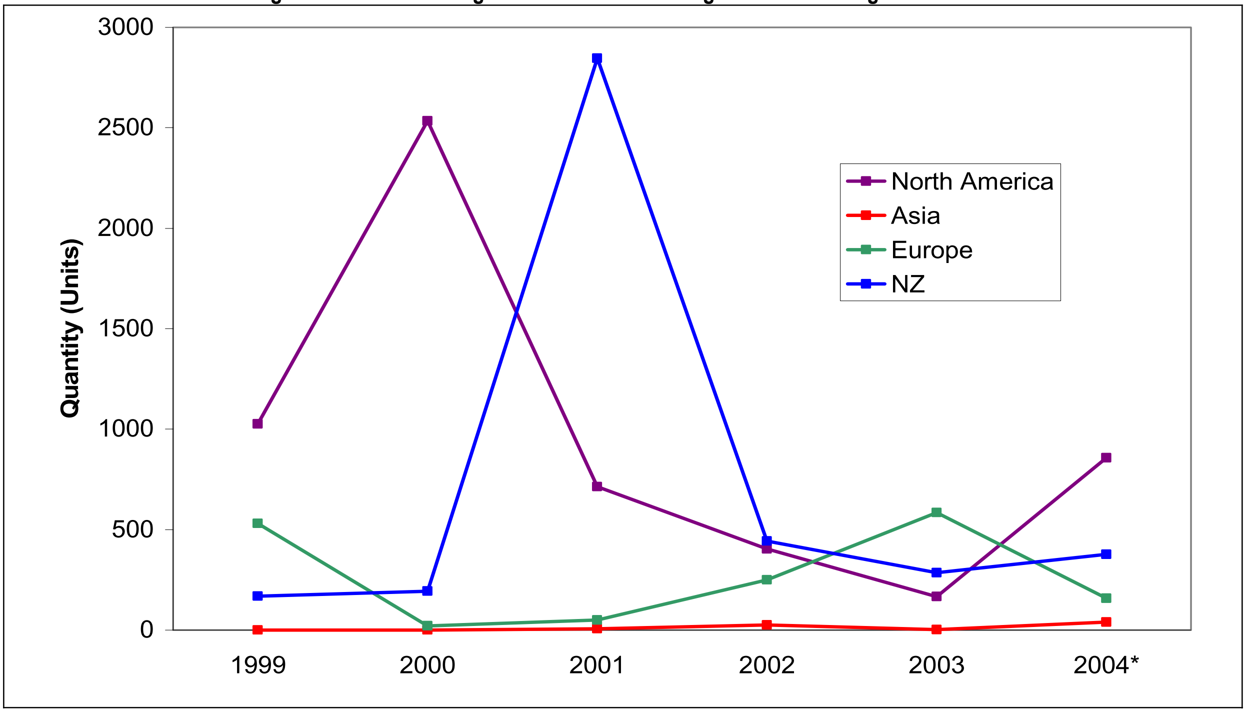
** 2004 data extrapolated from Oct 2004*

Industry sources suggest a slowing in imports of refrigerated beverage vending machines in more recent years, indicating that the post Olympic rise of beverage vending machines shown in Figure 1 is attributable to imports of other types of beverage vending machines. Given the increasing volume of imports from Europe shown in Figure 2, this recent growth in total imports is most likely a reflection of rising coffee vendor sales (particularly 'bean to cup' style vendors), primarily from Italy and Spain. Based upon import region, coffee vendors are estimated to comprise approximately 60% of 2004 ABS import figures.

Industry sources predict however that imports of refrigerated beverage vendors from the US will increase in 2005.

Figure 3 shows imports by origin of automatic vending machines incorporating heating or refrigerating devices, but excluding automatic beverage-vending machines. The bulk of these figures are attributed to chilled snack / frozen food vending machines. Imports of these machines also exhibit large variations in the numbers of machines imported from one year to the next.

Figure 3: Goods vending machines - non beverage – source of origin ABS 2004



** 2004 data extrapolated from Oct 2004*

3.3 Sales and Stock – Refrigerated Vending Machines

Most refrigerated vending machines are not actually 'sold' in Australia once imported. The bulk of vending machines are owned by the companies that also supply the products stocked in the vending machine. In the main, these companies source their vending machines overseas, depending on machine type and local availability, then retain ownership of the machines after deployment (installation on-site). Where the term 'sales' is used, it should be taken to refer more generally to include local sales and imports/deployment of vending machines.

Industry sources estimate sales/imports of the main types of refrigerated vending machines as follows:

Table 2: Estimated annual sales / installed stocks of refrigerated vending machines in Australia

Vendor type	Estimated annual sales*	Estimated installed stocks
Refrigerated beverage	1500 - 2000	100,000 - 120,000
Chilled snack	1000 - 1300	25,000 - 30,000
Refrigerated combination beverage/snack	1000 - 1300	5,000
Refrigerated food (includes hot foods stored cold/frozen)	200 - 300	6,000

** figures may vary considerably from year to year because of market dominance by a few large importers.*

The stock of refrigerated vending machines in Australia is dominated by traditional vendors (beverages-only and chilled snack-only machines), however there are increasing sales in recent years of combination style vendors dispensing both drinks and snacks.

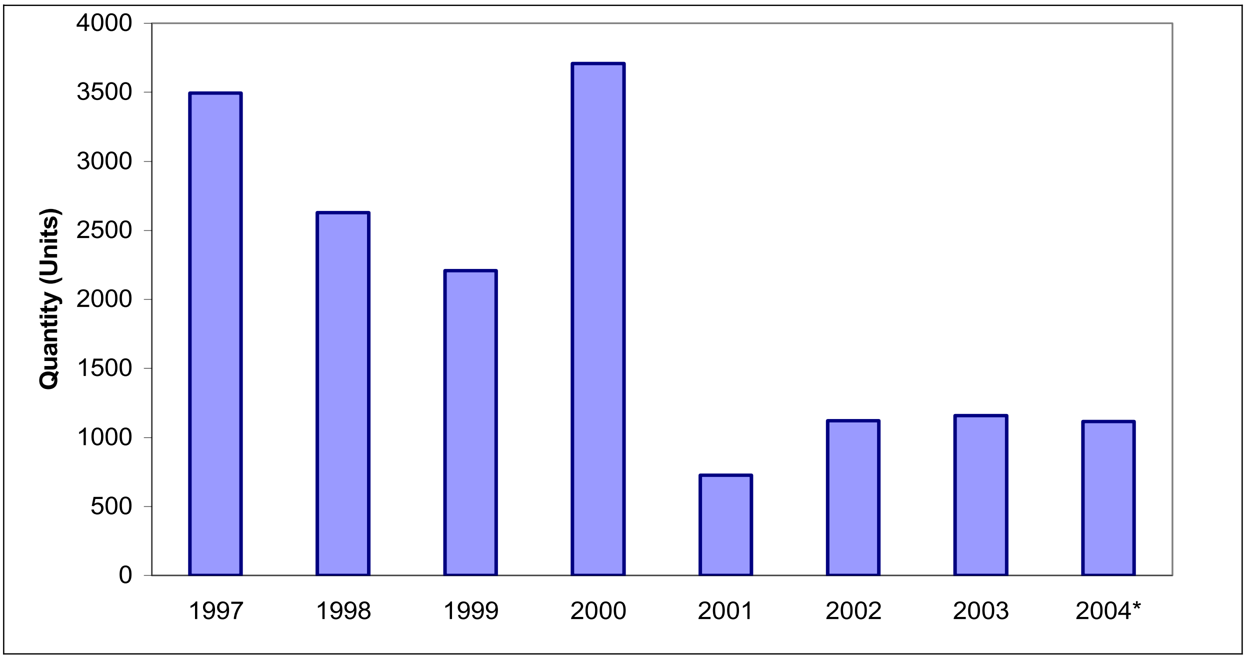
There is also a small market in Australia for second hand or refurbished vending machines (old machines which have been gutted and had the shelving/product display re-fitted). Cold beverage-only vending machines in particular are of quite simple design with long life-times, making them quite suitable for refurbishment and re-sale. Some second-hand machines are also brought in from overseas, however import costs make this viable only if the machine is sourced very cheaply.

3.4 Market Trends

In Australia the total Non Alcohol Ready To Drink (NARTD) market has grown by 380 million drinks per annum from 1999 to 2003, and was forecasted to grow by more than 500 million in 2004 alone.[1] While this figure is for total drink sales through all types of retail outlets, it is predicted that drink vending sales will increase, as will placement of vending machines. Some of the growth is attributed to Australia's increased consumption of non-carbonated soft drinks: Coca-Cola Amatil forecasts growth in bottled water of 10 – 15%, energy drinks of 20% and juices of 4%.[1]

Figure 4 shows ABS import figures for refrigerated/heated beverage machines from the US. These figures are largely attributed to be imports of refrigerated beverage vending machines. The large increase in 2000 reflects machines imported for the Sydney 2000 Olympics (and to cater for the influx of tourists either side of the Olympic Games). It is assumed that this saturated the market and replacement machines were not required for a few years.

Figure 4: US Imports By Year – Refrigerated/Heated Beverage Vending Machines - source ABS 2004



** 2004 data extrapolated from Oct 2004*

With increased penetration of glass fronted machines and more sophisticated payment options on the horizon (ie. dollar note readers, mobile phone and credit card payment facilities), vending sales in general are predicted to continue growing, as are the number of machines. Some industry players forecast growth in refrigerated vending machine sales of 15% per annum for the next five years - which is verified by the recent increase in sales of combination and chilled snack units reported by manufacturers and importers. The market for combination units in particular is likely to expand, given recent workplace trends towards phasing out canteens and placing vending machines in lunchrooms.

It is also probable that the distinction between chilled snack and combination vending will become less marked in the next few years, with combination vendors capable of being used for drinks or snacks

1 Investor presentation – Coca-Cola Amatil September 2004

alone, as well as for any combination of the two. However industry sources feel that the demand for these combination style units will not overtake that for traditional vendors for the following reasons:

- combination units are more expensive (up to 40% more) than beverage-only or snack-only vendors;
- they are generally placed in smaller public areas, hence product turn-over is lower and it takes longer to recoup purchase costs;
- combination units are more labour intensive because they have a wider product range and lower stocks of individual products, requiring more frequent re-stocking;
- they are technologically more complicated, incurring higher maintenance costs.

Traditional vendors are therefore most suited to high turnover public areas, often housing several different types of large vendors. A substantial proportion of current annual import figures would represent replacement stock for older traditional machines, since a large number of sites have had these vendors installed for many years.

Other factors influencing the vending market include:

- the recent introduction of computerized, networked vending machines allowing remote monitoring of temperature, stocks, etc. The demand for these products is likely to escalate;
- the off-loading of older electromechanical style machines onto the second hand market, and a possible slowing of the market for refurbished machines because of the increasing complexity of newer machines;
- occasional short-lived off-loading of cheap, imported equipment onto the market: for example recent importing of computerized units from Japan with an inferior (superceded) protocol.

Several industry sources expressed concern over strong trends overseas towards banning vending in schools and other areas where healthy eating is considered a priority. This may restrict the vending market in such areas, or at least force a swing towards stocking of healthier products in preference to snacks and drinks with added sugar. Such moves will benefit independent operators who offer a wider range of products, allowing schools to satisfy health requirements.

4 Estimated Energy Consumption By Vendor Type

Due to the variety of machines in the market place, it is difficult to obtain accurate energy consumption data. However, the Canadian Standard 804-96 provides useful energy consumption figures for the main machine types [MEA 2000], as shown in Table 3. There is a good correlation between this Canadian data and that obtained from Australian tests performed by Mechlab[2] on refrigerated beverage vending machines.

Table 3 provides an analysis of total energy consumption by machine type in Australia, based on the Canadian energy consumption figures.

Table 3: Estimated Energy Consumption By Vendor Type in Australia

Vendor type	Estimated installed Australian stocks	Daily energy use (from Canadian Std) kWh	Annual energy use GWh pa	Percentage of total energy consumption
Refrigerated beverage	110,000	13.0	522.0	75%
Chilled snack	27,500	12.3	123.5	18%
Refrigerated combination beverage/snack	5,000	7.5	14.6	2%
Refrigerated food (includes hot foods stored cold/frozen)	6,000	14.3	31.3	5%
TOTAL CONSUMPTION			**691.4 GWh pa**	

2 Mechlab - Refrigeration and Air Conditioning Laboratory, School of Mechanical and Manufacturing Engineering, University of New South Wales

This analysis shows the relative energy consumption of the different types of machines, and has been used in this report to identify future priorities for government action.

4.1 Recommended Priority for Government Action

Table 3 indicates that refrigerated beverage vending machines account for some 75% of energy consumption in the food and beverage vending machine sector. Due to this dominance in energy consumption, and the predicted continued market growth for this sector, it is recommended that the initial focus for MEPS be on refrigerated beverage vending machines.

Therefore the remainder of this report focuses on consideration of the most appropriate MEPS for refrigerated beverage vending machines, to ensure that the best near term outcomes are achieved.

4.2 Technical Description – Refrigerated Beverage Vending Machines

Refrigerated beverage vending machines consist of the following seven major components:

- An insulated chamber, with a solid/closed front or a glass front;
- A compressor driven by an electric motor;
- An evaporator with a circulating fan within the insulated chamber of the cabinet;
- A condenser coil with a cooling fan;
- A product dispensing mechanism;
- Lighting;
- Varying controls as appropriate: for refrigeration, lighting, payment, communications and dispensing.

The most common 'traditional' machine is a closed front machine, dispensing either bottles or cans which are stacked on their side in columns. Dispensing of product is by gravity, after a payment activated mechanism releases the selected product.

Glass fronted machines use shelving to store and display products rather than the simple stacking used in closed front machines. These machines are more versatile, being able to dispense products with a variety of packaging types, increasing product choice for consumers and product turnover for the operator. As noted by Coca Cola North America: *"The new multi-package vending machines can vend over forty different products of varying package types – juice boxes, tetra packs, aseptic cartons, glass bottles, as well as metal cans and plastic bottles*." [Coca Cola 2004]

Because gravity dispensing of a product from the higher shelves in these machines would excessively shake the product or damage the container, glass fronted vending machines have electrically controlled mechanisms allowing gentle dispensing of the selected product.

4.2.1 Operation

Refrigerated beverage vending machines have simple refrigeration systems based on a compressor, evaporator and condenser. Liquid refrigerant from the compressor is piped to the evaporator which comprises a series of heat exchange tubes within the insulated cabinet. An internal circulating fan blows air across the evaporator. When refrigerant fluid passes through the expansion valve in the evaporator, the liquid expands to become a gas, thus drawing heat from the air passing over the evaporator. This cooler air then circulates to chill the beverages.

The refrigerant gas is sucked from the evaporator by the compressor, which then compresses the gas to become a liquid and then forces it into the condenser coil, which is a series of heat exchange tubes. As the gas is compressed to a liquid, the liquid becomes hot – hotter than the ambient air temperature. The condenser fan blows air over the condenser coil to cool the refrigerant liquid which is then pumped by the compressor back into the evaporator to continue the cycle.

The compressor operation is controlled by whether or not the temperature within the chamber has attained a preset level. With the advent of voluntary and mandatory energy efficiency targets in the United States, machine controls are emerging with low power modes either pre-set in the machine or programmable by the operator. Energy-saving features can include for example the facility to switch off lights and allow product temperature to rise overnight in machines located in buildings that are unoccupied at night.

Up until recently, traditional machines have used mechanical coin operated mechanisms for accepting money and dispensing products. Payment control however is now becoming more sophisticated with control electronics based upon the MDB protocol, where MDB stands for "Multi-Drop Bus". MDB is currently being enhanced to allow communication with computers [UNI 2004]. See Appendix 4 for more information regarding the MDB protocol.

There are also a number of alternative payment methods being introduced around the world making use of developments in the "cashless" community, such as:

- using a mobile phone to purchase products and have the cost charged to the mobile phone account; and
- using a disposable or rechargeable card similar to a credit card in appearance.

5 Energy Consumption and Greenhouse Gas Emissions

5.1 Energy Consumption Issues

Typically, venue owners hosting beverage vending machines do not purchase them. The machines are usually owned by beverage suppliers/manufacturers and are customised to their specifications. Since hosts pay for the electricity consumed, there is little or no cost incentive for vendor owners to provide more energy efficient units. Most end users have little market power or knowledge of the potential energy savings possible. Therefore market forces do not favour the more efficient machines.

5.1.1 Traditional closed front machine

This machine, with products stacked in columns, uses zone cooling concentrated on the products next in line for vending (in the lower part of the machine). Close packing of the stacked product also allows better transfer of heat. These are generally coin-operated, with dispensing via gravity after product selection and payment. Solid front machines typically consume the least amount of energy by capacity of product because they have minimal lighting (in the case of backlit panel machines) or no lighting (models with signage only).

Closed front machines are designed for external use, with the front having an internal and an external door to assist in insulating the product chamber.

Energy consumption data by component is not readily available. One industry source advises the breakdown of consumption of closed front, backlit panel machines is as follows.

Table 4: Energy consumption data by component, closed door beverage vending machine

Component	% Energy consumption
Compressor	43%
Lighting (T12 fluorescent tube)	35%
Compressor fan and evaporator fan	20%
Electronics	2%

5.1.2 Glass fronted machines

In glass fronted machines all products are stored on shelves for easy selection by the consumer, however this design makes these machines more energy hungry than closed front models.

Glass fronted machines have to cool a wider range of next-to-be-vended products, and therefore require more powerful or extra evaporator fans. Furthermore the products are less densely packed and heat transfer is less effective than in traditional stacked product machines.

While the glass front design comprises multiple sheets of glass for improved insulation, industry sources say that it is not as effective as a closed front design. Some glass front machines also have a heated outer pane of glass to prevent condensation that would obscure vision, requiring further energy use. In addition, the glass front design necessitates the use of internal lighting.

These machines also have electromechanical delivery systems such as an elevator tray, which minimise drink frothing by carrying the products down to the dispensing area.

Generally these machines are used indoors, but outdoor machines are also made. Glass front machines typically use 0.37kW compressors as opposed to 0.25kW in traditional closed front machines.

In general, these machines consume more energy than a closed front model with the similar product capacity. This issue is discussed further in the following section.

5.1.3 Comparative energy consumption: glass front vs closed door designs

Table 5 provides a comparison of the energy consumption of two machines with similar capacity, selected from the California Energy Commission's list of approved (energy-efficient) machines (the full list is provided in Appendix 2). Note that the data should be treated with caution due to the different lighting configurations.

Table 5: Comparison of energy consumption by machine type

Type	Model	Can capacity	Lighting types	Daily energy (kWh)
Closed door – backlit	DN501E	444	T8 – electronic ballast 95 LPW	11.87
Glass front	DN5500	405	T8 – magnetic ballast 84 LPW	13.92
Glass front	DN5000	405	T8 – magnetic ballast 41 LPW	16.00

More recent data, shown in Table 6, provides a better comparison of relative energy consumption for different machine types. This is due to the same or similar improvements made to each to increase energy efficiency. It is significant to note that the glass front machines consume 10 to 30% more than the closed front machine, which has greater can capacity and was tested at a much higher ambient temperature (since it is designed to operate outdoors). Unfortunately data is not available for the closed front machine at the lower test temperature.

Table 6: Comparison of energy consumption with energy efficiency measures

Type	Model	Can capacity	Test temperature	Daily energy (kWh)
Closed door – backlit	DN501EV	471	32.2±1°C	4.9
Glass front	DN5500V	405	23.9±1°C	6.4
Glass front	DN5000V	405	23.9±1°C	5.4

5.2 Estimated Total Energy Consumption

As discussed later in the report, the US has introduced guidelines for the testing of and energy consumption of machines. US Energy Star documents state that the typical consumption of refrigerated beverage vending machines without energy efficiency measures is 12 to 14 kWh per day [EPA 2004]. This data ties in well with tests conducted by Mechlab on three typical machines used in the Australian market and is also consistent with Canadian standards data.

It must be noted that the Mechlab and Canadian standards energy consumption figures are derived from a 'static' test which does not take into account the dispensing or restocking of products. However from observations made during laboratory and field tests it is evident that the energy consumed during the 'static' state comprises the majority of total energy consumed in a typical unit. Therefore, test results are a reasonable proxy for actual consumption, although it should be noted that the ambient temperature is likely to be highly influential on the total energy consumed by a unit in use.

A comparison of energy consumption data for the same model machines from the US and Australia reveals that Australia is currently using non-Energy Star compliant machines. [Data sourced from the US EPA Energy Star web site (see Appendix 3); California Energy Commission (see Appendix 2) and Mechlab]. The Australian machines are not compliant because they are fitted with inefficient T12 lamps and magnetic ballasts (Australian MEPS for fluorescent lighting did not come into force until March 2003).

Therefore, using the Energy Star figure of 13 kWh average consumption per day for non Energy Star compliant machines, and an estimated stock of 110,000 units, total energy consumption of Australian machines is estimated to be approximately 520 GWh per annum.

Peak demand is difficult to quantify as it depends upon machine type and operating state (i.e. – is the compressor running or not). Consumption tests on three machines [MEA 2004] yielded the following measurements.

Table 7: Energy consumption of 3 refrigerated beverage vending machines [MEA 2004]

Operating state	Energy consumption (Watts)			
	Solid door non-backlit model	*Solid door backlit model 1*	*Solid door backlit model 2*	*Average*
Refrigeration off	70	92	210	124
Refrigeration on	698	655	780	711
After restocking	840 est*	797 est*	922	853

** extrapolated from the data for 'Solid door backlit model 2'*

The tests indicate that the machines are in the refrigeration on state for 33% of the day.

To estimate peak demand for the current estimated stock, in 2004, of 110,000 machines in Australia, the following assumptions have been used.

At any time of the day, 33% of machines are in the "Refrigeration on" state at 711 Watts.

$$(110,000 \times 0.33 \times 711)/10^6 = 25.81 \text{ MW}$$

At any time of the day, 67% of machines are in the "Refrigeration off" state at 124 Watts.

$$(110,000 \times 0.67 \times 124)/10^6 = 9.14 \text{ MW}$$

Therefore the total estimated peak demand at any time is 34.95 MW

5.3 Greenhouse Emissions

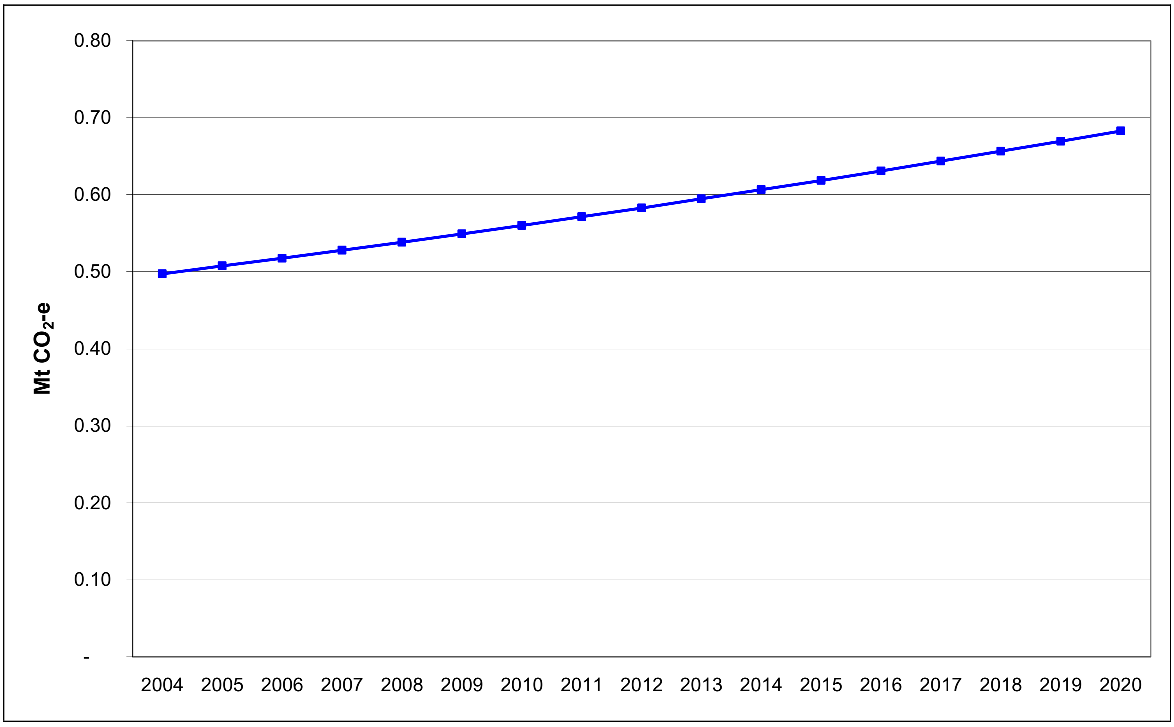
5.3.1 Current Emissions

As already discussed, the current stock of refrigerated beverage vending machines in Australia is estimated to be 110,000 units. Assuming that the average energy consumption for these units is 13 kWh per day (in accordance with US Energy Star data), greenhouse gas emissions in 2004 are estimated to be 0.50 Mt CO_2-e.

5.3.2 Forecast Emissions

Industry predictions for the sales growth of refrigerated beverage vending machines vary greatly. This report assumes a market growth of 2% per annum on installed stock (with stocks increasing by 2,200 machines in 2005) to estimate business as usual (BAU) greenhouse gas emissions. Figure 5 charts the estimated emissions from machines with technology currently used in Australia, with 2% growth in stock per annum, to the year 2020. This also assumes that retired stock is replaced with machines of the same technology.

Figure 5: BAU greenhouse gas emissions from refrigerated beverage vending machines at 2% market growth on stock



5.4 Improving the Performance of Beverage Vending Machines

Refrigerated beverage vending machines manufactured in the US for their home market have since 2002 included more efficient components, better insulation and low power mode options. This has been mainly driven by the Energy Star program and energy efficiency legislation in California. These more efficient components significantly reduce energy consumption by these units in the US. Low power mode features are of varying benefit however because they may be disabled, with one industry source citing that the option is rarely used.

Initial high efficiency initiatives in the US included Royal Vendors' *Econo-Cool* package which reduces consumption by 47% via the use of T8 lamps with electronic ballasts (14% saving), a more efficient evaporator fan and brushless DC motor (15% saving), and a high efficiency compressor (15%) [PG&E 2004]. Econo-Cool also includes a lighting controller that switches off the lights in periods of no demand. Testing carried out on a machine before and after fitting with the Econo-Cool package showed a reduction of 47% in consumption [DoE 2005].

The other major US manufacturers followed suit during 2003/2004. Typical reductions for machines compliant with the US Energy Star rating scheme is 8.45 kWh per day [EPA 2004], reduced from 13 kWh per day (when tested to the American Society of Heating, Refrigeration and Air-conditioning Engineers' test standard: ANSI/ASHRAE 32.1 - 1997R).

External motion detector devices are also available in the US which switch off power to the machine when no movement is detected nearby. One such device, *Vendo-Miser*, manufactured by Bayview Technology, automatically shuts down the machine if no motion is detected for 15 minutes (subject to the compressor being off at the time). If motion is detected it reconnects power thus returning the machine to normal thermostat control. The device also applies power to the machine every 1 - 3 hours to keep the products cool, regardless of movement detection.

A Vendo Model 630 machine fitted with Vendo-Miser reduced consumption from 10.02 to 5.19 kWh (a 48.2% reduction) when tested at 90°F / 32.2°C [Foster Miller 2000]. However, this is a best case scenario with no motion over 24 hours - in reality the percentage reduction will not be so great due intermittent use of the machine. Vendo-Miser can also be disabled, however this is less likely if the machine operator has purchased the device to reduce energy consumption.

The following table (from a report to the California Energy Commission) shows the impact of energy efficiency measures on refrigerated beverage vending machines [PG&E 2004).

Table 8: Energy efficiency measures in refrigerated beverage vending machines, and associated savings [PG&E 2004]

Measure	Energy savings
High efficiency evaporator fan/ motor system	21%
Evaporator fan ECM motor	14%
Condenser fan ECM motor	3%
ECM/ Variable speed compressor	15%
High efficiency compressor	9%, 15%
Improved insulation	5.4%
Motion-sensor activated controls[1]	47%

Note: Savings not additive due to interactions between measures

1 Given the test procedure we propose, this measure is irrelevant as a means to meet the proposed standards options; however, under other test procedures, motion-sensor controls could be relevant."

In a typical refrigerated vending machine, refrigeration accounts for 65% of energy consumption and lighting accounts for the remaining 35% [PG&E] Mechlab tests on a backlit machine showed 78% for refrigeration and 22% for lighting, tested as per ANSI/ASHRAE 32.1 - 1997 and hence without vending or reloading the machines with warm product.

5.4.1 Lighting

In 2002, a typical vending machine with a lighted front display panel (lit by two 4 or 5 ft long, high-output T12 fluorescent lamps, powered by conventional magnetic ballasts) drew as much as 180 Watts of power [Xcel Energy 2002]. This continuous load consumed 1,580 kWh per year.

In such a model, the heat from the lights significantly increases the machine's refrigeration load. Machines using low-temperature electronic ballasts paired with T8 lamps can reduce lamp power to about 80 Watts. In addition, high-colour-rendering T8s significantly improve the appearance of the translucent front panel [Xcel Energy 2002].

Note: Australia mandated MEPS for ballasts in March 2003 and for linear fluorescent lamps in April 2004, which also apply to any appliances where these are installed. New machines entering the market should therefore comply with these requirements.

6 Australian Standards for Refrigerated Beverage Vending Machines

Currently Australia does not have specific standards targeting refrigerated beverage vending machines, however mandatory minimum energy performance standards (MEPS) apply to both ballasts and linear fluorescent lamps. Refrigerated beverage vending machines sold in Australia must have ballasts and lamps installed which comply with these.

7 Overseas Standards for Beverage Vending Machines

7.1 Canada

In 1996, the Canadian Standards Association issued a Standard incorporating energy performance standards and test methods for refrigerated beverage vending machines: CAN/CSA C804-96. This standard specifies that maximum energy consumption determined by:

$$E_D = (E_T / t_T) \times (24 / 1000)$$

Where

E_D = rated energy consumption per day (kWh)

E_T = energy consumed during the test

t_T = duration of the test (hours)

24 = hours per day

1000 = conversion from Watts to kilowatts

The test specifies that the internal temperature control be set to 1±1°C and that ambient temperature is controlled at 32.2±1°C

The baseline energy consumption is determined by:

Y = 8.66 + (0.009 x C)

Where

Y = total daily energy consumption (kWh)

C = the vending capacity of 355mL cans

In October 2004, Canada's Office of Energy Efficiency (under NRCan – Natural Resources Canada) decided to amend their energy efficiency regulations to match the USA's Energy Star Tier 1 levels (described in Section 7.2.1 below) - with the exception that a low power mode would not be mandatory (as also proposed by the California Energy Commission). Test methodology will be based on ANSI/ASHRAE 32.1 – 1997 Methods of Testing for Rating Bottled and Canned Beverage Vending machines. The new standards come into effect in Canada on 1st January 2006.

7.2 United States

7.2.1 Energy Star

The US Environment Protection Agency (EPA) established eligibility criteria for voluntary labelling of vending machines under its Energy Star program, based upon the Canadian Standards Association standard: CAN/CSA C804-96. These efficiency criteria are as follows:

Energy Consumption: Qualifying models shall consume equal to or less energy in a 24-hr period than the values obtained from the equations, shown below:

Tier I: *effective 1st April 2004 to 31st December 2006*

Y = 0.55 [8.66 + (0.009 x C)]

Tier II: *effective 1st January 2007*

Y = 0.45 [8.66 + (0.009 x C)]

Where

Y = 24 hr energy consumption (kWh/day) after the machine's internal temperature has stabilized at the set point

C = vending capacity of 355 mL cans

Testing methods are as per ANSI/ASHRAE Standard 32.1 1997R (Note the 2004 version is acceptance of 1997R)

The EPA differentiates test ambient temperatures and relative humidity for indoor and outdoor machines, as follows:

- Indoor machines are tested at an ambient temperature of 75°F and 45% relative humidity.
- Outdoor machines are tested at 90°F and 65% relative humidity.

Full details are included in References.

7.2.2 California

The California Public Utilities Commission commissioned Pacific Gas and Electric to prepare a report (PG&E 2004) analysing standards and legislative options for refrigerated beverage vending machines.

The report recommended that the California Energy Commission introduce a Minimum Energy Performance Standard in line with Energy Star's Tier 1 target, to be implemented in 2006.

In December 2004, the Californian Energy Commission approved new regulations for MEPS based upon the Tier 1 targets in the US Energy Star guidelines and ANSI/ASHRAE test specifications (1997R/2004 version), as follows:

$Y = 4.76 + (0.005 \times C)$

(Note – this provides the same result as the Energy Star formula Y = 0.55 [8.66 + (0.009 x C)])

Where

Y = 24 hr energy consumption (kWh/day) after the machine's internal temperature has stabilized at the set point

C = vending capacity of 355 mL cans

This new regulation applies to refrigerated canned and bottled beverage vending machines manufactured on or after 1st January 2006 and will be legislated by the State of California in the near future.

The PG&E report also recommended that vending machines were shipped from the manufacturer with the following default low power mode settings:

7 am - 11:59 pm: lights on and temperature set to 37°F (2.8°C)

12 am - 6:59 am: lights off and temperature set to 50°F (10°C)

The Californian Energy Commission regulations specify machine control requirements such that machines shall be equipped with hard-wired controls or software capable of automatically placing the machine into each of the following low power mode states (and of automatically returning the machine to its normal operating conditions at the conclusion of the low power mode):

a) Lighting low power state – lights off for an extended period; (Note - Actual times not specified)

b) Refrigeration low power state – the average beverage temperature is allowed to rise above 40°F (4.4°C) for an extended period of time;

c) Whole machine low power state – the lights are off and the refrigeration operates in its low power state;

d) The low power mode related controls/software shall be capable of on-site adjustments by the vending operator or machine owner.

Note. Communication with CEC to clarify low power mode during testing has confirmed that all low power mode options are to be disabled during testing.

7.3 Test Methods for Beverage Vending Machines – ANSI/ASHRAE

ASHRAE standards are prepared by a committee established by the American Society of Heating, Refrigeration and Air-conditioning Engineers Inc (ASHRAE). The committee must include members of ASHRAE, but may also include non-ASHRAE members subject to them being technically qualified in the subject.

Currently there are three versions of the ANSI/ASHRAE 32.1 "X dated" test standard referenced by US and Canadian organisations.

The latest and current standard, ANSI/ASHRAE 32.1 2004, was approved by the ASHRAE Board in June 2004 and later approved by American National Standards Institute (ANSI) in December 2004

ANSI/ASHRAE 32.1 - 2004 is the approved version of ASHRAE 32.1 - 1997R. ASHRAE 32.1 – 1997R was an interim modified version of the original 1997 test methods to cater for a lower ambient temperature to reflect indoor conditions for machines designed for indoor use only.

ASHRAE 32.1 – 1997 was based upon Canada's Standard CAN/CSA-C804-96 *Energy Performance of Vending Machines*, which was published in 1996.

References by the various organisations to the different versions appears to be based upon which Standard was current at the time of drafting regulations and standards.

A recent review of current documents on NRCan's, CEC's and US Energy Star web sites shows

- CEC refers to the 2004 Standard.
- US Energy Star refers to the 1997R Standard
- NRCan refers to the 1997 Standard and is dated October 2004.

It is anticipated that Energy Star and NRCan will adopt the latest standard.

7.3.1 ANSI/ASHRAE 32.1 – 1997 and ANSI/ASHRAE 32.1 – 1997R

ANSI/ASHRAE 32.1 – 1997 only tests machines at an ambient temperature of 32.2 ±1ºC and 65% relative humidity, which is deemed to be outdoor (external use) conditions.

The revised version: ANSI/ASHRAE 32.1 - 1997R, included another category for indoor machines, which uses an ambient temperature of 23.9±1ºC and 45% relative humidity. This test temperature for indoor machines has been adopted by the US Energy Star program and their web site refers to ASHRAE 32.1 - 1997R.

7.3.2 ANSI/ASHRAE 32.1 – 2004

ANSI/ASHRAE standards are reviewed every 5 years and in 2004 a revised draft of 32.1 – 1997 was completed. This review of ANSI/ASHRAE 32.1 – 1997 was quite timely, given the increasing use of the relatively recent introduction of a new class of machines - glass fronted/multi-package machines designed mainly for indoor use only.

The original 1997 test method only allowed for testing at an ambient temperature of 32.2ºC. This caused consternation in the US industry because 1997 test rationale was for traditional closed front stacked models and based upon total beverage can capacity and an external use temperature of 32.2±1 ºC. Glass front machines are principally designed for use in internal locations and like any other machine, consume more power if tested outside their design parameters. I.e. at an external(ambient) temperature of 32.2ºC.

Manufacturers doubted that they could meet the CEC's proposed MEPS if tested at 32.2ºC and requested that a lower temperature consumption test for glass fronted machines, in line with the lower ambient temperature option adopted by Energy Star. South California Edison also questioned the test regimes for these machine types for similar reasons [SCE 2004].

Ultimately, ANSI/ASHRAE 32.1 – 2004 also included:

- Testing at 23.9±1ºC and 45% relative humidity for designated indoor machines, which covers both glass front machines and traditional closed front machines for internal use;
- Changing the condition that all ratings be based on 12 oz (US) cans such that machines which are not capable of vending cans are to be loaded to maximum capacity with the standard product specified by the manufacturer;
- The machine is to be operated at normal lighting and control settings, using only the pre-set energy management controls that cannot be changed by an operator.

7.4 Comparison of Beverage Vending Machine Standards / Efficiency Recommendations

The US Energy Star program led the way in setting base performance requirements for refrigerated beverage vending machines which vend bottles, cans and other sealed-package beverages. Current test methodology specifies ANSI/ASHRAE 32.1 – 1997R. As noted earlier, this is the same as ANSI/ASHRAE 32.1 - 2004

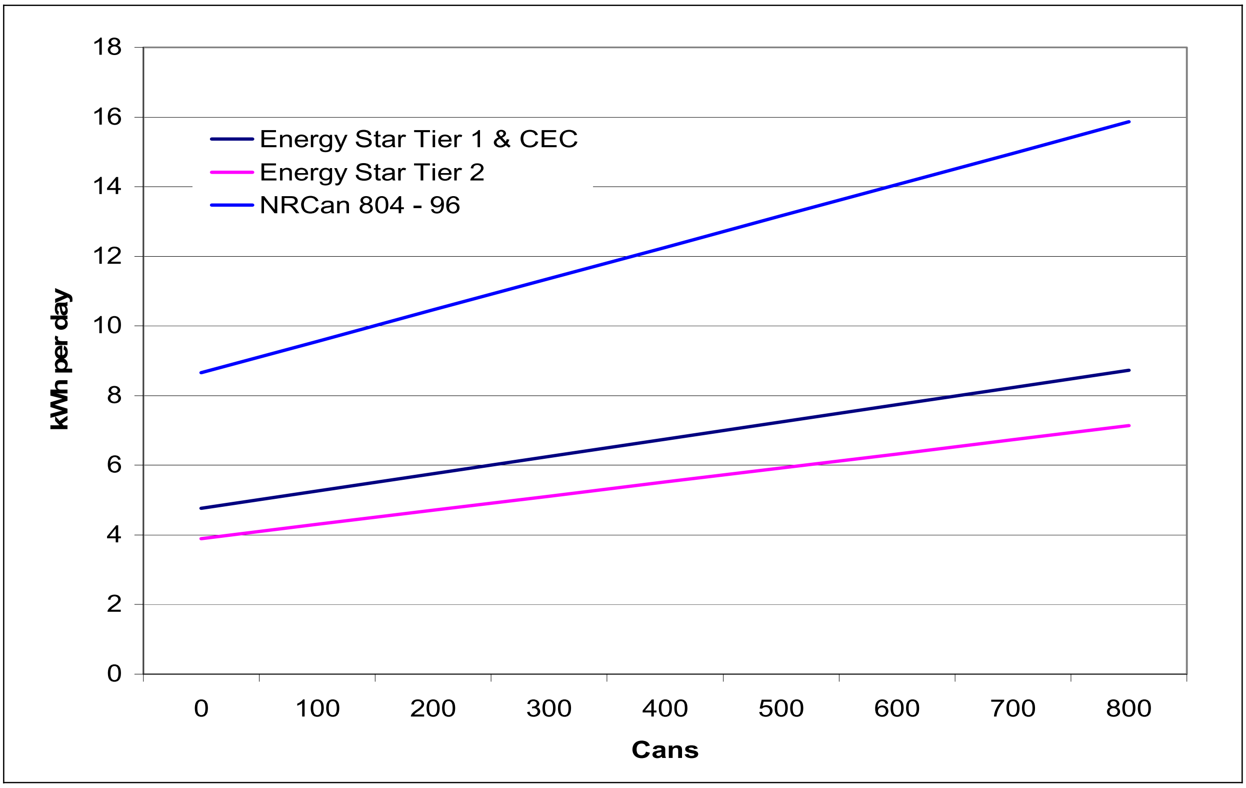
In October 2004, Canada's NRCan published a proposal to harmonise with the California Energy Commission's standards, at that time NRCan referred to ANSI/ASHRAE 32.1 – 1997 (testing at an ambient temperature of 32.2±1°C only, with no requirement for a mandatory low power mode). The proposed date of introduction of Canada's revised standard is 1st January 2006, subject to public/industry comment. As NRCan's documentation refers to superseded ANSI/ASHRAE test standards, it is the authors' view that NRCan's current proposal will ultimately be amended to harmonise with US (CEC and Energy Star) MEPS and test standards.

In December 2004, the California Energy Commission introduced regulation for MEPS equal to those set by Energy Star for machines which vend bottles or cans (based upon on ANSI/ASHRAE 32.1 – 2004), but have not to have set MEPS for machines vending other packaging types.

Given NRCan's intention to harmonise with California, it is anticipated that they will revise their proposal to meet the new Californian legislation.

Figure 6 shows a comparison of daily energy consumption limits versus can capacity for the three programs: CEC standards, current Canadian standards and Energy Star voluntary tiers.

Figure 6: Comparison of daily energy consumption standards by program



Note – Current stock in Australia are as per NRCan 804-96

Table 9 provides a comparative overview of the standards and guidelines applicable to refrigerated beverage vending machines.

Table 9: Comparison of standards and guidelines applicable to refrigerated beverage vending machines

	Energy Star	CEC	NRCan (current)	NRCan (proposed)
Test standard				
ANSI/ASHRAE 32.1 – 2004		✓		
ANSI/ASHRAE 32.1 - 1997R	✓			
ANSI/ASHRAE 32.1 - 1997			✓	✓
Types of machines				
Indoor machines	✓			
Outdoor machines	✓	✓	✓	✓
Glass front indoor machines	✓	✓		
Glass front outdoor machines	✓	**NA***		
Type of products				
Cans	✓	✓	✓	✓
Bottles	✓	✓		
Other sealed beverages				
Low power mode during test	✓	Disabled		

** CEC specifies performance of glass front machine at indoor test temperatures only.*

8 Conclusions

8.1 General Discussion

It is clearly apparent that US manufactured machines dominate the Australian market for refrigerated beverage vending machines. Since 2002, US manufacturers have been designing energy efficient models, driven by the voluntary Energy Star program and mandatory California Energy Commission standards, and now have machines which meet these performance limits.

North America is currently the only region requiring energy performance declarations for vending machines, based on tests on ASNI/ASHRAE test method, and the majority of RDVM in the Australian market are sourced from North America. Therefore it is reasonable that Australia should also require performance declaration based on an identical test method.

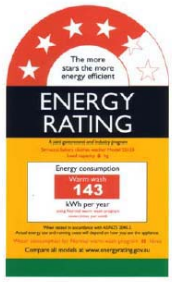
With the growing popularity of glass fronted machines, there is an increasing need to develop more appropriate performance criteria and test methodologies for these vendors. At the moment Energy Star guidelines for glass fronted machines are more stringent than CEC standards, which only test these machines under indoor conditions (Energy Star requires that glass fronted machines designed for outdoor use are tested accordingly).

A further issue is that these US programs base their performance testing formulae on cans, making them less appropriate for machines which vend multi-package products.

8.2 Program Options

The major program choices open to Australian Governments are minimum energy performance standards (MEPS) and/or product labelling. Other programs such as government preferential purchasing or voluntary agreements with major end-users may also assist.

8.2.1 Energy Performance Labels



The comparative energy label used in Australia on many whitegoods has been highly effective. It provides an easily understood and credible means for consumers to compare the energy performance of competing products. However the success of these labels relies upon purchaser selection of more efficient appliances. This form of labelling would be ineffective for refrigerated beverage vending machines because they are not displayed in store front environments along with competing products.

8.2.2 Minimum Energy Performance Standards (MEPS)

MEPS aim to remove the worst performing products from the marketplace altogether, rather than promoting the best. In Australia this is usually achieved by including the criteria within an Australian Standard which is implemented through State and Territory legislation. These requirements apply to all products covered by the standard which are sold in Australia (and usually New Zealand as well).

Australia has introduced MEPS for a range of products and has a very successful track record in this area. (Further information is available from: www.energyrating.gov.au/meps1.html.)

For some commercial products including distribution transformers and commercial refrigerated display cabinets, Australia has introduced a ‘high efficiency’ level within the appropriate standard. The purpose of this is to provide a marketing advantage to manufacturers who supply products meeting these requirements. Under the standards, products which fail to meet this level are prevented from being promoted as ‘high efficiency’. The high efficiency levels can also be used to indicate likely future levels for MEPS, which are usually implemented 3-4 years after the current MEPS levels.

It is considered unlikely that comparative energy labelling alone will have much effect on the market, as products are rarely purchased ‘off the shelf’, and purchasers are primarily driven by capital cost, rather than the financial payback achievable on higher efficiency models. By removing the worst performing products from the market, MEPS would deliver immediate results, creating a mandatory benchmark which all manufacturers and importers must meet. The introduction of MEPS is therefore the preferred option, together with the establishment of a ‘high efficiency’ category to encourage the manufacture and promotion of high efficiency vending machines.

8.2.3 International Harmonisation

In terms of setting appropriate MEPS levels, the Australian Government has a policy of matching world's best regulatory practice where feasible. The US Energy Star and Californian levels (which Canada is proposing to match) are very similar, however as discussed in Section 8.1, Energy Star has more stringent requirements for glass fronted machines.

There are also some other advantages in adopting the Energy Star approach:

- US manufacturers are currently designing and manufacturing machines to comply with the Energy Star criteria;
- the categories used in the Energy Star guidelines are more appropriate than those used by California;
- the Energy Star (and Californian) levels are very recent, and therefore reflect achievable performance levels;
- it is expected that California will eventually adopt the Energy Star categories. California has a history of implementing mandatory energy efficiency measures which are later adopted throughout the United States.

9 Recommendations

In conclusion, the following recommendations are made:

- That NAEEEC plans to introduce MEPs for refrigerated beverage vending machines, for implementation on 1st April 2007, based upon Energy Star Tier 1 as follows:

  Qualifying models shall consume equal to or less energy in a 24-hr period than the values obtained from the equations, shown below:

  $Y = 0.55 [8.66 + (0.009 \times C)]$

  Where

  Y = 24 hr energy consumption (kWh/day) after the machine's internal temperature has stabilized at the set point

  C = vending capacity of cans.

- That NAEEEC establishes a voluntary higher efficiency level equal to Energy Star Tier 2 (due to be introduced in the US in 2006), as follows:

  Qualifying models shall consume equal to or less energy in a 24-hr period than the values obtained from the equations, shown below:

  $Y = 0.45 [8.66 + (0.009 \times C)]$

  Where

  Y = 24 hr energy consumption (kWh/day) after the machine's internal temperature has stabilized at the set point

  C = vending capacity of cans.

- That NAEEEC consider adoption of these high efficiency levels for subsequent implementation for MEPS in April 2011.
- That MEPS and high efficiency requirements should be based on the test methodologies described in ANSI/ASHRAE 32.1 – 2004. NAEEEC should develop an Australian Standard for measuring energy consumption which replicates ANSI/ASHRAE 32.1 – 2004, via a working group under the Standards Australia committee ME-008 (Commercial Refrigeration).
- That NAEEEC allow vending machines covered by regulation to be tested according to their designated location - that is, machines designed for indoor and outdoor usage should be tested at appropriate ambient conditions.
- Detailed issues regarding the testing requirements for product type and capacity of glass front machines should be addressed during the Australian Standards committee stage, after further consultation with the US industry, CEC and Energy Star.

9.1 Timetable

The recommended timetable for the implementation of MEPS for refrigerated beverage vending machines, as outlined above, is shown in Table 10. It is important that sufficient time is allowed for manufacturers, importers and customers to adjust to these proposals, and hence a period of two years has been allowed from the first public announcement of government intentions to the date that these measures are implemented.

This allows for a period a consultation regarding the proposals, and for Government to consider representations from industry and other stakeholders. Following this, a working group under the Standards Australia committee ME-008 (Commercial Refrigeration) should be formed to consider a new draft Standard. Since this would be based on existing standards, it is envisaged that this drafting exercise could be completed relatively quickly.

Subsequent to publication of a draft standard, a further period of one year should be allowed for completion of a regulatory impact statement, including the mandatory consultation associated with this task. It should be noted that it is a requirement that a regulatory impact assessment is undertaken before any new legislation is passed, ensuring that national cost-benefit of the proposal is positive.

This period timetable also allows for the AGO to advertise the impending requirements to industry and customers.

Table 10: Proposed timetable for implementation of MEPS for refrigerated beverage vending machines

Item	Date
Completion of Technical Report	March 2005
Release of NAEEEC Plan	April 2005
Consultation with Industry	March – June 2005
Consideration of draft Standard by Working Group of Standards Committee (ME-008)	March – December 2005
Publication of Draft Standard	March 2006
Regulatory Impact Statement	April 2006 – June 2006
Implementation of MEPS	March 2007

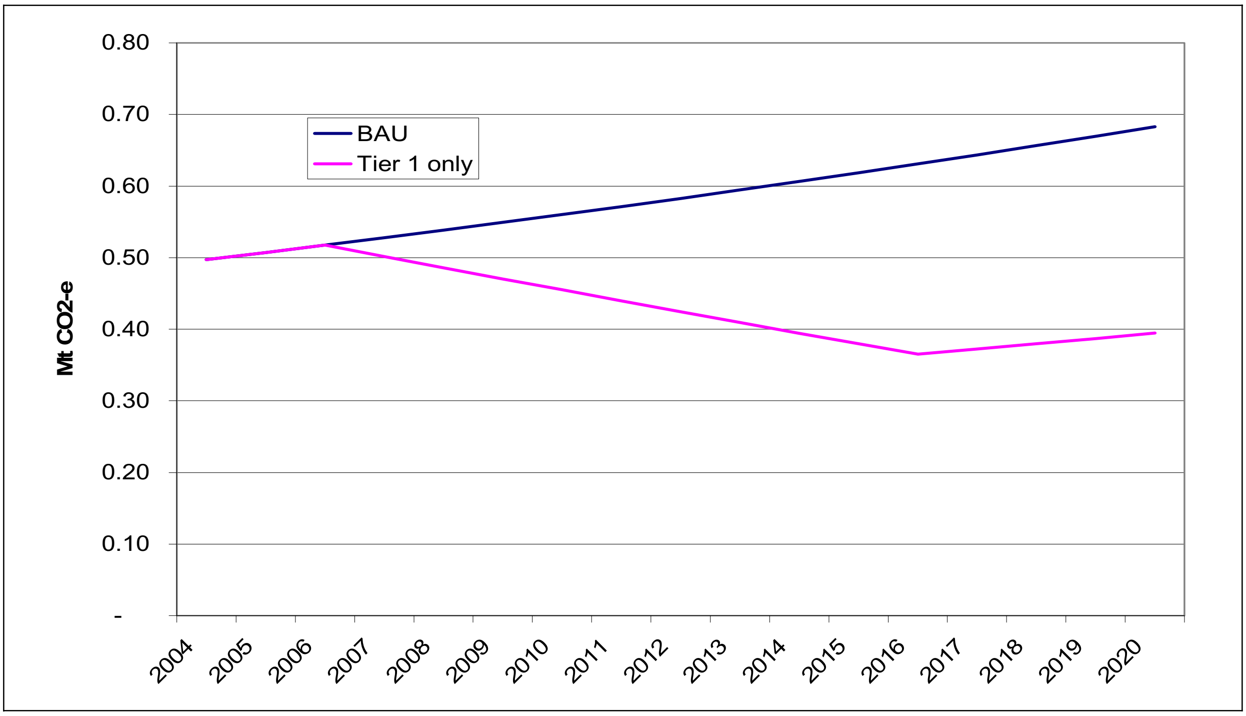
10 Energy and Greenhouse Reduction Potential

This analysis of the potential for reducing energy consumption and greenhouse emissions from refrigerated beverage vending machines is based upon the following assumptions:

- The 2004 estimated stock is 110,000 refrigerated beverage vending machines;
- Current installed machines in Australia are not US Energy Star Tier 1 compliant;
- Machines, on average, consume 13 kWh as per Mechlab tests, US Energy Star documents and NRCan data;
- Machines have a 10 year life after which they are retired, not refurbished;
- 2% annual growth in number of machines deployed;
- MEPS as per US Energy Star Tier 1 are introduced 1st April 2007.

Figure 7 compares the annual greenhouse emissions from refrigerated beverage vending machines if MEPS are introduced in 2007, with the business as usual (BAU) scenario (no MEPS).

Figure 7: Greenhouse emissions from refrigerated beverage vending machines: BAU vs MEPS introduced April 2007

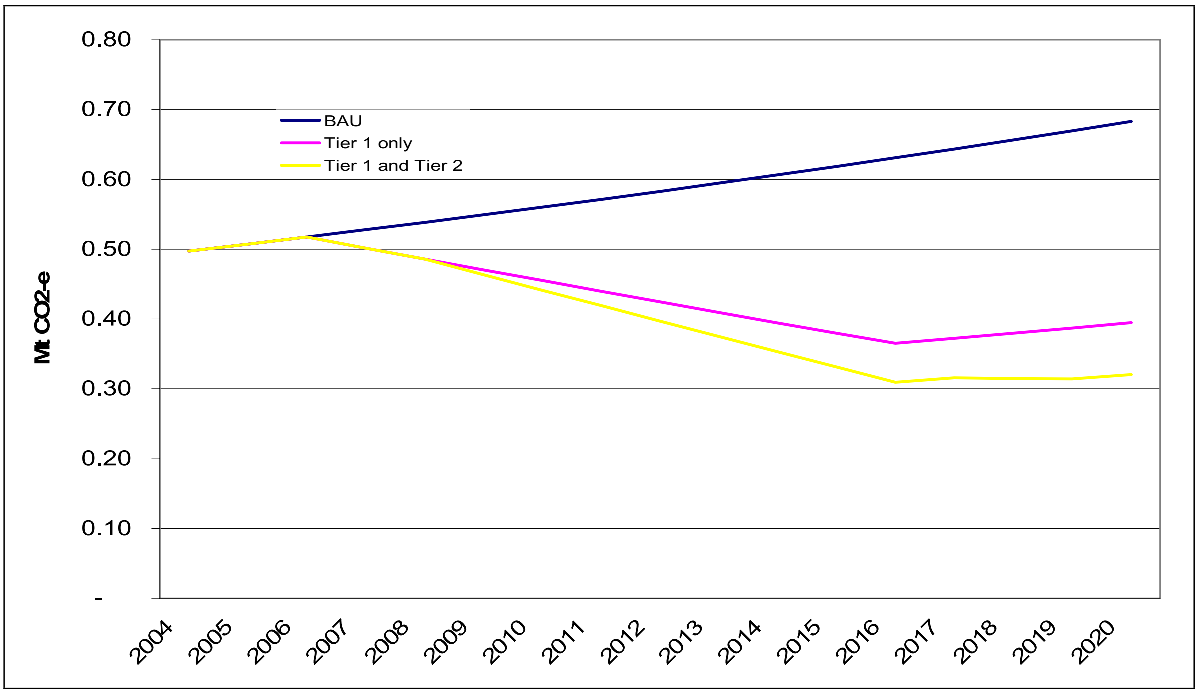


The cumulative greenhouse gas reduction achievable following the introduction of MEPS in 2007 (to the year 2020) is estimated to be 2.57 MT CO_2-e.

Figure 8 shows the annual energy consumption for three scenarios: business as usual (BAU); MEPS equivalent to Tier 1 introduced in 2007; and voluntary or regulated MEPS equivalent to Energy Star Tier 2, fully implemented by the industry in 2011.

Cumulative greenhouse emission reductions possible (to the year 2020) following the introduction of MEPS in 2007 and implementation of (Tier 2 equivalent) MEPS by 2011 is estimated to be 3.09 MT CO_2-e.

Figure 8: Greenhouse emissions from refrigerated beverage vending machines: BAU; MEPS in 2007; MEPS Tier 2 in 2011



11 Financial and Trade Implications

11.1 Overview

The Council of Australian Governments (COAG) requires that all proposed Australian regulations undergo a Regulatory Impact Statement (RIS) process. This includes detailed analysis of the costs and benefits of the proposal, together with examination of any associated economic and trade implications. The resultant report must be published for comment, and any adverse reaction must be addressed.

A Regulatory Impact Statement shall therefore be prepared after publication of a draft Australian Standard for refrigerated beverage vending machines, and before the implementation of MEPS.

However, some points are worth making at this stage.

- With respect to the impact on trade, the vast majority of refrigerated beverage vending machines are imported. Therefore any impact on Australia's manufacturing industry should be small. Importers and product specifiers will need to ensure that refrigerated beverage vending machines comply with the new MEPS requirements, and there is a wide range of products currently available which meet these requirements.
- By allowing at least 12 months between the publication of the new Australian Standard and implementation of MEPS in 2006, there should be adequate time for the Australian industry to make any necessary adjustments to purchasing policies.

11.2 Financial Analysis

Financial cost benefit analysis of the installation of more efficient refrigerated beverage vending machines reveals that significant savings accrue for the machine operator.

For the purposes of this analysis the following assumptions were made:

- To achieve a Tier 1 compliant machine, the additional cost over current non Tier 1 machine cost is A$139.69 [Royal Vendors 2005].
- The additional cost is paid by the operator of the machine at the date of supply of the machine, rather than complicating the calculation by amortising the cost through cost of vended product;
- The cost of electricity is 9 cents per kWh;
- Net Present Value discount rate of 8%;
- Current Australian (pre Tier 1) machines consume 13kWh per day;
- Tier 1 compliant machines consume 7.52kWh per day, resulting in a daily energy saving of 13 – 7.52 = 5.48 kWh per day.

This analysis reveals that there is an annual energy saving of 2,000kWh achievable per machine, and a resultant financial saving of $180 per machine per annum.

In the first year the saving is $180 minus the additional cost of $133.69, thereafter the saving is $180 pa .

NPV is $ 1,128.36

IRR is 135%

Benefit cost ratio is 9

Simple payback is 0.74 years

A copy of the calculations is shown in Appendix 5

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EPA 2004	Presentation by United States Environment Protection Agency, June 2004
Xcel Energy 2002	*Vending machine energy savings*, Excel Energy web site www.xcelenergy.com/XLWEB/CDA/0,3080,1-1-3_749_8521_7875-7012-2_68_132-0,00.html
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SCE 2004	South California Edison, Refrigeration and Thermal Test Centre, August 2004 www.energy.ca.gov/2003_appliances/documents/public_comments/2004-8-17_EDISON.PDF
UNI 2005	Upstate Networks Incorporated website, www.upstatenetworks.com/mdb/main.html, March 2005

Appendix 1

ENERGY STAR® Program Requirements for Refrigerated Beverage Vending Machines

Eligibility Criteria

Below is the product specification (Version 1.0) for ENERGY STAR qualified refrigerated beverage vending machines. A product must meet all of the identified criteria if it is to be qualified as ENERGY STAR by its manufacturer.

1) **Definitions:** Below are the definitions of the relevant terms in this document.

A. Refrigerated Beverage Vending Machine: A self-contained system designed to accept consumer payments and dispense bottled, canned, and other sealed beverages at appropriate temperatures without on-site labor intervention.

1. Indoor Vending Machine: A machine intended for placement inside a building and not subjected to the effects of weathering. These machines are marked "For Indoor Use Only" in accordance with UL Standard 541 "*Refrigerated Vending Machines*."
2. Outdoor Vending Machine: A machine intended for placement outdoors and subjected to the full effects of weathering. These machines are marked "Suitable for Outdoor Use" or "Suitable for Protected Locations" in accordance with UL Standard 541 "*Refrigerated Vending Machines*."

B. Low Power Mode: The reduced power state of a refrigerated beverage vending machine during extended periods of inactivity.

C. Standard Product: The standard product shall be 12 oz (355 ml) cans for machines that are capable of dispensing 12 oz (355 ml) cans. For all other machines, the standard product shall be the product specified by the manufacturer as the standard product[1].

D. Vendible Capacity: The maximum quantity of standard product that can be dispensed from one full loading of the vending machine without further reload operations when used as recommended by the manufacturer.[2]

E. ASHRAE: American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc.

F. CSA: Canadian Standards Association

G. UL Standard 541: UL Safety Standard for Refrigerated Vending Machines.

2) **Qualifying Products:** In order to qualify for the ENERGY STAR, a refrigerated beverage vending machine must meet the definition in Section 1A. All qualifying models must also meet the performance requirements provided in Section 3, below, at the time of manufacturing. This Version 1.0 specification applies to new machine models and machines in the field that are identical to the models that are ENERGY STAR qualified as new machines. The ENERGY STAR label may be affixed to those qualified field machines once the qualifying product information is posted on the ENERGY STAR Web site. **The ENERGY STAR Remanufactured Vending Machine specification shall commence on a date to be determined through industry discussions regarding the administration and implementation of this program.**

[1] ANSI/ASHRAE Standard 32.1-1997R, *Methods of Testing for Rating Vending Machines for Bottled, Canned, and Other Sealed Beverages*, Section 5, Vending Machine Capacity.

[2] Ibid.

3) **Energy-Efficiency Specifications for Qualifying Products**: Only those products listed in Section 2 that meet both criteria A and B provided below may qualify as ENERGY STAR.

A. Energy Consumption: Qualifying models shall consume equal to or less energy in a 24-hr period than the values obtained from the equations[3], shown below. Effective dates for Tier I and Tier II are provided in Section 5 of this specification.

Tier I

Y = 0.55 [8.66 + (0.009 x C)]

Tier II

Y = 0.45 [8.66 + (0.009 x C)]

Where: Y = 24 hr energy consumption (kWh/day) after the machine has stabilized C = vendible capacity

Example: Under Tier I, a 650-can capacity machine may consume no more than 7.9805, or 7.98 kWh/day (rounded). Under Tier II, a 650-can may consume no more than 6.5295 or 6.53 kWh/day (rounded).

Note: Approximately one year before Tier II becomes effective, EPA will reassess the performance level presented in this specification to ensure its feasibility in the marketplace.

B. Low Power Mode: In addition to meeting the 24-hour energy consumption requirements in Section 3A, qualifying models shall come equipped with hard wired controls and/or software capable of automatically placing the machine into a low power mode during periods of extended inactivity while still connected to its power source to facilitate the saving of additional energy, where appropriate. The machine shall be capable of operating in each of the low power mode states described below:

1. Lighting low power state – lights off for an extended period of time.

2. Refrigeration low power state – the average beverage temperature is allowed to rise above 40°F for an extended period of time.

3. Whole machine low power state – the lights are off and the refrigeration operates in its low power state.

In addition, the machine shall be capable of automatically returning itself back to its normal operating conditions at the conclusion of the inactivity period. The low power mode-related controls/software shall be capable of on-site adjustments by the vending operator or machine owner.

Note: EPA's goal in including these low power mode requirements is to ensure that existing machine software capabilities are available and may be used to their fullest potential based on the individual requirements of the host site. However, machines that are vending temperature sensitive product, such as milk, must not have the refrigeration low power state enabled on site by the vending operator or machine owner due to the risk of product spoilage.

4) **Test Criteria**: Manufacturers are required to perform tests, according to the requirements included in this Version 1.0 specification, then submit qualifying model information to EPA for approval.

[3] The energy consumption equation is based on CAN/CSA C804-96 Energy Performance of Vending Machines (for Machine Type A).

A. In performing these tests, partner agrees to measure a model's daily energy consumption according to ANSI/ASHRAE Standard 32.1-1997R, *Methods of Testing for Rating Vending Machines for Bottled, Canned, and Other Sealed Beverages*, using the test conditions provided in Section 6 of the standard:

1. Machines marked "For Indoor Use Only" must be tested at 75+2 °F (23.9+1 °C); 45+5% relative humidity; and 36+1 °F (2.2+0.5 °C) average beverage temperature throughout the test.

2. Machines marked "Suitable for Outdoor Use" or "Suitable For Protected Locations" must be tested at 90+2 °F (32.2+1 °C); 65+5% relative humidity; and 36+1 °F (2.2+0.5 °C) average beverage temperature throughout the test.

B. Test results must be reported to EPA using the Refrigerated Beverage Vending Machine Qualifying Product Information (QPI) form.

5) **Effective Date**: The date that manufacturers may begin to qualify products as ENERGY STAR will be defined as the effective date of the agreement.

A. Tier I – The first phase, Tier I, shall go into effect on **April 1, 2004** and conclude on **December 31, 2006**. Upon signing the agreement, the Partner may begin to use the ENERGY STAR on qualifying product models and related marketing materials. Refer to the ENERGY STAR Identity Guidelines at www.energystar.gov/partners.

B. Tier II – The second phase of this specification, Tier II, shall commence on **January 1, 2007**. All products, including models originally qualified under Tier I, with a **date of manufacture** on or after January 1, 2007, must meet Tier II requirements in order to bear the ENERGY STAR on the product or in product literature.

6) **Future Specification Revisions**: ENERGY STAR reserves the right to change the specification should technological and/or market changes affect its usefulness to consumers, industry, or the environment. In keeping with current policy, revisions to the specification are arrived at through industry discussions. **In the event of a specification revision, please note that ENERGY STAR qualification is not automatically granted for the life of a product model**. To carry the ENERGY STAR label, a product model must meet the ENERGY STAR specification in effect on the model's date of manufacture. The date of manufacture is specific to each unit and is the date by which a unit is considered to be completely assembled.

Glass Front Machines: Approximately one year after the Tier I effective date, EPA will review glass front machine data to ensure that the Tier I performance level continues to provide differentiation in the marketplace as this product category begins to expand.

Appendix 2

California Energy Commission - List of approved machines

Table 11: At 4 November 2004

Manufacturer	Model Number	Vending Type	Vendible Products	Vendible Capacity	Illumination Type	Illumination LPW	Daily Energy Use kWh	Add Date
AMS	AMS 35-VCB	Cans	12	216	T8 w/Electronic Ballast		24	9/07/2004
AMS	AMS 35-VCB*	Bottles	20	180	T8 w/Electronic Ballast		24	9/07/2004
AMS	AMS 35-VCF	Cans	12	216	T8 w/Electronic Ballast		24	9/07/2004
AMS	AMS 35-VCF*	Bottles	20	180	T8 w/Electronic Ballast		24	9/07/2004
AMS	AMS 39-VCB	Cans	12	288	T8 w/Electronic Ballast		24	23/04/2003
AMS	AMS 39-VCB*	Bottles	20	240	T8 w/Electronic Ballast		24	23/04/2003
AMS	AMS 39-VCF	Cans	12	288	T8 w/Electronic Ballast		24	23/04/2003
AMS	AMS 39-VCF*	Bottles	20	240	T8 w/Electronic Ballast		24	23/04/2003
AMS	AMS 39-VRM	Cans	12	216	T8 w/Electronic Ballast		24	9/07/2004
AMS	AMS 39-VRM*	Bottles	20	180	T8 w/Electronic Ballast		24	9/07/2004
API	ROBO*QUENCHER	Bottles	16	360	No Match		13.46	12/12/2002
Crane	490	Cans	12	136	T12 w/Magnetic Ballast	59	3.44	31/01/2003
Crane	493	Cans	12	136	T12 w/Magnetic Ballast	59	3.44	31/01/2003
Crane	784	Cans	12	136	T12 w/Magnetic Ballast	59	3.44	31/01/2003
Crane	785	Cans	12	136	T12 w/Magnetic Ballast	59	3.44	31/01/2003
Crane	786	Cans	12	136	T12 w/Magnetic Ballast	59	3.44	31/01/2003
Crane	797	Cans	12	220	T12 w/Magnetic Ballast	46	3.41	31/01/2003
Dixie	DN5000	Cans	12	405	T8 w/Magnetic Ballast	41	16	27/11/2002
Dixie	DN501E	Cans	12	444	T8 w/Electronic Ballast	95	11.87	27/11/2002
Dixie	DN5500	Cans	12	405	T8 w/Magnetic Ballast	84	13.92	27/11/2002
Royal	RVCC 550-**Econo-Cool	Cans	12	550	T8 w/Electronic Ballast		7.25	14/01/2003
Royal	RVCC 660-**Econo-Cool	Cans	12	660	T8 w/Electronic Ballast		7.27	14/01/2003
Royal	RVCC 780-**Econo-Cool	Cans	12	550	T8 w/Electronic Ballast		8.39	14/01/2003
Royal	RVCC 804-**Econo-Cool	Cans	12	804	T8 w/Electronic Ballast		7.52	14/01/2003
Royal	RVCCR550-**Econo-Cool	Cans	12	550	T8 w/Electronic Ballast		7.25	14/01/2003
Royal	RVCCR660-**Econo-Cool	Cans	12	660	T8 w/Electronic Ballast		7.27	14/01/2003
Royal	RVCCR780-**Econo-Cool	Cans	12	550	T8 w/Electronic Ballast		8.39	14/01/2003
Royal	RVCCR804-**Econo-Cool	Cans	12	804	T8 w/Electronic Ballast		7.52	14/01/2003
Royal	RVCDE480-**Econo-Cool	Cans	12	480	T8 w/Electronic Ballast		7.35	14/01/2003
Royal	RVCDE542-**Econo-Cool	Cans	12	542	T8 w/Electronic Ballast		7.29	14/01/2003
Royal	RVCDE650-**Econo-Cool	Cans	12	650	T8 w/Electronic Ballast		7.79	14/01/2003
Royal	RVCDE654-**Econo-Cool	Cans	12	654	T8 w/Electronic Ballast		8	14/01/2003
Royal	RVCDE768-**Econo-Cool	Cans	12	768	T8 w/Electronic Ballast		7.89	14/01/2003
Royal	RVCDE780-**Econo-Cool	Cans	12	550	T8 w/Electronic Ballast		8.39	14/01/2003
Royal	RVDPE542-**Econo-Cool	Cans	12	542	T8 w/Electronic Ballast		7.29	14/01/2003
Royal	RVDPE650-**Econo-Cool	Cans	12	650	T8 w/Electronic Ballast		7.79	14/01/2003
Royal	RVDPE654-**Econo-Cool	Cans	12	654	T8 w/Electronic Ballast		8	14/01/2003

Table 11: At 4 November 2004 continued

Manufacturer	Model Number	Vending Type	Vendible Products	Vendible Capacity	Illumination Type	Illumination LPW	Daily Energy Use kWh	Add Date
Royal	RVDPE768-**Econo-Cool	Cans	12	768	T8 w/Electronic Ballast		7.89	14/01/2003
Royal	RVDPE780-**Econo-Cool	Cans	12	550	T8 w/Electronic Ballast		8.39	14/01/2003
Royal	RVDVE650-**Econo-Cool	Cans	12	650	T8 w/Electronic Ballast		6.7	14/01/2003
Royal	RVHV 542-**Econo-Cool	Cans	12	542	T8 w/Electronic Ballast		7.29	14/01/2003
Royal	RVHV 650-**Econo-Cool	Cans	12	650	T8 w/Electronic Ballast		7.79	14/01/2003
Royal	RVHV 654-**Econo-Cool	Cans	12	654	T8 w/Electronic Ballast		8	14/01/2003
Royal	RVHV 768-**Econo-Cool	Cans	12	768	T8 w/Electronic Ballast		7.89	14/01/2003
Royal	RVHV 780-**Econo-Cool	Cans	12	550	T8 w/Electronic Ballast		8.39	14/01/2003
Royal	RVMCE542-**Econo-Cool	Cans	12	542	T8 w/Electronic Ballast		7.29	14/01/2003
Royal	RVMCE650-**Econo-Cool	Cans	12	650	T8 w/Electronic Ballast		7.79	14/01/2003
Royal	RVMCE654-**Econo-Cool	Cans	12	654	T8 w/Electronic Ballast		8	14/01/2003
Royal	RVMCE768-**Econo-Cool	Cans	12	768	T8 w/Electronic Ballast		7.89	14/01/2003
Royal	RVMCE780-**Econo-Cool	Cans	12	550	T8 w/Electronic Ballast		8.39	14/01/2003
Vendo	576C*	Cans	12	576	T8 w/Electronic Ballast		6.8	28/03/2003
Vendo	576P*	Cans	12	576	T8 w/Electronic Ballast		7.6	28/03/2003
Vendo	576T*	Cans	12	576	T8 w/Electronic Ballast		6.8	28/03/2003
Vendo	576TLDSP*	Cans	12	576	T8 w/Electronic Ballast		6.5	28/03/2003
Vendo	621C*	Cans	12	544	T8 w/Electronic Ballast		6	28/03/2003
Vendo	621P*	Cans	12	544	T8 w/Electronic Ballast		6.8	28/03/2003
Vendo	621T*	Cans	12	544	T8 w/Electronic Ballast		6	28/03/2003
Vendo	621TLDSP*	Cans	12	544	T8 w/Electronic Ballast		5.7	28/03/2003
Vendo	720C*	Cans	12	720	T8 w/Electronic Ballast		7.2	28/03/2003
Vendo	720P*	Cans	12	720	T8 w/Electronic Ballast		8	28/03/2003
Vendo	720T*	Cans	12	720	T8 w/Electronic Ballast		7.2	28/03/2003
Vendo	720TLDSP*	Cans	12	720	T8 w/Electronic Ballast		7	28/03/2003
Vendo	721C*	Cans	12	680	T8 w/Electronic Ballast		6.3	28/03/2003
Vendo	721P*	Cans	12	680	T8 w/Electronic Ballast		7.1	28/03/2003
Vendo	721T*	Cans	12	680	T8 w/Electronic Ballast		6.3	28/03/2003
Vendo	721TLDSP*	Cans	12	680	T8 w/Electronic Ballast		6	28/03/2003
Vendo	821C*	Cans	12	800	T8 w/Electronic Ballast		6.7	28/03/2003
Vendo	821P*	Cans	12	800	T8 w/Electronic Ballast		7.5	28/03/2003
Vendo	821T*	Cans	12	800	T8 w/Electronic Ballast		7.5	28/03/2003
Vendo	840C*	Cans	12	840	T8 w/Electronic Ballast		8	28/03/2003
Vendo	840P*	Cans	12	840	T8 w/Electronic Ballast		8.8	28/03/2003
Vendo	840T*	Cans	12	840	T8 w/Electronic Ballast		8.8	28/03/2003

Appendix 3

USA Energy Star Refrigerated Beverage Vending Machine Qualified Model

Table 12 USA Energy Star Refrigerated Beverage Vending Machine Qualified Models as of December 29, 2004

Company Name	Model Name	Model Number	Door Type	Machine Use Designation	Vendible Capacity	Energy kWh/day*
Indoor Machines						
Dixie-Narco, Inc.	Baby GFV	DN3000V	Glass Front	Indoor only	270	5.40
Dixie-Narco, Inc.	GFV	DN5000V	Glass Front	Indoor only	405	5.40
Dixie-Narco, Inc.	Beverage Max	DN5500V	Glass Front	Indoor only	405	6.40
Dixie-Narco, Inc.	Baby Beverage	Max DN3500V	Glass Front	Indoor only	270	5.30
Outdoor Machines						
Dixie-Narco, Inc.	E-Series	DN276E-HV	Closed Front	Indoor/Outdoor	336	6.20
Dixie-Narco, Inc.	E-Series	DN501E-HV	Closed Front	Indoor/Outdoor	471	6.56
Dixie-Narco, Inc.	E-Series	DN501EV	Closed Front	Indoor/Outdoor	471	4.90
Dixie-Narco, Inc.	E-Series	DN600E-HV	Closed Front	Indoor/Outdoor	561	6.49
Dixie-Narco, Inc.	P-Series	DN552	Closed Front	Indoor/Outdoor	552	7.17
Royal Vendors, Inc.	72 W M4 Display	RV DVE 650-10	Live Display	Indoor/Outdoor	650	6.70
Royal Vendors, Inc.	CC TDV 79 W LS	RVCC 780-9	Closed Front	Indoor/Outdoor	780	8.39
Royal Vendors, Inc.	CC TDV 79 W MKT	RVCCR 780-12 / 13	Closed Front	Indoor/Outdoor	780	8.39
Royal Vendors, Inc.	Cold Drink 72 N M4	RVCDE 542-8	Closed Front	Indoor/Outdoor	542	7.29
Royal Vendors, Inc.	Cold Drink 72 W M4	RVCDE 650-10	Closed Front	Indoor/Outdoor	650	7.79
Royal Vendors, Inc.	Cold Drink 79 W M4	RVCDE 768-10	Closed Front	Indoor/Outdoor	768	7.89
Royal Vendors, Inc.	Cold Drink TDV 72 W	RVCDE 654-10	Closed Front	Indoor/Outdoor	654	8.00
Royal Vendors, Inc.	Cold Drink TDV 79 W	RVCDE 780-10	Closed Front	Indoor/Outdoor	780	8.39
Royal Vendors, Inc.	DP 72 W M4	RVDPE 650-10	Closed Front	Indoor/Outdoor	650	7.79
Royal Vendors, Inc.	DP 72N M4	RVDPE 542-8	Closed Front	Indoor/Outdoor	542	7.29
Royal Vendors, Inc.	DP 79 W M4	RVDPE 768-10	Closed Front	Indoor/Outdoor	768	7.89
Royal Vendors, Inc.	DP TDV 72 W	RVDPE 650-10	Closed Front	Indoor/Outdoor	654	8.00
Royal Vendors, Inc.	DP TDV 79 W	RVDPE 780-10	Closed Front	Indoor/Outdoor	780	8.39
Royal Vendors, Inc.	GIII 72 N LS	RVCC 550-7	Closed Front	Indoor/Outdoor	550	7.25
Royal Vendors, Inc.	GIII 72 W LS	RVCC 660-9	Closed Front	Indoor/Outdoor	660	7.27
Royal Vendors, Inc.	GIII 72N MKT	RVCC R550-9	Closed Front	Indoor/Outdoor	550	7.25
Royal Vendors, Inc.	GIII 72W MKT	RVCCR 600-12 or 13	Closed Front	Indoor/Outdoor	660	7.27
Royal Vendors, Inc.	GIII-79 W LS	RVCC 804-9	Closed Front	Indoor/Outdoor	804	7.52
Royal Vendors, Inc.	GIII-79 W MKT	RVCC R804-12 or 13	Closed Front	Indoor/Outdoor	804	7.52
Royal Vendors, Inc.	P2 Magnum 72N M4	RVMCE 542-8	Closed Front	Indoor/Outdoor	542	7.29
Royal Vendors, Inc.	PC HVV 72 W M4	RVHV 650-12	Closed Front	Indoor/Outdoor	650	7.79
Royal Vendors, Inc.	PC HVV 79 W M4	RVHV 768-12	Closed Front	Indoor/Outdoor	768	7.89
Royal Vendors, Inc.	PC HVV 79 W TDV	RVHV 780-12	Closed Front	Indoor/Outdoor	780	8.39
Royal Vendors, Inc.	PC HVV TDV 72 W	RVHV 654-12	Closed Front	Indoor/Outdoor	654	8.00
Royal Vendors, Inc.	PC Magnum 72 W M4	RVMCE 650-10	Closed Front	Indoor/Outdoor	650	7.79
Royal Vendors, Inc.	PC Magnum 79 W M4	RVMCE 768-10	Closed Front	Indoor/Outdoor	768	7.89
Royal Vendors, Inc.	PC Magnum TDV 72 W	RVMCE 654-10	Closed Front	Indoor/Outdoor	654	8.00
Royal Vendors, Inc.	PC Magnum TDV 79 W	RVMCE 780-10	Closed Front	Indoor/Outdoor	780	7.89
Royal Vendors, Inc.	Royal Vision Vender	RVRVV 400-40	Glass Front	Indoor	320	6.10
Vendo Company	Coke LMV	576	Closed Front	Indoor/Outdoor	576	6.80
Vendo Company	Coke LMV	621	Closed Front	Indoor/Outdoor	544	6.00
Vendo Company	Coke LMV	721	Closed Front	Indoor/Outdoor	680	6.30
Vendo Company	Pepsi HVV	576	Closed Front	Indoor/Outdoor	576	7.60
Vendo Company	Pepsi HVV	621	Closed Front	Indoor/Outdoor	544	6.80
Vendo Company	Pepsi HVV	720	Closed Front	Indoor/Outdoor	720	8.00

Vendo Company	Pepsi HVV	721	Closed Front	Indoor/Outdoor	680	7.10
Vendo Company	Pepsi HVV	821	Closed Front	Indoor/Outdoor	800	7.50
Vendo Company	Pepsi HVV	840	Closed Front	Indoor/Outdoor	840	8.80
Vendo Company	Trade	621	Live Display	Indoor/Outdoor	544	5.70
Vendo Company	Trade	621	Closed Front	Indoor/Outdoor	544	6.00
Vendo Company	Trade	721	Closed Front	Indoor/Outdoor	680	6.00
Vendo Company	Trade	721	Live Display	Indoor/Outdoor	680	6.00
Vendo Company	Trade	821	Closed Front	Indoor/Outdoor	800	7.50

*** Note: (1) Indoor/Outdoor machines tested at 90 degrees 65% relative humidity (2) Indoor only machines tested at 75 degrees 45% relative humidity**

Appendix 4

MDB

MDB stands for "Multi-Drop Bus" and is a protocol developed by vending machine industry. The "Multi-drop Bus" (MDB) protocol is not compatible with the standard RS-232 PC protocol and therefore a hardware and software interface is necessary. The MDB2PC™ is a microprocessor controlled hardware interface with embedded firmware that converts the MDB protocol to an RS232 protocol and also performs the necessary voltage conversion. The MDB2PC™ also relieves the Polling requirements thereby allowing the same PC to perform other tasks.

The MDB2PC™ is necessary to interface the industry standard MDB Vending machine protocol to a standard PC because:

- The MDB uses 11 Bits and a nine (9) bit byte.
- The polling requirements for the various MDB devices are excessive (20-200 ms).
- A non-dedicated PC can not meet the polling requirements.
- The MDB2PC™ takes care of the polling requirements and generates an interrupt on the serial port of the PC.
- This methods allows the PC to perform normal operations and respond to interrupt driven comm events in the UART buffer.
- All data from an MDB device is available to the PC.
- Additionally, all commands can be sent to the MDB device from the PC (ie. dispense, write to smart card etc...)

The MDB2PC™ interfaces any MDB vending device (6-pin molex/5pin MTA) to the PC via the serial port (DB-9). Future support may include Universal Serial Bus. The MDB2PC™ protocol is compatible with standard RS-232 Protocol.

Appendix 5

Financial Analysis

Life	10	years	
Electricity cost	$ 0.09	per kWh	

	Daily kWh	Annual kWh	Annual $
Pre Tier 1	13.00	4,745.0	$ 427.05
Tier 1	7.52	2,744.8	$ 247.03
Saving	5.48	2,000.2	$ 180.02

	US$	A$
Cost of Tier 1	100.00	133.69
Exchange rate	0.748	

Discount rate.	8%	NPV & IRR data
$ 1,128.36	NPV	-$ 133.69
135%	IRR	$ 180.02
		$ 180.02
6.71	Present worth factor	$ 180.02
10	Term	$ 180.02
8%	Disc rate	$ 180.02
		$ 180.02
$ 1,207.94	Total benefit	$ 180.02
$ 133.69	Total cost	$ 180.02
9.0	Benefit cost ration	$ 180.02
0.74	Years simple payback	$ 180.02