COST EFFECTIVENESS ANALYSIS OF WELS

the WATER EFFICIENCY LABELLING and STANDARDS SCHEME

Final Report

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for the Australian Government

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Disclaimer

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Executive Summary

The Water Efficiency Labelling and Standards Scheme (WELS), introduced in July 2006, is a key program in the suite of options recently implemented by government agencies and water utilities to address water scarcity. WELS primarily influences water consumption by providing consumers with information about the water efficiency of all washing machines, dishwashers, toilets, urinals, taps and showers sold in Australia – thus enabling consumers to consider water efficiency as a factor in their purchase decisions.

However, the WELS program is not without costs. Governments, suppliers, retailers and consumers of WELS-products potentially incur costs due to WELS activities and requirements. The Department of the Environment, Heritage, Water and the Arts, in its capacity as the WELS Regulator, commissioned the Institute of Sustainable Futures to analyse the cost-effectiveness of WELS in contributing to the overarching objective of water security, compared to other urban water management options. Consistent with the regulatory impact statement conducted in 2003, this analysis uses a time horizon of 2005-06 to 2020-21.

WELS contributes to water security by reducing water consumption

WELS was introduced at a time of severe and prolonged drought across many Australian regions. During this period of water shortages and restrictions, many factors have combined to influence consumers' decisions to purchase and use more water-efficient products, and it is inherently difficult to attribute water savings due to WELS or any other individual program.

However, the expanded coverage of water efficiency information provision (compared to the previous voluntary labelling) is likely to have further encouraged consumers and suppliers to target water-efficient products. At least some of the offer and uptake of rebates on water-efficient products can be attributed to WELS. Furthermore, WELS has achieved water savings by enabling Australia-wide implementation of some building regulations and minimum standards targeting water efficiency.

At the commencement of this study, WELS had only been in operation for 18 months and therefore insufficient data was available to conduct a comprehensive ex-post program evaluation. The approach used in estimating and projecting water savings varied according to different data availability for each product type. Where possible, recent end-use survey data and sales data were used to conduct end-use and stock-modelling for each product.

Over the period 2005-06 to 2020-21, WELS is estimated to reduce Australia-wide water consumption by a total of 800 GL (compared to a baseline of no WELS, but voluntary labelling). The most significant conservation potential is from showerheads (290 GL) and washing machines (280 GL), followed by toilets and urinals (185 GL). As a proportion of the overall water savings, the direct contribution to water savings due to WELS on taps and dishwashers is expected to be much smaller, constituting approximately 6% of total savings. However, wide coverage of product types could underpin the effectiveness of WELS information in driving consumer decisions about all product types.

The relative contributions to water savings by different product types is partly due to different proportions of total water used by those products, but also reflects different expected rates of innovation, future potential for improvements in technical water efficiency, and the efficiency of products in the current stock.

WELS imposes costs to administrators and suppliers

The WELS administrators and suppliers of WELS-related products are likely to bear the largest share of direct WELS costs. Over the period 2005-06 to 2020-21, total administration costs to the Department of Environment, Water Heritage and the Arts are projected to be about $16 million (PV 2007 dollars, 7% discount rate), including costs of staffing and various activities including promotion, enforcement, and database management. Part of these will be offset by revenue from registration fees. Total supplier costs are estimated at around $16 million (PV 2007 dollars, 7% discount rate) comprising mainly labelling costs (around $7 million) and registration fees ($5 million).

These cost estimates are based on a number of assumptions about future activities, which are uncertain. Using upper estimates of future registration fees, supplier staff involvement in registration processes, testing and labelling costs, suppliers costs are estimated at around $36 million.

Another key area of uncertainty is current and future price premiums due to WELS. However, there is a range of evidence to suggest that price premiums are not likely to be as substantial or as long-lived as those originally estimated in the WELS Regulatory Impact Statement. Most suppliers indicated that products at each star rating are available at a range of prices, that prices adjust quickly downward in response to increased demand, and that as supplier markets have expanded, price premiums are generally lower. As more price information becomes available, further analysis will clarify the extent and duration of any price premiums due to WELS.

In addition to water savings, WELS has a number of other sustainability and financial benefits

As a group, consumers who purchase water-efficient WELS products stand to significantly benefit from the financial value of water saved (PV $400 million at 7% discount rate, with no increase in real water prices). However, these water savings also lead to other significant sustainability benefits, in terms of the avoided energy used to heat water – and hence avoided greenhouse gas emissions. Over the period 2005-06 to 2020-21, WELS is projected to result in a total of over 9 million MWh of energy savings and about 6 million tonnes of avoided greenhouse gas emissions, due to avoided water heating.

Avoided water and wastewater pumping and treatment will also lead to avoided energy consumption (over 0.6 million MWH) and avoided greenhouse gas emissions (about 0.6 million tonnes).

WELS cost-effectively contributes to water security, compared to most other urban water management options

The levelised unit cost of WELS (taking into account net costs, but excluding transfer costs/benefits between stakeholders) is estimated at $0.08/kL (7% discount rate). At a lower discount rate of 1.6% and using the upper limiting estimates of supplier costs (10%), the levelised cost is estimated at $0.21/kL.

WELS therefore compares favourably to other water urban water management options which have been recently implemented, or are proposed for implementation, in various Australian states and territories. Supply options in particular appear to be less cost-effective than WELS, ranging from $1.19 - $2.55/kL for desalination, to $3.58/KL for some surface supply options and $5.50/kL for more expensive recycling options.

Opportunities exist to streamline WELS to leverage further water savings.

Notwithstanding the cost-effectiveness of WELS in contributing to water security, opportunities exist for WELS to extend how it drives innovation and achieves water efficiency, and potentially reduce the cost burden on suppliers and administrators.

Although it was beyond the scope of this study to examine these opportunities in detail, stakeholders contacted raised various issues, particularly relating to streamlining the registration process and requirements with other regulations (such as plumbing regulations and energy efficiency labelling scheme). Some technical aspects of the standards themselves could also be re-shaped to encourage innovation, some of which will depend on changing minimum flow requirements for products. The WELS Regulator’s plans to establish a clear enforcement and compliance process will also be significant in guaranteeing future water savings.

These opportunities will be enabled by ongoing monitoring, evaluation and collection of data to inform savings, costs and benefits.

Table of Contents

Appendices

List of Tables

List of Figures

Abbreviations

AS/NZS	Australian Standard / New Zealand Standard
ASL	Average staffing level
CWM	Clothes washing machine
DEWHA (DEW)	Department of Environment Water Heritage and the Arts (formerly Department of Environment and Water)
DWM	Dish washing machine
FC	Flow controller
GL	gigalitres
GWh	Gigawatt hours
ISF	Institute for Sustainable Futures
kL	kilolitres
kWh	kilowatt hours
LE	Lavatory Equipment
ML	megalitres
MWh	Megawatt hours
RIS	Regulatory Impact Statement
S	Showers
TE	Tap Equipment
UE	Urinal Equipment
WELS	The Water Efficiency Labelling Scheme

1 Introduction

In response to the recent and ongoing drought across many parts of Australia, the water industry and government agencies have focussed efforts on implementing measures to address water scarcity. In this context, the Water Efficiency Labelling and Standards Scheme (WELS) has the potential to cost-effectively contribute to ensuring water security for Australian cities and towns. By providing information to enable consumers to compare models on the basis of relative (and absolute) water efficiency, WELS influences the choice of models installed, and hence the water consumed in their use. It has also been argued that at least some of the water savings achieved by those demand management programs that are linked to mandatory labelling (such as some rebate schemes and building regulations) are attributable to WELS.

The Australian Government Department of the Environment and Water Resources (DEW) commissioned the Institute for Sustainable Futures to analyse the cost-effectiveness of WELS, relative to other urban water management options. These water management options include: outdoor water efficiency programs; indoor water efficiency exchanges; rebates and retrofits; building regulations; desalination; new storages; new recycling schemes; and residential raintank programs.

Although this study is one of several commissioned by DEW prior to the preparation of Regulatory Impact Statements (RIS) for the possible expansion of WELS, this report is not intended to specifically address RIS requirements, nor does it address issues relating to scheme expansion.

At the commencement of this study, WELS had operated for less than 18 months and grace periods for some products manufactured or imported prior to the commencement of WELS were still in place. Therefore in this study, the analysis includes elements of both *evaluation* of the program to date (necessarily limited mainly to costs directly incurred so far as a result of WELS) as well as *estimation/projection* of costs, benefits and water savings from scheme commencement into the future.

This study includes analysis for those products for which labelling is mandatory – washing machines, dishwashers, showerheads, taps, toilets and urinals. Labelling for flow controllers is voluntary under WELS, and water savings, costs and benefits for this voluntary component have not been explicitly analysed.

1.1 WELS Scheme background

The Department of the Environment, Water, Heritage and the Arts (DEWHA, previously DEW) administers WELS, in partnership with the State and Territory governments. The scheme requires that toilets, clothes washing machines, dishwashers, urinals, taps and showers display a star rating of their water efficiency at the point of sale. It also sets some mandatory maximum water use limits for toilets. Compared to other mandatory or voluntary water efficiency labelling schemes internationally, the Australian WELS Scheme has a wide coverage in terms of product types (see Box 1-1).

Box 1-1 International water efficiency labelling programs

Although there are other water efficiency labelling programs operating internationally, Australia is an international leader for water labelling in terms of the diversity of products included and the review process for products. WELS has often provided a basis for the design of these international programs (Ministry of Consumer Affairs, 2007). Most of these programs, however, are voluntary, including:

- **U.S.A**. – The WaterSense labelling scheme was launched in June 2006 and is sponsored by the U.S. Environmental Protection Agency. In order to display the WaterSense label, the products must demonstrate water use of less than 20% than their competitors. WaterSense, unlike WELS, is a voluntary program. The products currently included in the scheme are high efficiency toilets, bathroom taps, showerheads and irrigation control technologies.
- **Singapore** – The Water Efficiency Labelling Scheme is administered by the Singapore Environment Council. The labelling system is relatively simple, involving a rating of 'good', 'very good' and 'excellent' water efficiency. The program is voluntary and currently includes taps, showerheads, toilets and washing machines.

A summary of these and other international labelling programs is included below.

Country	Name	Mandatory	Administration	Products
Schemes in operation				
China	China Standards Certification Centre[1]	Yes	Government	Washing Machines (minimum standards)
Singapore	Water Efficiency Labelling Scheme [2]	No	Government	Taps, Toilets, Showerheads, Washing Machines
UK	Water Efficient Product Labelling Scheme[3]	No	Manufacturers Association	Taps, Toilets, Showerheads, Baths
UK	Waterwise Marque[4]	Yes	Water Saving Group	Any products - awarded annually to best performing products.
Proposed schemes				
New Zealand	Mandatory Water Efficiency Labelling[5]	Yes	Government	Taps, Toilets, Showerheads, Washing Machines
Canada	Water Star[6]	No	Canadian Water and Wastewater Association	Taps, Toilets, Showerheads, Washing Machines

1. http://www.cecp.org.cn/
2. http://www.sec.org.sg/wels/index.php
3. http://water-efficiencylabel.org.uk/default.asp
4. www.waterwise.org.uk/reducing_water_wastage_in_the_uk/house_and_garden/waterwise_marque.html
5.http://www.consumeraffairs.govt.nz/policylawresearch/water-eff-label/discussion-document/index.html
6. http://www.cwwa.ca/waterstar_e.asp

WELS replaced the National Water Conservation Rating and Labelling Scheme, a voluntary scheme managed by the Water Services Association of Australia (WSAA) since it was introduced in 1988. George Wilkenfeld and Associates (2004) reported that this voluntary labelling scheme was not effective in achieving water savings, as only a small proportion of total available models were labelled. Informal interviews conducted for this study indicate that, prior to the introduction of WELS, there was widespread support from industry for a mandatory water efficiency labelling scheme.

WELS requires all products imported or manufactured since 1 July 2006 to be registered and labelled before they are sold. The following transition arrangements applied for products imported or manufactured prior to 1 July 2006:

- Unlabelled tapware, showers, lavatory and urinal equipment manufactured or imported prior to 1 July 2006 could be sold through retail outlets only until 31 December 2006.
- Unlabelled washing machines and dishwashers manufactured or imported prior to 1 July 2006 could be sold from manufacture/import through to retail until 31 December 2007.

Registration of a WELS product normally lasts for five years. If the Minister makes a change to the WELS Standard that affects the registration of a product, it needs to be re-registered (WELS Regulator, 2008). These arrangements differ from the "grandfathering" arrangements available to those applying under the mandatory Energy Labelling Scheme. Under this scheme, stocks of non-complying products that were manufactured in or imported to Australia prior to the effective date of legislation affecting them (eg. introduction or change of Standard) can be sold for an indefinite period, provided they were properly registered before the date of new regulations (AGO 2005).

1.2 POLICY AND DROUGHT CONTEXT

The period since the commencement of WELS has coincided with severe drought across many parts of Australia. Consequently, the recent water consumption decisions of water users have been influenced by multiple, interrelated factors. Some factors are directly associated with the drought (including outdoor water use restrictions and other campaigns to raise awareness of water shortages and water efficiency), and others to ongoing demand management programs (including rebate and retrofit programs). Building regulations, targeting water efficiency, have also been introduced or strengthened to varying extents across Australian states or territories.

In terms of how various programs and factors interact to create incentives to reduce water use, both complementarities as well as inconsistencies exist. However, quantitative modelling of the complex interactions between WELS and other programs, in order to precisely determine the extent of water savings attributable to WELS to date, would not necessarily yield meaningful results. The opportunity for more complex modelling is likely to arise in future years, as data becomes more comprehensive and a longer time series becomes available to enable evaluation of the effectiveness (or cost-effectiveness) of other policies and programs. However, there are always difficulties in determining the hypothetical base case (without WELS) and attributing savings where multiple programs are in operation.

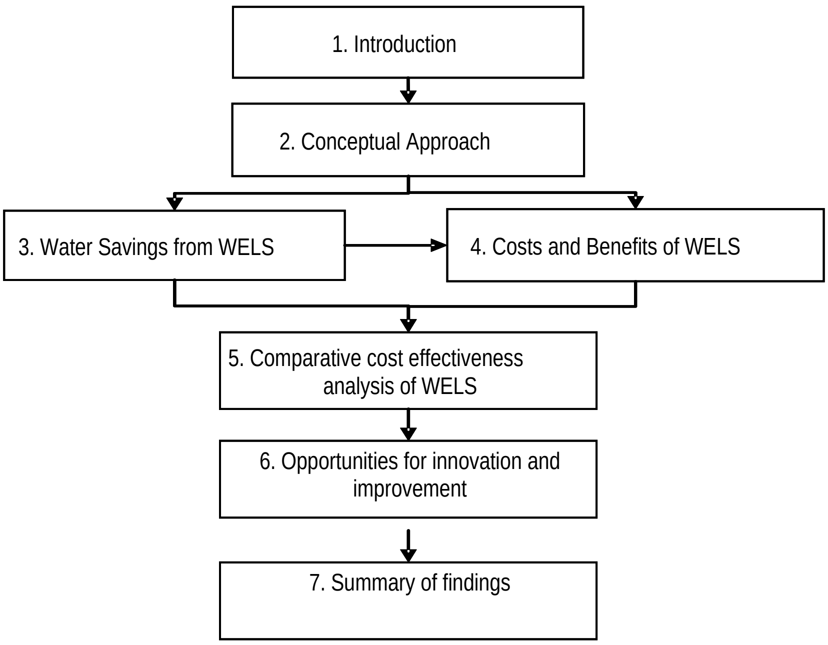
Prior to WELS, various stakeholders (including manufacturers, importers and the plumbing industry) were already required to meet different standards and regulations – a situation not unique to these industry sectors. For plumbing products, legislation and standards (such as the WaterMark scheme) covered aspects such as the quality of fittings and minimum flow rates. AS 3500 has specified the maximum allowable water use per flush for toilets since around 1993 – although this was not made mandatory in some states until recently. Energy labelling has been mandatory for washing machines and dishwashers since 1998. In this context, this study acknowledges (where possible) how issues of consistency, overlap and additionality between WELS and other regulations can result in a regulatory burden on industry.

At the time of this study, the WELS program has not been in place for sufficient duration to conduct an ex-post statistical evaluation of water savings, costs and benefits. This has limited the extent to which the factors described above have been quantitatively modelled in projections of the cost-effectiveness of the scheme, going forward. Nevertheless, where these might substantially affect impacts or water savings, these influences have been noted and analysed throughout this report.

1.3 REPORT OUTLINE

An outline of the report is given in Figure 1-1. Following this introduction, the conceptual approach to analysis is described in Section 2. Section 3 analyses the water savings from WELS in the context of other factors such as rebates, the recent drought and changes to building regulations. Section 4 assesses the costs and benefits associated with WELS. Combining the water savings and cost/benefit analysis, Section 5 details the results of cost effectiveness analysis ($/kL) comparing WELS with other options for urban water savings. Section 6 concludes with a summary of key points and a discussion of next steps relating to modelling, evaluation and WELS in general.

Figure 1-1: Outline of report



2 Conceptual approach

2.1 OVERVIEW

The underlying conceptual approach applied in this study is *cost-effectiveness analysis*. This is a technique that can be used to compare different options which have a common or similar type of predominant effect or objective, which is measured in physical units.

In this study, the predominant benefit is contribution to water security – measured in terms of **water saved** (in the case of WELS and other water efficiency options) or **water supplied** (in the case of supply or re-use options). Cost-effectiveness analysis requires that the other costs and benefits of each option are quantified, where possible, in monetary terms.

Unlike cost-benefit analysis, cost-effectiveness analysis provides no absolute criterion for accepting or rejecting a policy or program (COAG 2007). However, in the context of urban water management, which requires comparison of a large number of different options, cost-effectiveness analysis is the appropriate approach. It is also consistent with previous work by ISF on development of Australian and international guidelines for urban water management costing and options analysis (Mitchell *et al., 2007*, Turner *et al.,* 2007).

This chapter describes key characteristics of the conceptual approach applied in this study, including:

- *Levelised cost approach.* The best-practice metric of comparison is levelised costs, which involves discounting both costs as well as water savings (effectively a stream of benefits).
- *The role of WELS in achieving water savings, and additionality of WELS impacts*. Water savings, costs and benefits are analysed against a hypothetical baseline which is the "business as usual" case of what would have occurred anyway, in the absence of WELS. Conceptually, this baseline includes policies, programs, market conditions and consumer preferences in place at the time of introduction of WELS, as well as expectations of trends and changes in these factors if WELS had not been implemented.
- *Whole-of-society cost or benefit of options.* To enable comparison between the cost-effectiveness of WELS and other water management options, the whole-of-society net cost or benefit is used in the cost-effectiveness metric. This approach requires specifying boundaries of analysis in terms of stakeholders and impacts. In calculating this net cost or benefit, externalities are included (where possible) but transfer payments between stakeholders excluded. Whole-of-society analysis of costs and benefits is supplemented by distributional analysis of costs and benefits – that is, impacts according to different stakeholder perspectives.

Although impacts associated with lifecycle phases of WELS products, including manufacture and disposal, could be significant, lifecycle analysis of water savings, costs and benefits is beyond the scope of this study. The analysis in this study is limited to impacts associated with product registration and use.

2.2 COST-EFFECTIVENESS ANALYSIS: LEVELISED COST APPROACH

Measures of unit cost are used when comparing different water saving and water supply options in terms of their cost-effectiveness. The measure of unit cost adopted for the assessment of WELS is levelised cost, also known as the average incremental cost (AIC). Levelised cost is a metric which has the basic form of the present value (PV) of the stream of net costs in the numerator divided by the present value of the volume of water saved or supplied in the denominator:

Levelised Cost = PV (Ct)/PV(St)

Where St is the amount supplied in each period t, and Ct equals capital and operating costs for each period. The levelised cost allows for the comparison of demand and supply options in order to inform decision making for water security. This is particularly useful in least cost planning to assist in the identification of lowest cost options that meet the supply demand balance into the future.

Another feature of the levelised cost is that it can be directly compared with the long run marginal cost (LRMC) of the current system to determine whether the next option is in fact cheaper than the marginal cost of current supply.

The levelised cost can usefully be interpreted as the price, held constant in real terms over time, that would ensure the present value of revenues from water output equals the present value of the costs, allowing for financing costs.

PV (P x St) = PV (Ct) (1)

Where P equals the constant price. In other words the levelised cost is the price that equates a revenue stream to a cost stream, expressed in present value terms - i.e., it is a 'break even price'.

The levelised cost measure of unit cost also takes account of the time preference of consumption, that is, the changing levels of consumption over the specified time horizon for analysis. This is conducted by discounting the stream of water to a net present value in the same way that the cost stream is discounted. Conceptually, this equates to the recognition that the denominator of the levelised cost equation is a function of future demand rather than a volumetric quantity. Put differently, the denominator represents the satisfaction of a demand for water (as distinct from a volume of water) and is therefore an economic quantity, it represents a level of utility. Therefore, the same principle applies as for the value of money. That is, if we accept that the denominator is in fact a utility, and additionally accept that consumers assign a time preference to utility (i.e. consumers prefer satisfaction of their needs now) then it follows that the denominator should be discounted to account for this time preference.

By way of comparison, some other costing metrics, for example annualised cost, have a denominator equal to the arithmetic sum of water supplied over the time horizon. In these calculations water supplied at some point in the future is not treated any differently than water supplied immediately.

2.3 THE ROLE OF WELS IN DELIVERING WATER SAVINGS

As discussed in chapter 1, WELS has been introduced during a period where there are multiple other drivers and programs influencing water consumption and efficiency. It is therefore difficult to attribute overall water savings to WELS or any individual program element. Nevertheless, WELS provides key information to facilitate the feasibility and effectiveness of other programs.

Compared to the baseline scenario of voluntary labelling, WELS influences consumer choice and achieves water savings through several mechanisms:

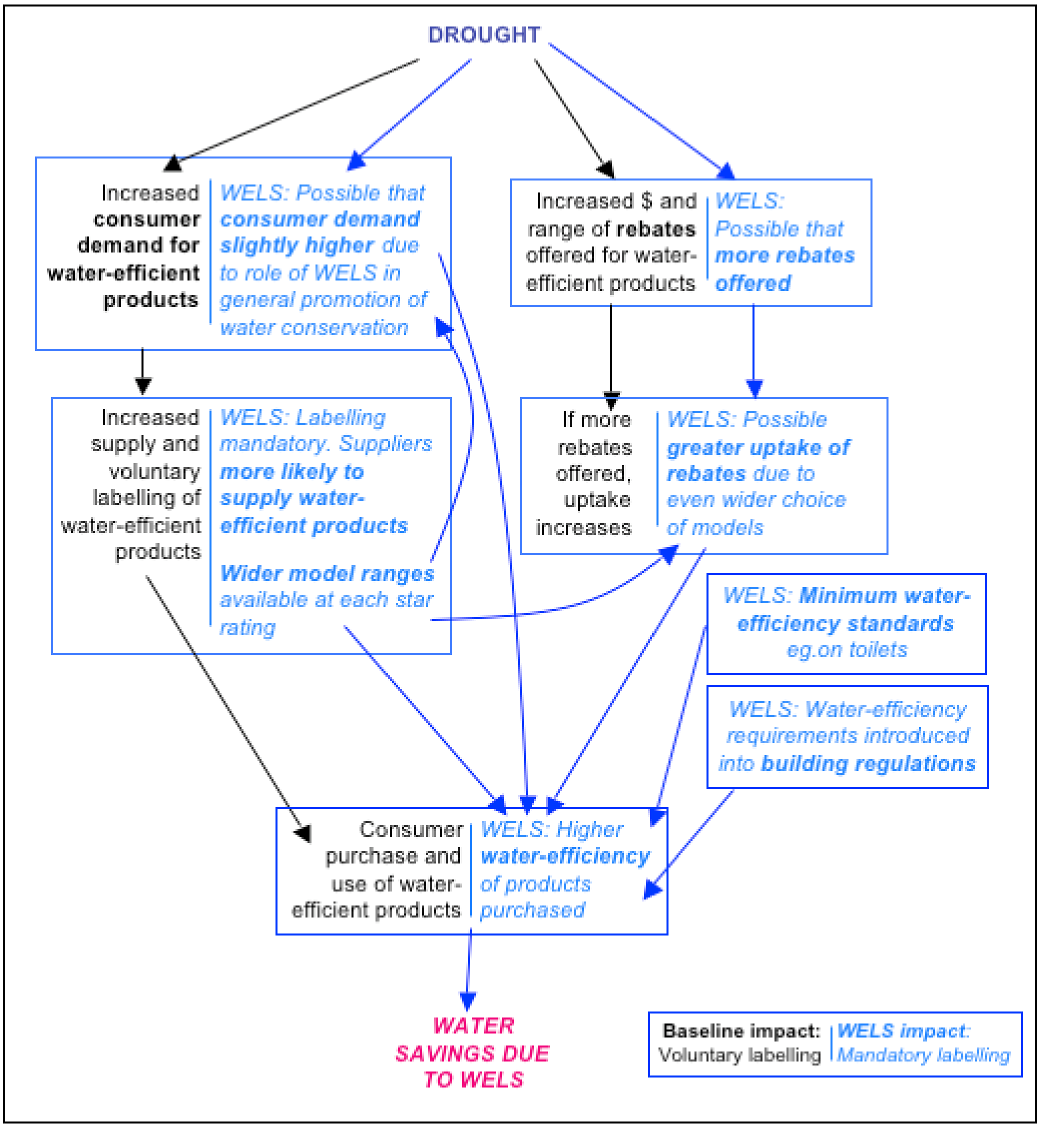
- The primary mechanism is by providing consumers with **information** about the water efficiency of all products covered by the scheme. This allows consumers to differentiate between models on the basis of water efficiency, and to include it as a factor (amongst other features, eg. price) in their purchase decisions.
- WELS also acts as a vehicle for **incentives programs**, such as rebate schemes. WELS could affect the extent and nature of rebates offered, as well as uptake rates (by ensuring all products are labelled, enabling greater consumer choice than under voluntary labelling).
- **Building regulations** that target the water efficiency of products and fixtures rely on the mandatory aspect of WELS. WELS has also enabled the Australia-wide implementation of **minimum standards**, such as water efficiency of toilets.

WELS was introduced at a time of severe and prolonged drought across many parts of Australia. In various locations, widespread education and promotion of water conservation has been accompanied by restrictions on outdoor water use and aspirational targets or mandated rationing of total water use – particularly focussing on residential users. It is likely that even if WELS had not been introduced, consumers responding to water shortages and the drought could have shifted towards more water-efficient products, albeit constrained by the lesser coverage of the voluntary labelling scheme.

However, Figure 2-1 illustrates the pathways by which WELS is likely to have reduced (and continue to reduce) water consumption *in addition to that which would have occurred under voluntary labelling scheme*, giving regards to the various drivers and influences associated with drought and water shortages.

A further important feature of the water savings achieved by WELS is that they are "locked-in" – that is, are related to technology choices rather than drought-dependent behaviour. In the suite of possible measures to achieve water savings, WELS has the advantage of locking in savings for the life of products, compared to restrictions on water use behaviour, which guarantee savings only during the period of regulation.

Figure 2-1 WELS mechanisms to achieve water savings: additional to that which would have occurred under voluntary labelling baseline.



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2.3.1 Direct information provision

As shown in the diagram, under a baseline situation of voluntary labelling, consumers are likely to have to respond to drought and water shortages by seeking to purchase more water-efficient products. Although evidence from the 2003 RIS indicates that coverage under the voluntary labelling scheme was low, it is plausible that with sufficient demand some suppliers may have expanded their range of water efficient labelled products, thus increasing the effectiveness of the voluntary scheme in delivering water savings. For example, the number of outdoor water use products registered under the Smart Water Mark scheme, despite being a voluntary labelling scheme, rose sharply in response to the recent drought, reflecting an increasing sentiment within industry that labelling results in a market advantage, although an additional direct driver for this is outdoor water use restrictions, (Gray, J. pers. comm.).

However, by ensuring full (or close to full) coverage of all models, WELS has necessarily lead to a greater uptake of water efficient products and hence water savings. More consumers are likely to include water use efficiency as a factor in their purchase decisions because all models are labelled.

Furthermore, longer-term, if the drought subsides, the water conservation ethic and consumer preference for water efficient products may also decrease (see, for example, discussion of "bounce-back" in demand after restrictions in Chong et. al (forthcoming)). Without mandatory labelling, suppliers may not necessarily choose to introduce water efficient products, and thus the reinforcing factor of widespread model label coverage would also be lost.

2.3.2 Rebates

Rebates for water efficient products are a significant driver of consumer choice. Rebates were available under the voluntary scheme. Under the baseline scenario, in response to drought, agencies offering rebates may have expanded the schemes even if labelling remained voluntary, and consumer uptake is likely to have increased. Nevertheless, the mandatory characteristic of WELS would lead to higher water savings through rebates by:

- possibly facilitating agency decisions to provide more extensive or higher value rebate programs.
- ensuring wide product coverage, thus increasing uptake of rebates.

Table 2-1: Selected rebate programs in Australia

Area	Scheme Name	Agency	Rebates offered
SA	Rebate Scheme	SA Water	• Up to $30 for 3 star showerhead • $150 for replacing a single flush toilet with a dual flush toilet suite • $200 for 4 star washing machine
NT (Alice Springs and Tennant Creek)	NT Waterwise Central Australia Rebate Scheme	NT Government Department of Natural Resource, the Environment and Arts	• Up to $50 for 3 star showerhead, 4 star toilet or 4 star washing machine
WA	Waterwise Rebate Program	WA Government Department of Water	• $150 for 4 star washing machine
Victoria	Water Smart Gardens and Homes Rebate Scheme	VIC Government Department of Sustainability and Environment in partnership with water businesses	• $50 for 3 star toilet • $10 or $20 for 3 star showerhead, depending on purchase price
Queensland (south-east Queensland)	Home WaterWise Rebate Scheme	Queensland Government	• $200 for 4 star washing machine • $150 for dual-flush toilet replacing existing single-flush toilet
NSW (Sydney)	Washing machine rebate	Sydney Water	• $150 for 4 star washing machine.
Tasmania (Hobart)	Rebate Scheme	Hobart City Council	• $50 for dual-flush toilet replacing existing single-flush toilet • $12 for 3 star showerhead • $12 for 3 star tapware • $105 for 4 star washing machine • $105 for 4 star dishwasher

Note: rebates available as at December 2007. Indicates minimum star rating required for rebate.

2.3.3 Regulations

Building regulations

A significant influence on the levels of water efficiency in different states is the nature of regulations on new buildings. In NSW, BASIX regulations effectively require all households in NSW to adopt low-flow showerheads, as this is one of the cheapest means of meeting the 40% water reduction target. Apartments in NSW can also claim savings which result from installing an efficient washing machine toward their water reduction target. In Victoria, the 5 Star sustainable building standard effectively requires that new and renovated households must have WELS rated fixtures, resulting in the increase in water efficiency across the state.

Table 2-2: Selected state based building regulations and their link to WELS products

Area	WELS-related regulation
Western Australia	• All tap fittings other than bath outlets and garden taps are minimum 4 star • All showerheads are minimum 3 star • All toilets are minimum 4 star
Queensland	• All showerheads are minimum 3 star • All toilets are dual-flush
Victoria – 5 star houses	• Showerheads, basins, kitchen sinks and laundry trough tap flow rates cannot be more than 9L/min or less than 7.5 L/min.

Notes: on new homes as at December 2007.
Some of the above regulations also apply to major renovations

Minimum standards

WELS is also a potential mechanism for ensuring Australia-wide compliance with minimum standards. Because labelling under WELS is mandatory for all pathways of sale to end-user, it could facilitate the comprehensive adoption of minimum water efficiency standards. This has already been implemented for toilets, where single flush toilets are no longer manufactured for selling in Australia, and is currently being considered as an approach to other WELS products such as washing machines and showerheads.

Minimum standards are an important mechanism to lock-in savings achieved under the WELS program. Whilst WELS may deliver more permanent water savings than restrictions, complete lock-in of water savings can only be achieved through minimum standards on WELS rated products. This is particularly important for products such as showerheads, where it is possible to easily change the fixture to a less efficient model.

2.4 ANALYSIS OF COSTS AND BENEFITS DUE TO WELS

The key elements of analysing the costs and benefits due to WELS include:

- **Setting the boundaries of analysis**, which involves identifying the key stakeholders affected by WELS and the costs and benefits affecting these stakeholder compared to business-as-usual (Mitchell *et al.*, 2007). Both market and non-market impacts (e.g. externalities) should be identified.

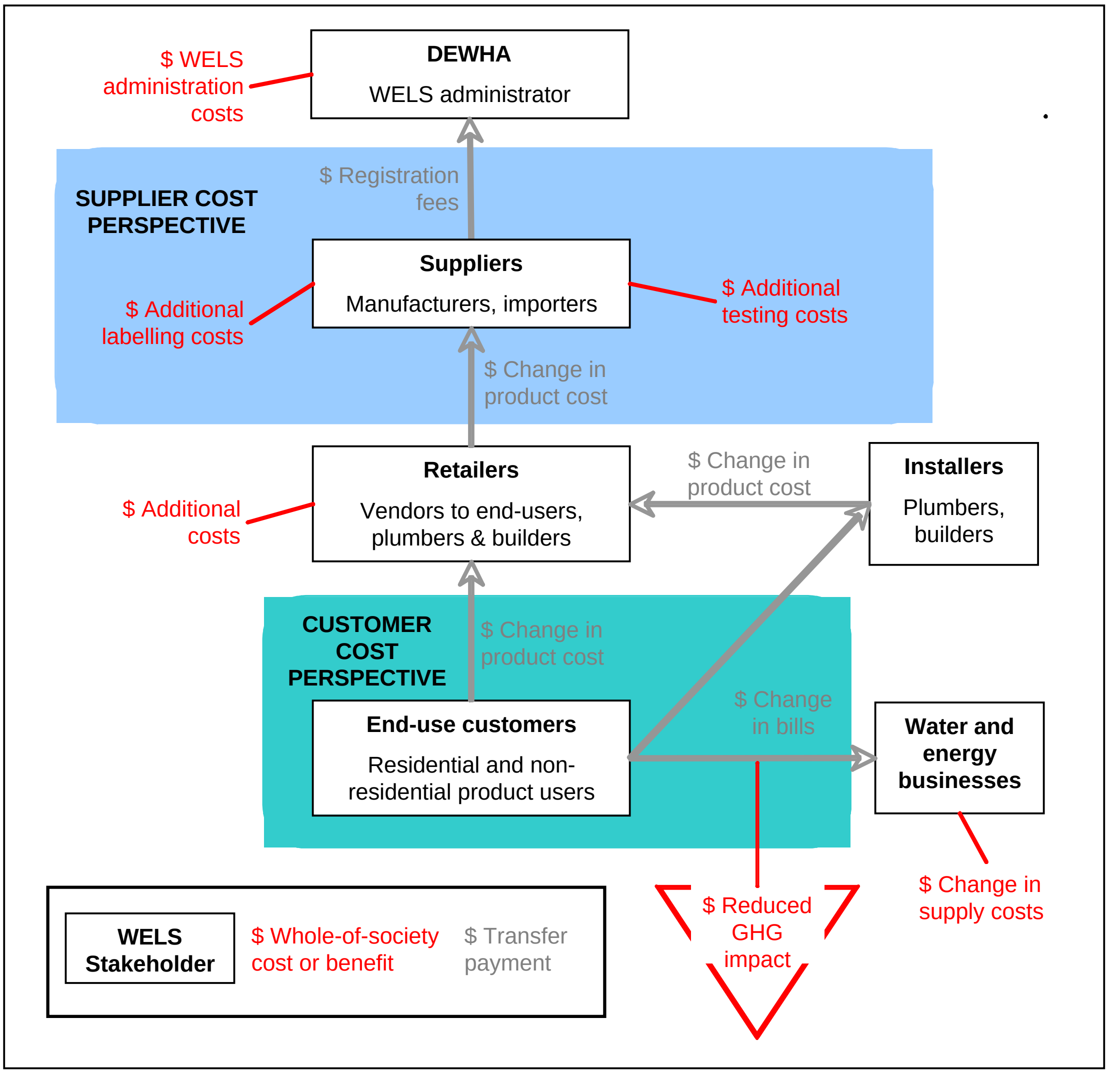
- **Identifying transfer costs and whole-of-society costs** to determine which impacts are relevant for distributional analysis, and which impacts are relevant for comparative cost-effectiveness analysis.

- **Measuring costs and benefits** in ways appropriate to the extent of and uncertainty in available data. There are many available methods for quantifying and/or placing dollar values on costs and benefits, but not all may yield meaningful results.

2.4.1 Boundaries of analysis and stakeholder perspectives

Figure 2-2 illustrates the boundaries of analysis and stakeholder identification underpinning the analysis of costs and benefits in this study.

Figure 2-2: Conceptual approach and boundaries for cost-benefit analysis



The key stakeholders affected by WELS, and the nature of costs and benefits, are listed in Table 2-3.

Table 2-3: Costs and benefits affecting key stakeholders

Stakeholder	Cost or benefit	Description
DEWHA	WELS administration costs	Costs include promotion, enforcement activities, database administration, staffing and overheads (see chapter 4 for full list).
	WELS registration fees	$1500 per model or family of models registered.
Suppliers	Other registration costs	Staffing requirements to undertake registration process, including preparing documentation.
	Additional labelling costs	Printing and affixing labels. Costs are those incurred *in addition* to those associated with labelling under other schemes (eg. energy labelling).
	Additional testing costs	Accredited testing for water-efficiency rating. Costs are those incurred *in addition* to those associated with other procedures, (eg. testing for product development or testing to meet requirements of other standards).
	Change in cost of products sold from suppliers to retailers	Due to any price premium for higher water-efficiency products.
Retailers	Additional retailers' costs	Staffing requirements to check labels, train staff. Transition between unlabelled and labelled stock.
End-use customers	Change in product cost sold from retailers to end-users (possibly through installers)	Due to any price premium for higher water-efficiency products.
	Change in energy bills	Due to reduced water heating required (energy bills).
Water utilities	Change in water bills/revenue	Due to reduced water consumption (water bills).
	Change in operating costs (analysis limited to energy costs)	Due to reduced pumping for water supply and sewage treatment.
Global	Reduced greenhouse gas impact	Due to reduced energy use associated with hot water use.

3 Water savings due to WELS

This section presents the results of analysis of water savings due to WELS. It also identifies confounding factors which influence the realised savings, including rebate programs and building regulations. Experiences and perspectives from stakeholders in different locations in Australia regarding WELS and their interaction with other influencing factors for various products are described throughout.

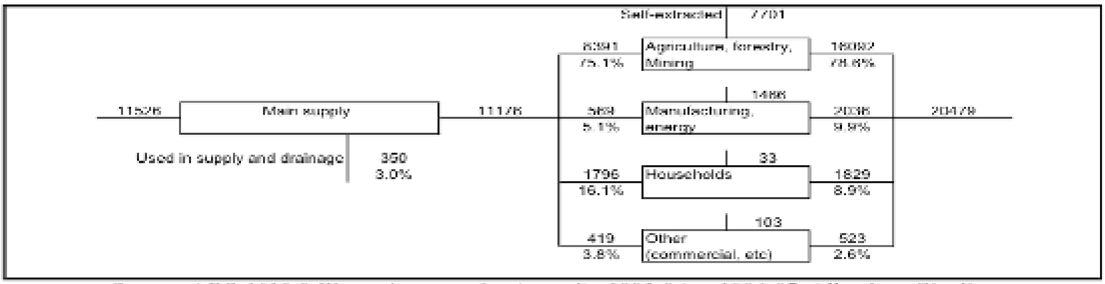
3.1 INTRODUCTION TO THE ANALYSIS OF WATER SAVINGS

In order to analyse and project water demand figures, water use is typically disaggregated into sectors, such as residential, commercial and industrial. Within each of these sectors, the demand can be disaggregated further into end uses. These end uses will include the residential components of outdoor water use, toilets and clothes washers, but also will include non-revenue water[1], and commercial and industrial end-uses.

Each of these constituent end uses is then analysed in further detail to establish the use and potential growth or decline in water consumption. An analysis of end uses may reveal, for example, the difference in outdoor water use around the country, and that Sydney has much less outdoor water use per capita than Western Australia. Alternatively, the analysis may reveal the end uses that require the most focus in terms of designing demand management programs.

George Wilkenfeld and Associates (2003) includes a disaggregation into sectors for demand across Australia, including the categories of domestic use, manufacturing and agriculture. This analysis showed that across Australia in 1996-1997, domestic use accounted for about 16% of total water use. This is shown below in Figure 3-1.

Figure 3-1 Mains water use by sector, Australia 1996-1997 (George Wilkenfeld and Associates, 2003)



Source: ABS 4610.0 *Water Accounts for Australia 1993-94 to 1996-97*; All values Gigalitres

Within the 'households' end use, George Wilkenfeld and Associates (2003) then disaggregated this sector into taps, showers, baths, clothes washers, dishwashers, toilets, water heaters and outdoor water use. WELS products reduce water use indoors, and therefore it is reasonable to focus on indoor end uses in this analysis.

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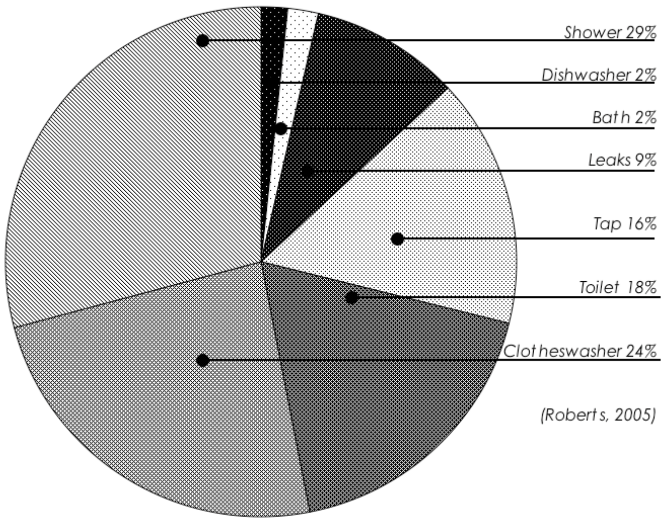
[1] In recent years it has become common practice to use the International Water Association (IWA) and Water Services Association of Australia (WSAA) term " non revenue water" to describe leakage and losses associated with current annual real losses (CARL), unavoidable annual real losses (UARL) and apparent losses. These are described in WSAA Facts (WSAA, Facts, 2004).

A snapshot of residential indoor water end uses in Melbourne is given in Figure 3-2. This shows the more significant end-uses in a household are clothes washers, showers and toilets. These are also the end-uses that have the greatest potential in terms of water savings. In particular, clothes washers and showerheads have a large conservation potential because there are a significant proportion of inefficient appliances and fixtures remaining in households (ABS, 2005). By comparison, a large proportion of toilets are already dual-flush and therefore relatively efficient. As a result, toilets have a lower but still significant potential to contribute water savings when compared with showerheads and clothes washers.

All the indoor water uses shown in Figure 3-2 can be reduced as a result of WELS products, except for bath use (which is a volumetric end-use). Water savings due to WELS should be considered in the context of their relative importance in the home and in commercial settings.

Figure 3-2: Relative magnitude of water end uses in Melbourne



In the analysis conducted in this report, an end-use analysis of all end uses for residential and non-residential end uses has not been conducted. This is because for many products insufficient data was available to build stock models for both the residential and non-residential sectors. As a result, the water consumption and savings have not been resolved into different building classes such as multi-residential blocks, single residential and semi-detached households. The 'residential' sector as it is analysed in this study is a conglomeration of all these components.

In the non-residential sectors, the assumption has been made that clothes washers and dishwashers have minimal contribution to overall consumption as the overwhelming majority of these appliances are used in domestic contexts. For showerheads, there was no available data regarding the different behaviours of people in the commercial context, although it is expected that showerheads in non-residential building would be used with a greater frequency than for residential. As a result, the assumption of 'residential' showerhead behaviours for all showers may result in a slightly underestimated water savings figure. Toilets, taps and urinals do however have a non-negligible commercial and industrial market, and this has been accounted for in the following discussion.

An alternative approach, focussing on sales data was adopted for clothes washers and dishwashers. This approach involved calculating the difference in projected sales figures with and without WELS was multiplied by projection of the changing efficiency of the stock. A similar approach was undertaken for showerheads.

3.2 METHOD AND DATA SOURCES

The overarching method for calculating water savings due to WELS is to establish the marginal difference in water savings achieved under the current mandatory labelling scheme, and the savings that would otherwise have been achieved under a voluntary labelling scheme. The water use that would have been achieved under the voluntary labelling scheme therefore form the baseline scenario for this analysis.

Projections of the market shifts under a voluntary scheme were conducted based on the most recent data available prior to the mandatory labelling scheme. Projections of the market shifts resulting from the mandatory scheme were based on the most recent data, paying particular attention to the market shift since mandatory labelling was implemented.[2]

The water savings calculations conducted in this study draw upon many of the assumptions used in George Wilkenfeld and Associates (2004)[3], establishing new projections based on current data collected since WELS has been in place. The new sources of data incorporated into this analysis includes:

- sales data of clothes washers and dishwashers up to 2006 (EES, 2008)
- latest ABS survey data on the uptake of efficient clothes washers, dishwashers and showerheads (ABS, 2005)
- results from a range of stakeholders interviews regarding the impact of WELS and the different roles played in achieving water savings
- recent analysis of building regulations, current literature regarding water security, demand management and cost effectiveness analysis.

[2] As 2006 was the first and only year in which sales data represents sales of efficient washing machines and dishwashers, it played a particularly important role in establishing future projections for the WELS mandatory labelling scenario.

[3] The spreadsheet model used for the WELS RIS was made available by courtesy of the authors of the RIS, George Wilkenfeld and Associates (GWA). GWA did not advise on the use of the model or otherwise participate in the present study, and ISF takes responsibility for all interpretations and conclusions based on its own use of GWA's model.

3.3 ANALYSIS OF WELS WATER SAVINGS

3.3.1 Washing machines

Clothes washers have a significant conservation potential, as there are a significant number of inefficient machines currently used, and the rate of improvement in the technology is relatively rapid. In addition, clothes washers form a significant proportion of indoor water use in most households.

The contribution of commercial washing machines is assumed to be minimal.

Available Data Sources

Principal sources of data relating to washing machines and their use in modelling water savings are shown in Table 3-1.

Table 3-1: Washing machines – data sources for water savings

Data Source	Components / Detail	Comment
1. George Wilkenfeld and Associates Model for RIS (2004)	• Water savings by State / Nationally • Water savings by Front loader / Top loader	• Based on changing trends in washing machine efficiency, split of sales between front and top loaders, predicted future sales, predicted declining occupancy ratio and constant kg of washing per person per year into the future
2. GfK Sales Data (to 2005)	• Actual sales trends by State / Nationally • Water and Energy Star • Capacity distribution • Washing machine type	
3. GfK 2006 Sales	• As for GfK to 2005 but with sales by model level of detail	• Useful to compare if water efficient models sold are also energy efficient and visa versa
4. WELS database	• Number of models registered	

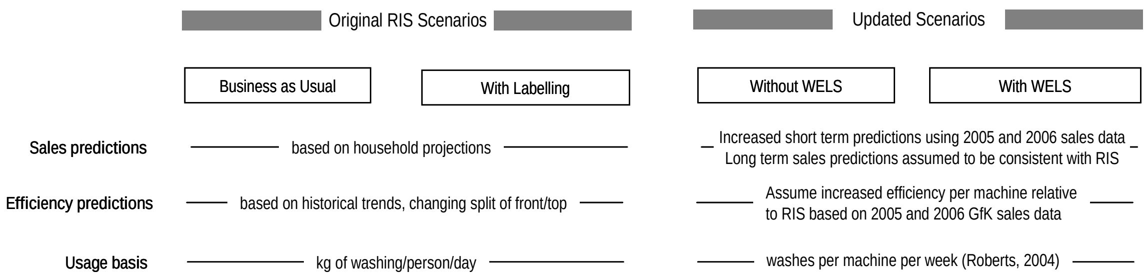
Modelling approach and key assumptions

For washing machines modelling occurs from financial year 2005/06 until 2020/21 and savings are calculated in accordance with Equation 1 below.

Savings due to WELS and other factors for Washing Machines(t) = [Machine Sales$_{NoWELS}$(t) ×Average Efficiency Per Wash$_{NoWELS}$(t) × Washes Per Year$_{NoWELS}$] – [Machine Sales$_{WELS}$(t) ×Average Efficiency$_{WELS}$(t) × Washes Per Year$_{WELS}$] Equation 1

The conceptual approach to modelling in the updated scenarios explored in this report and their relation to the original scenarios modelled in the RIS (George Wilkenfeld and Associates, 2004) are shown in Figure 3-3. The 'Business as Usual' and 'With Labelling' scenarios have been updated to the two scenarios of 'Without WELS' and 'With WELS'.

Figure 3-3: Conceptual modelling basis for RIS scenarios and updated scenarios



The estimates used for parameters in Equation 1 are detailed in

Table 3-2 and graphical representations of the time varying parameters are shown in Figure 3-4.

Table 3-2: Washing machines – parameters used to model updated scenarios

Parameters	Sources	Comment
Machine Sales$_{NoWELS}$(t)	• RIS • GfK recent data 2005 / 2006	• Updated sales projections to reflect recent sales trends which are assumed to have been augmented have been augmented as a result of rebates / drought and which are assumed to return to levels predicted in RIS in long term which grows in line with household projections. • Updated household projections are not yet available from ABS for 2006+. • Another possibility not modelled is that cheaper imported white goods may increase rate of sales in a continuing fashion in the longer term.
Machine Sales$_{WELS}$(t)	• RIS • GfK recent data 2005 / 2006	• Assumed to be same as *Machine Sales$_{NoWELS}$(t).*
Average Efficiency$_{NoWELS}$(t)	• RIS • GfK recent data 2005 / 2006	• Efficiency is expressed as L/wash with updated trajectory shown in Figure 3-4 assumed to continue recent trend and then incrementally progress toward a 4 star usage (72 L/wash) for a 7kg machine by 2021.
Average Efficiency$_{WELS}$(t)	• RIS • GfK recent data 2005 / 2006	• Efficiency is expressed as L/wash with updated trajectory shown in Figure 3-4 assumed to continue recent trend with more substantial improvements continuing in new few years whilst rebates are anticipated to continue to be offered and drought might and then incrementally progress toward a 5 star usage (51 L/wash) for a 7kg machine by 2021.
Washes Per Year$_{NoWELS\ /\ WELS}$	• Roberts, 2004	• 208.8 per year. • N.B. Same for No WELS / WELS.

Figure 3-4 shows the change in water efficiency, for top loading and front loading machines, as a result of WELS. As anticipated, WELS results in an increase in efficiency as a result of increasing sales of efficient models. The increase in sales of efficient products would happen in the business as usual scenario. This means that although WELS plays a significant role in reducing water use, a number of other factors at play (including rebates, building regulations and technological improvements) are also reducing water use.

Another feature of the reductions in water consumption is that top loading machines are increasing in efficiency at a much faster rate than front loading machines. This is a result of the average top loading washing machine currently being much less efficient than the average front loading machine. In order to increase efficiency, customers are switching to front loading models and more efficient top loading models. This results in significant improvements in the average top loading efficiency (because of a shift to more efficient models) but less significant improvements for front loaders that are already situated at the high end of the WELS rating scale.

The results of water efficiency projections in this project were based on data as recent as 2005 and 2006. The results of a previous study which was based on data up to 2003 are shown in comparison. This comparison shows that the average water consumption of models is now more optimistic than on the previous study, resulting from recent indications that the market is shifting to higher efficiency machines more rapidly than previously expected.

Figure 3-4: Average water consumption per wash (7 kg load) showing reductions from WELS compared with BAU scenario

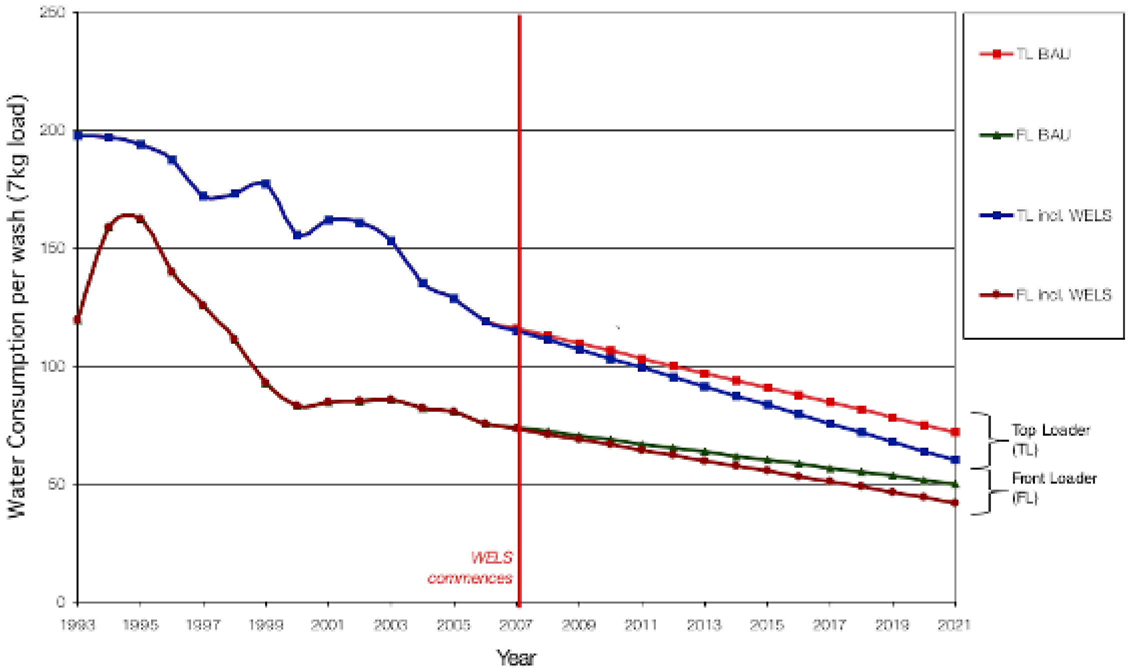
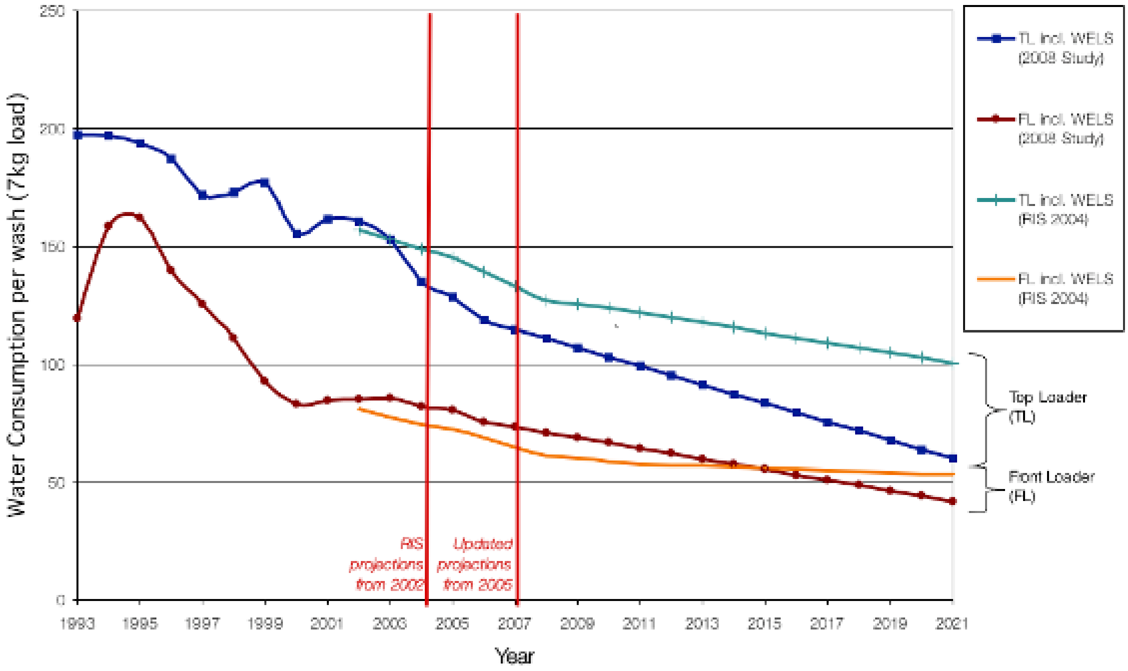


Figure 3-5: Water consumption per wash (7 kg load) showing the difference between the projections in the RIS (George Wilkenfeld and Associates 2004) and recent projections using updated data points.



Confounding Factors

There are a range of other factors that are operating to produce water savings from washing machines, and these factors therefore may limit the water savings attributable to WELS.

The most significant of these are rebates, which have been a key factor driving the increased uptake of efficient machines in many areas. Stakeholders interviewed for this study reflected that in Western Australia, recently introduced rebates on 4.5 Star washing machines will drive up demand for these machines significantly.

However, in Victoria rebates on washing machines only existed for a short period (approximately 2 months) but there has also been a significant increase in the sales of washing machines in this jurisdiction. It is expected that an increased water efficiency ethic resulting from the drought and restrictions is largely responsible for the large uptake of machines.

In other areas, the drought may also have had a significant impact upon the uptake of efficient machines. Two examples are given below:

- Geelong, Victoria - A complete outdoor water ban from December 2005 to October 2007 meant that utilising grey water from washing machines was one of the main ways people could still keep their garden alive decreasing the uptake of water efficient machines in this area, also no rebate was offered.[4]

[4] Water Utility Stakeholder, May 2007.

- Hobart, Tasmania - Hobart is not in restrictions but has rebate of $105 for installing a 4-star or better machine. Rebate uptake was much greater than expected with the annual quota being allocated within three months. Awareness of drought in other parts of Australia - particularly through gardening and home lifestyle TV programs - was thought to have promoted awareness and uptake in Hobart.[5]

Additionally, building regulations may also be having an impact upon the uptake of water efficient washing machines. Although in many areas the building regulations do not include washing machines (because they can be removed or replaced with changing owners) in NSW washing machines in apartments can be included in assessment of water efficiency to meet BASIX targets.

3.3.2 Dishwashers

Comprehensive sales data are also collected for dishwashers. However as shown earlier in Figure 3-2, their usage of water in the home is lower than for showers, toilets and washing machines and their contribution to commercial consumption is assumed minimal.

Available Data Sources

Table 3-3: Dishwashers – data sources for water savings

Data Source	Components / Detail	Comment
1. George Wilkenfeld and Associates Model for RIS (2004)	• Water savings by State / Nationally • Water savings by Front loader / Top loader	• Based on changing trends in dishwasher efficiency, predicted future sales, predicted declining occupancy ratio and a distribution of usage rates per person per year into the future
2. GfK Sales Data (to 2005)	• Actual sales trends by State / Nationally • Water and Energy Star • Capacity	
3. GfK 2006 Sales	• As for GfK to 2005 but with sales by model level of detail	• Useful to compare if water efficient models sold are also energy efficient and visa versa
4. WELS database	• Number of models registered	

Modelling approach and key assumptions

For dishwasher modelling occurs from financial year 2005-2006 until 2020-2021 and savings are calculated in accordance with Equation 2 below.

Savings due to WELS and other factors for Dishwashers (t) =

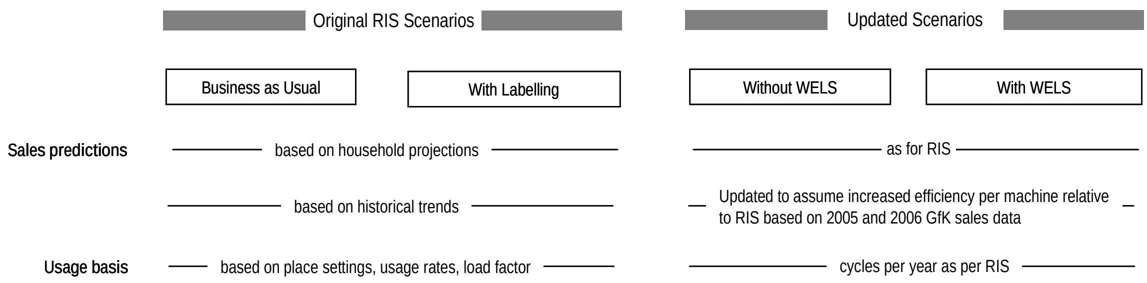
$$[\text{DishWasherSales}_{NoWELS}(t) \times \text{Average Efficiency Per Cycle}_{NoWELS}(t) \times \text{Cycles Per Year}_{NoWELS}] - [\text{DishWasherSales}_{WELS}(t) \times \text{Average Efficiency Per Cycle}_{WELS}(t) \times \text{Cycles Per Year}_{WELS}]$$

Equation 2

The conceptual differences between the RIS and updated scenarios used in this report are shown in Figure 3-6.

[5] Hobart Council Stakeholder, Dec 2007.

Figure 3-6: Dishwasher scenarios



The values for parameters used in Equation 2 to define the updated scenarios are described in Table 3-4.

Table 3-4: Dishwashers– parameters used to model updated scenarios

Parameters	Sources	Comment
$DishWasherSales_{NoWELS}(t)$	• RIS (George Wilkenfeld and Associates, 2004) • GfK recent data 2005 / 2006	• Sales for updated scenarios in this report are assumed (as per RIS) and indicates variability, however the two data points of 2005 and 2006 that are higher than the RIS projections were not considered sufficient evidence to assume a higher sustained trend. If a higher trend occurs the savings from WELS will be greater, hence the position adopted is conservative with respect to potential savings.
$DishWasherSales_{WELS}(t)$	• RIS • GfK recent data 2005 / 2006	• Assumed to be same as $DishWasherSales_{NoWELS}(t)$.
$Average\ Efficiency\ per\ Cycle_{NoWELS}(t)$	• RIS • GfK recent data 2005 / 2006	• Efficiency is expressed as L/wash with updated trajectory shown in Figure 3- assumed to continue recent trend and then incrementally progress toward a 3 star usage (15 L/cycle) for a 12 place machine by 2021.
$Average\ Efficiency\ per\ Cycle_{WELS}(t)$	• RIS • GfK recent data 2005 / 2006	• Efficiency is expressed as L/wash with updated trajectory shown in Figure 3- progressing toward a 5 star usage (10 L/cycle) for a 12 place setting machine by 2021.
$Cycles\ Per\ Year_{NoWELS\ /\ WELS}$	• RIS	• Same as RIS as shown in Figure 3-. • N.B. Same for No WELS / WELS.

Figure 3-7: Dishwasher efficiency; actual and projected

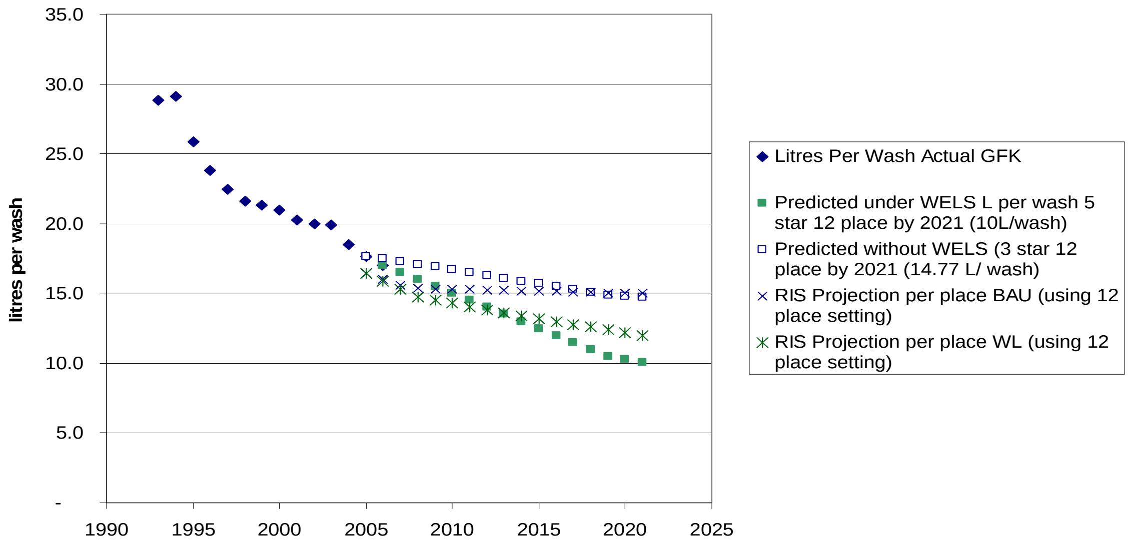
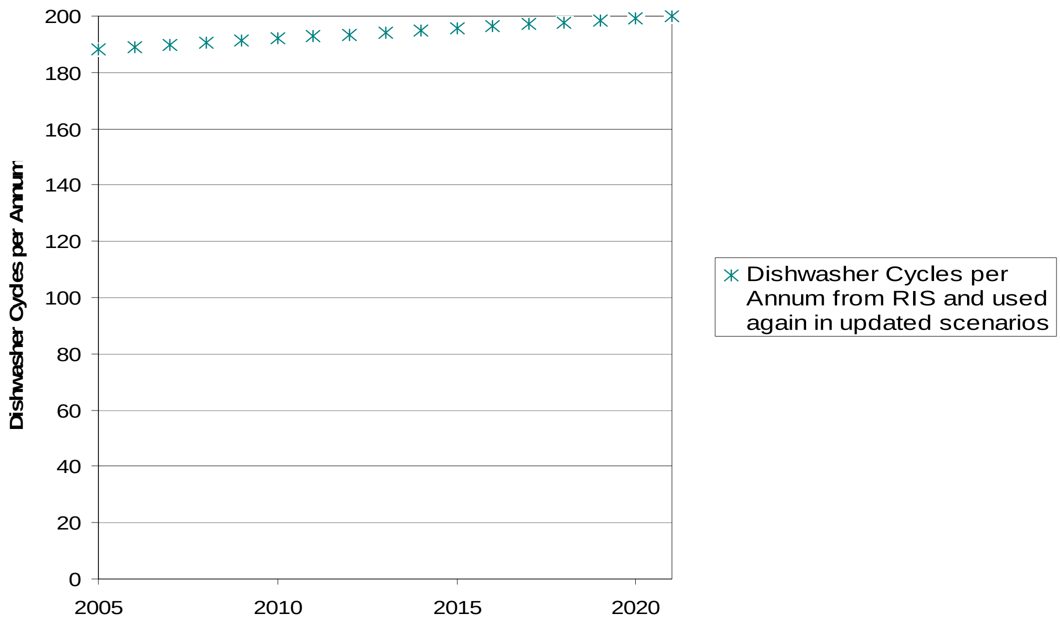


Figure 3-8: Dishwasher usage projections



Analysis of confounding factors

Residential behaviours have been assumed for commercial dishwasher use rather than evaluating this sector separately. The dishwasher use is expected to be minor in the commercial sector, as it would be much smaller than the residential sector dishwasher consumption.

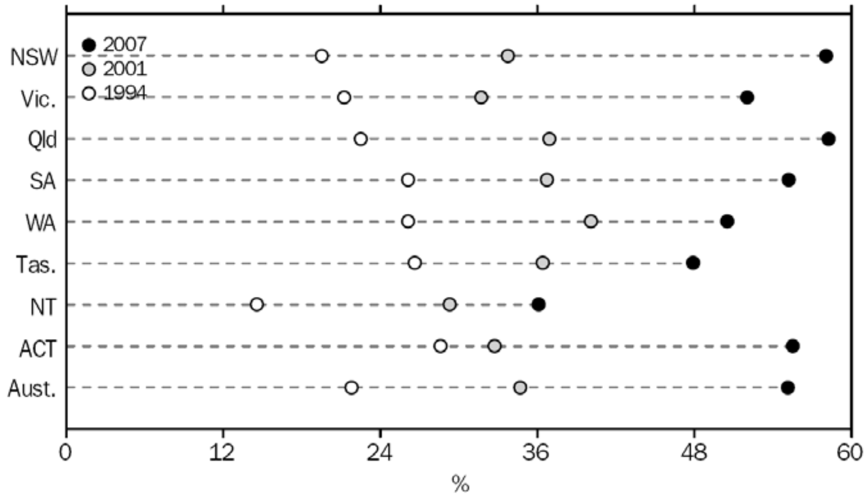
3.3.3 Showerheads

Showerheads are the most significant indoor end use of water in Australian homes and whilst this has lead to a significant uptake of more efficient showerheads through retrofit and exchange programs (e.g. approximately 400 000 homes in Sydney), the on-going conservation potential available through the use of more efficient shower heads remains substantial. Consistent with the RIS (George Wilkenfeld and Associates, 2004) commercial showerheads have not been modelled as part of the residential stock.

Table 3-5 – Showerheads – data sources for water savings

Data Source	Components / Detail	Comment
1. George Wilkenfeld and Associates Model for RIS (2004)	• Water savings by State / Nationally	• Based on changing trends in showerhead efficiency, predicted future sales, predicted declining occupancy ratio and a distribution of usage rates per person per year into the future
2. ABS 4602.0	• Uptake of efficient showerheads	• Latest version has data from 1994, 2001 and 2007 broken down by state as shown in • Figure 3-9
3. WELS database	• Number of models registered	• Shows flow rate of products
4. Sales data (unavailable)		• Would be useful but currently not collected (as it is for dishwashers and clothes washers) • Information on commercial market size from hotels, hospitals, gymnasiums, schools and other non-residential installations would be beneficial

Figure 3-9: Households with water-efficient shower heads installed (ABS 4602.0 (2007), Graph 4.4, p47)



Comparing the data gathered in

Figure 3-9 on the presence of installed efficient showerheads with the predictions generated for the RIS (George Wilkenfeld and Associates, 2004) for both the business as usual scenario (Figure 3-10) and the 'with labelling' scenario (Figure 3-11), the actual installation rate achieved is represented by a yellow star in Figure 3-11.

Figure 3-10: RIS modelled stock of showerheads 'business as usual' (George Wilkenfeld and Associates, 2004)

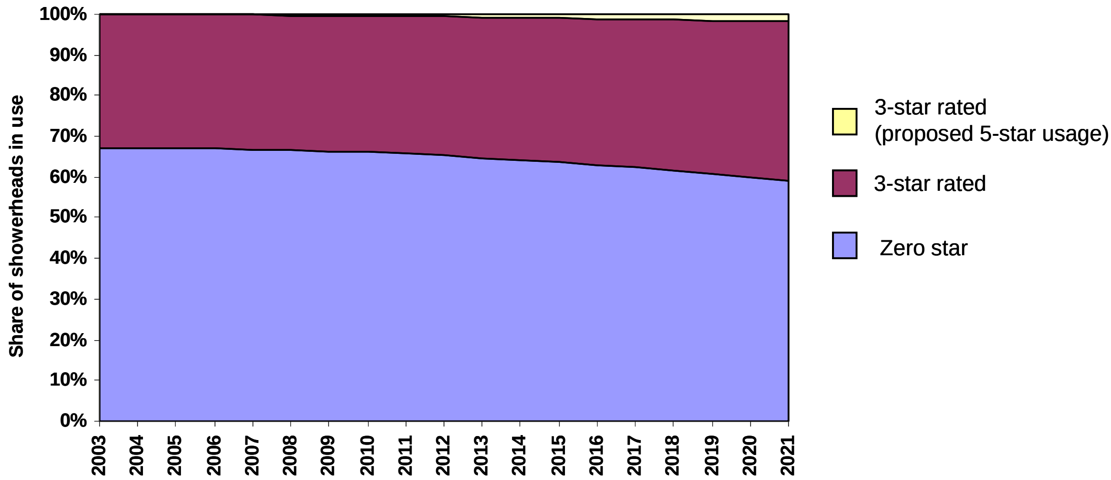
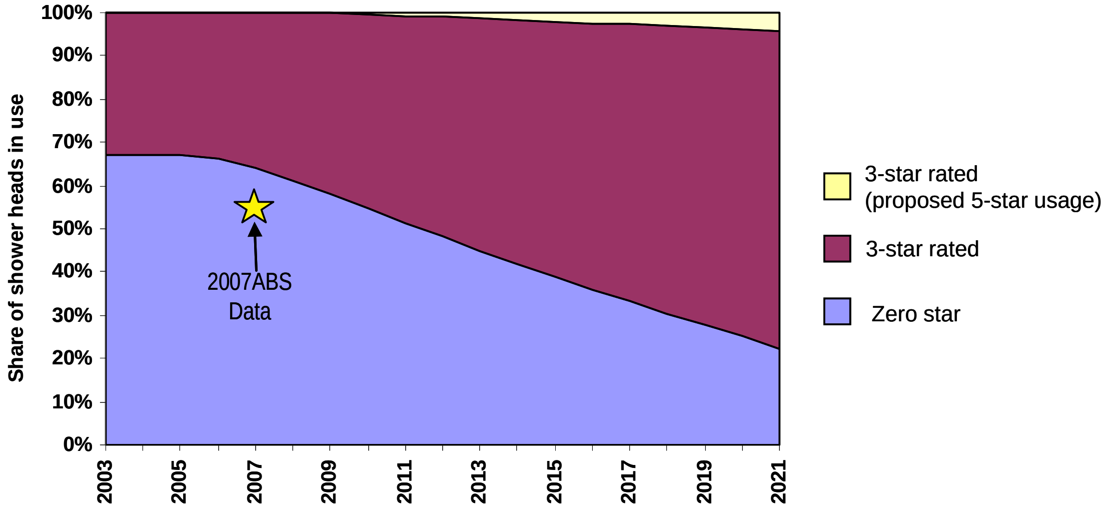


Figure 3-11: RIS modelled stock of showerheads 'with labelling' (George Wilkenfeld and Associates, 2004)



Modelling approach and key assumptions

For the shower savings modelling, the RIS model was used with updated assumptions for efficient showerhead uptake. Assumptions for all scenarios are listed in Table 3-6, Table 3-7 and Table 3-8.

Table 3-6: RIS - Business as usual and 'without WELS' scenario in this report

Time	New or renovated	Showers/ dwelling	Zero star	3-star	5-star
2002	New	1.5	90%	10%	0%
2021	New	1.7	80%	20%	0%
2002	Renovated	1.5	60%	40%	0%
2021	Renovated	1.7	40%	55%	5%

Table 3-7: RIS - With labelling scenario

Time	New or renovated	Zero star	3-star	5-star
2008	New	70%	28%	2%
2011	New	60%	35%	5%
2021	New	45%	45%	10%
2008	Renovated	40%	55%	5%
2011	Renovated	30%	63%	7%
2021	Renovated	20%	70%	10%

Table 3-8: Updated with WELS scenario in this report

Time	New or renovated	Zero star	3-star	5-star
2008	New	10%	90%	0%
2011	New	5%	90%	5%
2021	New	0%	90%	10%
2008	Renovated	20%	80%	0%
2011	Renovated	5%	90%	5%
2021	Renovated	0%	90%	10%

Analysis of confounding factors

Commercial showers: estimated savings from this analysis will be conservative as they do not consider the showers that will be installed in new commercial buildings (e.g. hotels, gymnasiums, workplaces).

3.3.4 Toilets and urinals

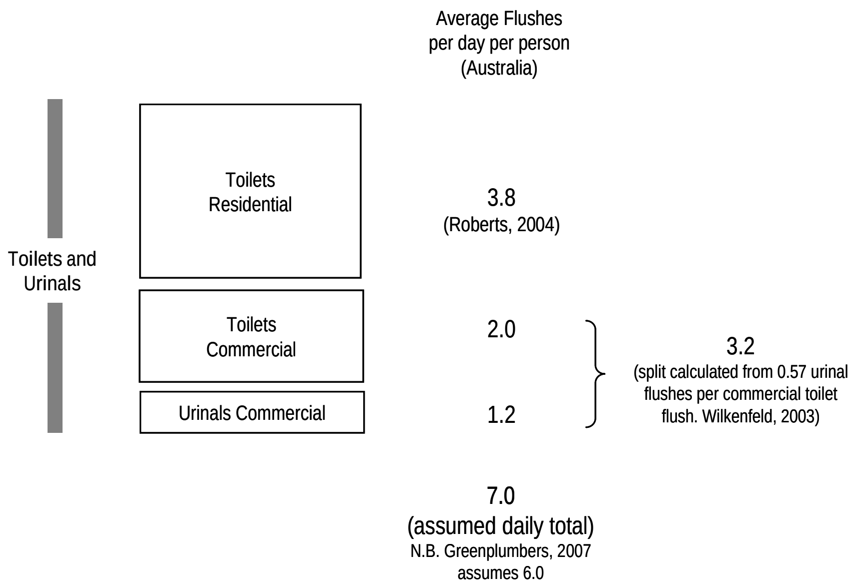
Table 3-9 – Toilets and urinals available data sources

Data source	Components / detail	Comment
1. ISF Toilet Stock Model in "Analysis of Australian opportunities for more water-efficient toilets" (Schlunke et al., 2008)	• Toilet stock model by toilet type • Single flush • 11/6L Dual flush • 9/4.5L Dual flush • 6/3L Dual flush • 4.5/3L Dual flush	• National toilet model, calibrated against ABS 4602.0 (2007)
2.WELS database	• Number of models registered	• Not used for calculating water savings
3. Sales data (unavailable)		• Would be useful but currently not collected (as it is for dishwashers and clothes washers)
4.Urinals: Plumbing Regulation Update	• Estimate urinal sales and water usage of average and efficient urinals	

Modelling approach and key assumptions

The Australia-wide total water consumption due to toilets and urinals was calculated based on a set number of flushes per person per day, and the total population. These flushes were then assigned to either residential or commercial, and in the commercial sector they were assigned to either toilets or urinals. This approach is shown below in Figure 3-12.

Figure 3-12. Approach to estimation of toilet and urinal water use



A toilet stock model was used to estimate the toilet stock over time in the residential and non-residential sectors of Australia. A detailed explanation of these models is given in *Analysis of Australian opportunities for more efficient toilets* (Schlunke *et al*., 2007). The predicted toilet stock was used to calculate the average flush volume, which was used in conjunction with the number of flushes per day per sector to calculate Australia-wide toilet water use.

The only new toilet suites that are allowed under the Australian Standard for toilet cisterns (AS 1172.2—1999) are the 6/3L and 4.5/3L models, so the only impact that WELS can have on the sales of new toilets is the way sales are shared between 3 star and 4 star toilets.

In the original toilet stock model (modelling what would happen under WELS), after the 4.5/3L toilet model was introduced (in 2006), the market share of this model was set to increase gradually until it reached 50% in 2008, and then remain at 50% until 2021. The remaining market share was given to 6/3L toilets. To simulate what would have happened without WELS, it was assumed that the sales of 4.5/3L toilet models would have been negligible (and so all toilets sold were 6/3L models). Figure 3- and Figure 3- show the predicted residential toilet stock for each scenario (with and without WELS). With WELS, over 20% of the toilet stock was predicted to be 4.5/3L models by 2021 (and more than 50% 6/3L models), and without WELS it was predicted that there would be no 4.5/3L models (and over 70% 6/3L models) in the toilet stock by then. The predicted effect of WELS on non-residential toilet stock was similar.

Figure 3-13. Residential toilet stock prediction with WELS.

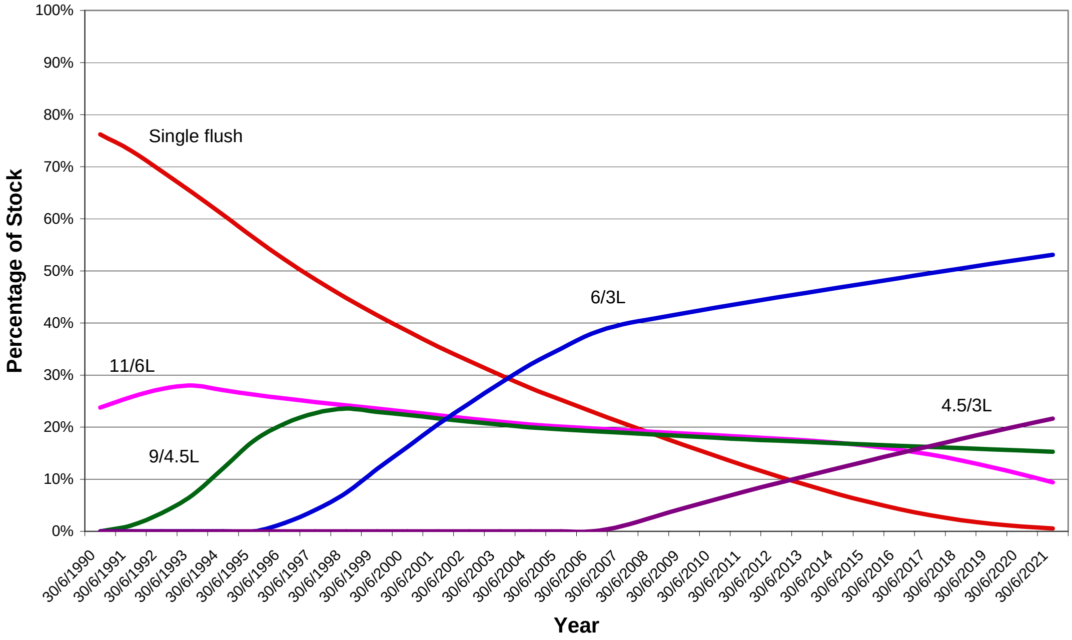
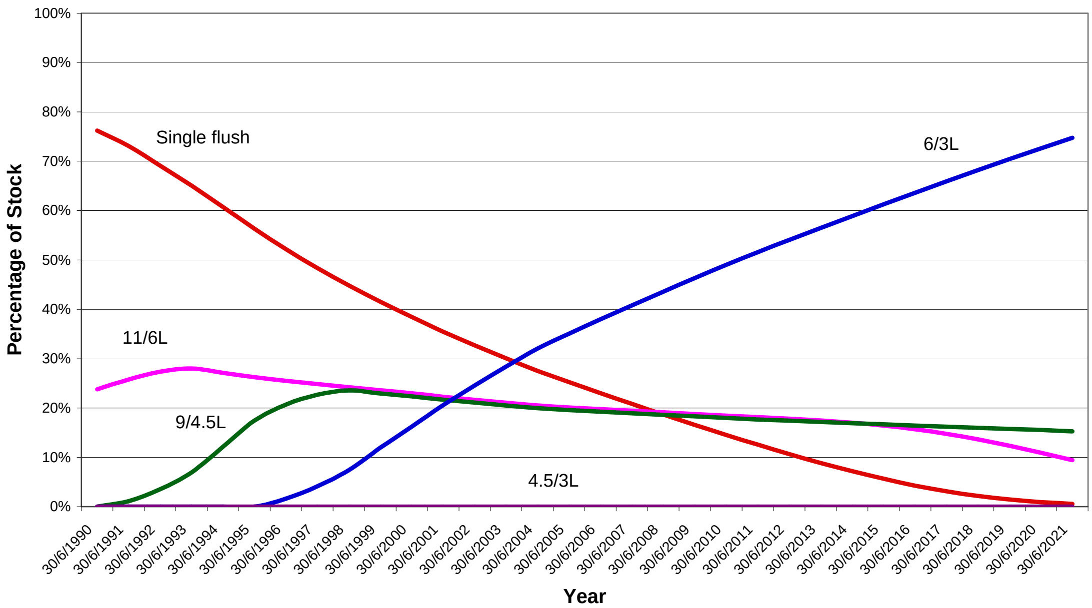


Figure 3-14. Residential toilet stock prediction without WELS.



The toilet water use was calculated using the toilet stock predicted for both cases (with and without WELS) and the difference between these two values was the savings due to WELS.

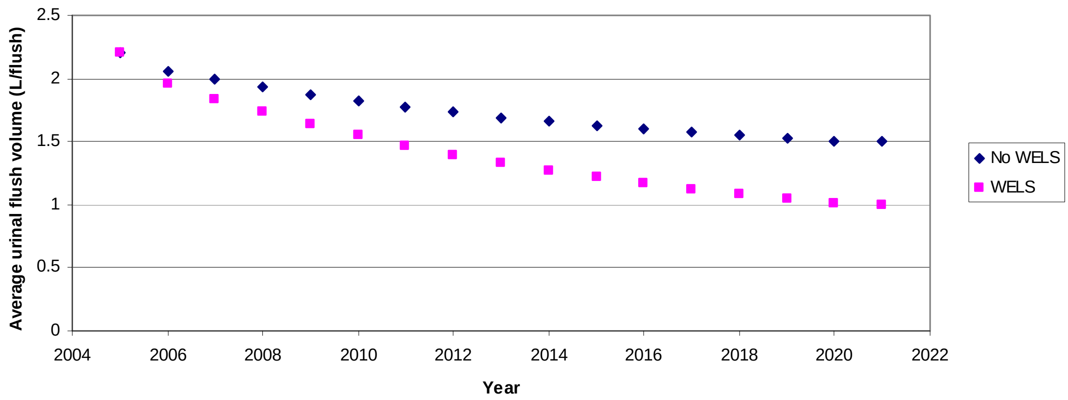
As there was no stock model for urinals, the starting point for the calculation of urinal water savings due to WELS was sales data and the average flush volume of urinals in February 2005 (taken from the Plumbing Regulation News Update released on 15/02/2005 by the Tasmanian Department of Infrastructure, Energy and Resources).

This indicated that 60 000 urinals were sold in 2005 and the average flush volume of these was 2.2L.

To simulate the change in urinal sales over time, the sales were increased at the same percentage per year as the population was predicted to rise (according to ABS 3222.0, *Population Projections, Australia, 2004 to 2101*), reaching 76 000 in 2021.

The average flush volume was assumed to decrease from 2.2L over time. The impact of WELS on the average flush volume of urinals was assumed to be a 0.5L difference by 2021. This is shown in Figure 3-15.

Figure 3-15. Estimated average urinal flush volume over time.



Along with the number of urinals sold each year and the average flush volume of these urinals, the number of flushes per urinal (per day or year) was also necessary to be able to calculate the difference in water use between the WELS and no WELS scenarios. According to the *2005 Building Code of Australia* (Table F2.3, Facilities in Class 3 to 9 buildings), commercial buildings need to have 1 urinal per 25 people. Combining this information with an average of 1.2 urinal flushes per person per day allowed calculation of the daily water use of the urinals sold each year.

Analysis of confounding factors

As for other types of fittings and appliances, the savings calculated in the updated scenario "with WELS" are also influenced by other factors.

Information is readily available on the water saving benefits of replacing a single flush toilet with a dual flush toilet, and rebates are also available for this. However, these campaigns and rebates do not always distinguish between the 3 star and 4 star models, and so while they may impact on the number of new toilet sales, they may not impact on the ratio of 3 star to 4 star toilets sold. For example, the Sydney Water website (www.sydneywater.com.au/SavingWater/WaterWiseProducts.cfm) suggests

> "Using a water efficient dual flush toilet means you can choose to flush only half the water in the cistern. Find out which toilets are water efficient at the Water Efficiency Labelling and Standards (WELS) website. Look for toilets with 6/3 litre dual flush with at least 3-star rating."

Building regulations will not affect the number of new toilets sold but they will affect the proportion of toilets sold that are rated 4 star. For example, BASIX in NSW uses the toilet model to calculate the water score and so dwellings with 4 star toilets will achieve a higher water score than equivalent dwellings with 3 star toilets. In Western

Australia the effect of regulations is even stronger, because the Five Star plus program makes 4 star toilets mandatory for new dwellings.

3.3.5 Taps

There is a significant amount of variability surrounding the estimates of tap water use, resulting from the diversity of uses of taps (bathroom, kitchen, laundry, commercial) and a range of behaviours that are exhibited with regards to duration and flow rate of tap use.

Taps can provide either a flow of water (or 'free flow' use) or provide a volume of water (or 'volumetric use'). As efficient taps only reduce the free flow usages, reduction of the water used by taps is achieved predominantly by reducing the 'free flow' component of use. Volumetric usages, such as filling the sink for washing dishes, will not be reduced through more efficient taps. Free flow uses are estimated to constitute approximately 50% of total tap consumption (Roberts, 2004).

Further complexity in the measurement of tap usage and potential water savings results from the discrepancy between capacity and actual flow rates of taps. From Roberts (2004) and George Wilkenfeld and Associates (2005), it appears that a significant proportion of inefficient tap actual flow rates are already below the capacity flow rates of efficient taps. For example, an inefficient tap with a capacity flow rate of 15 L/min may be only ever used at 6 L/min, and therefore there is little or no advantage from a conversion to an efficient tap which has a capacity flow rate of 7 L/min.

The drought, restrictions and the communication of water efficiency messages to the community is expected to also reduce free flow tap usage, which may also inhibit the potential for water efficient taps to reduce water usage.

This situation is contrasted in the commercial setting where, as reported by the industry stakeholders contacted for this study, water is largely flow dependent. Commercial tap use generally may have higher average flow rates than residential taps because the users are not affected by the price of water. It is therefore expected that tap savings in the commercial setting may be significant, and this is reflected by the focus on installing flow restrictors in the non-residential business programs in Sydney and Melbourne (Roberts, P. pers. comm., 2008).

Even though the potential water savings from efficient taps may be small in each household, and even negligible in many cases where the flow rates are low, the potential for water savings across Australia is still significant because of the large number of taps sold. Across Australia, approximately 1 million taps may be sold every year, leading to a potential for savings from nearly 20 million taps by 2020-2021.

A key assumption in estimating water savings from taps was flow rate. As a result of the only marginal discrepancy between the actual flow rate for taps at different star ratings, all taps were assumed to fall into either of two groups: 0 Star or 3 Star and above. Following George Wilkenfeld and Associates (2005), the actual flow rate was assumed to be 3.5 L/min for Zero Star taps and 3.0 L/min for 3 Star Taps, which corroborated Roberts' (2004) finding that the average flow rate was 3.3 L/min.

In order to capture the level of uncertainty surrounding the input assumptions to the tap modelling, a range of scenarios were modelled.

The achievable water savings were particularly sensitive to the duration of use, and the number of uses of the tap per day. The duration of use was determined by Roberts (2004) as less than 10 seconds for the majority of events. The number of uses per day for residential taps is calculated at approximately 5 uses per tap per day. Based on these assumptions, the water savings from taps are approximately 1.4 GL/a in 2021.

The frequency of use assumption is expected to be the main point of difference between residential and non-residential use. In an office environment, there are likely to be more people per tap. Non-residential tap usage is expected to be approximately 1/8th of total tap consumption (George Wilkenfeld and Associates, 2004) and this would limit the degree to which the increased frequency of use would impact upon the overall consumption of water from taps. There is also a potential for these non-residential tap savings to be less variable than the residential savings as the uses may be more standardised.

An assumption of 10 uses per day for an average tap conservatively incorporates the possible variation from commercial tap usage into a weighted average figure for the residential and non-residential sectors. Based on this assumption, the water savings from taps is approximately 2.8 GL/a in 2021.

Table 3-10 Water savings from taps (ML/a)

Assumptions	2006	2010	2020	2021
Residential (5 uses/tap/day, 10 seconds /use)	79	406	1323	1422
Residential / Commercial (Weighted average 10 uses/tap/day, 10 seconds/use)	158	813	2646	2845

These results for taps imply that the water savings from taps across the country, although small and highly variable on a per tap and per house basis, have the potential to be significant across the country.

The results for taps pose an intriguing question for further research into tap efficiencies and behaviours as to whether, contrary to previous studies Roberts (2004) and George Wilkenfeld and Associates (2005), efficiency measures could in fact provide significant savings across Australia in both the residential and non-residential sectors. Further research, in particular the analysis of results from Smart Metering studies, is required to gain a clearer picture of the savings possible from installing efficient taps in homes and in industry.

3.4 SUMMARY OF WATER SAVINGS

The water savings by product type are shown below.

Figure 3-16 Summary of water savings by product type (ML/a)

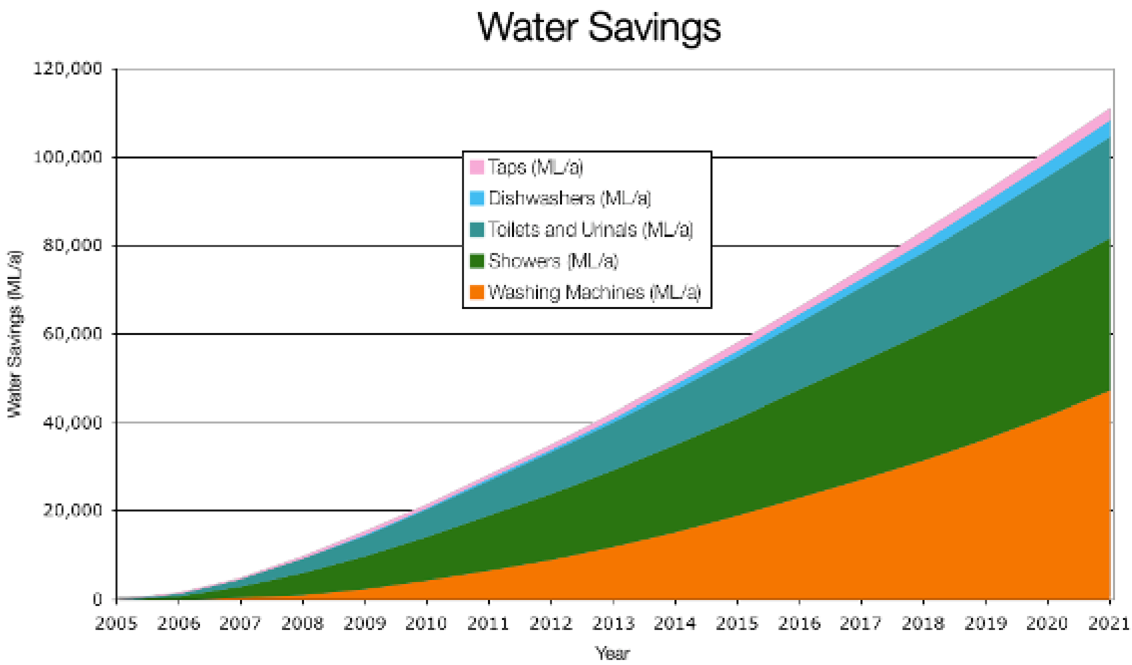


Table 3-11 Summary of water savings by product type (ML/a)

Water Savings	2006	2010	2015	2020	2021
Washing Machines	38	4 254	18 931	41 653	47 255
Dishwashers	30	372	1 424	3 339	3 822
Toilets and Urinals	446	6 304	13 820	21 289	22 718
Showers	850	9 794	22 132	32 572	34 460
Taps	158	813	1 694	2 646	2 845
Total	1 457	20 894	56 049	97 729	106 923

4 Cost and benefits due to WELS

4.1 OVERVIEW OF METHODS AND DATA SOURCES

A range of quantitative and qualitative methods have been applied to measuring the costs and benefits due to WELS. Most of the quantified impacts in this study have been analysed using market prices and projections of various registration and sales volumes. Where costs have not been possible to quantify, a qualitative discussion on impacts (including distribution of impacts) has been included.

Key approaches to measurement include:

- Interviewing industry stakeholders and DEWHA, to obtain direct estimates of costs.
- Analysis of trends in registrations and sales data, where available. However, as WELS has been in operation for less than two years, information on which to base estimates of future trends is limited.
- Price and wage data obtained from various sources including sales data (for washing machines and dishwashers), energy and water retailers, and the ABS.

Table 4-1 summarises the sources of data and the modelling approaches used to estimate the parameters required to analyse each cost or benefit.

Table 4-1: Data sources used for cost and benefit estimates

Cost or benefit	Parameters required	Data source or modelling approach	
		Measurement of WELS to date	Estimations / projections
WELS administration costs	Costs	• Supplied by DEWHA	• Supplied by DEWHA
WELS registration fees	Registration fee amount	• $1500 / model family	• Assume fixed in real terms
	Registrations of models, families, and model additions	• WELS registration database	• Trends in WELS registration databases and WELS registration tracking spreadsheets • WELS RIS • Informal interviews
Other registration costs	Time taken to fill in registration form	• Data from WELS registration database, informal interviews (qualitative)	• Examine trends • Assume improves over time
	Proportion of applications requiring returning	• Data from WELS registration database, informal interviews (qualitative)	• Examine trends • Assume improves over time
	Other impacts due to timing and duration of application process	• Informal interviews with stakeholders (qualitative)	• N/A
	Staff and overhead rates	• ABS data on wages and salaries in the Manufacturing Industry	• Assume fixed in real terms
Additional labelling costs	Costs of printing and affixing labels	• As for estimated	• WELS RIS • Informal interviews
	Units labelled per year	• For CWM and DWM, historical sales data • For toilets, stock model • Informal interviews	• Examination of trends of sales • For toilets, stock model
Additional testing costs	Price of testing in addition to that already required or conducted	• Estimated	• WELS RIS • Informal interviews
	Proportion of models tested internally/ externally	• Informal interviews	• Informal interviews
Change in wholesale product cost	Price distribution of product range	• Assume cost pass through (see retail cost)	• Assume cost pass through (see retail cost)
Additional retailers' costs	Retailers cost	• Informal interviews	• Informal interviews
Change in retail product cost	Price distribution of product range	• For CWM and DW, sales data • Informal interviews	• For CWM and DW, examine trends • Informal interviews
Reduced water bill payments (consumers)	Water tariffs (see section 4.7)	• Weighted average Australian tariff	• Assume constant linear rate of real growth
	Water savings	• Estimated	• Estimated
Reduced energy bill payments (consumers)	Electricity and gas tariffs	• Weighted average Australian tariffs	• Assume constant linear rate of real growth
	Electricity and gas savings	• Estimated	• Estimated
Reduced operating costs (water businesses)	Electricity and gas tariffs	• Weighted average Australian retail peak tariffs	• Assume constant linear rate of real growth
	Energy savings	• Estimated	• Estimated
Reduced greenhouse gas impact	Greenhouse gas intensities	• Australia-wide weighted greenhouse gas intensities	• Assume constant (conservative)
	Cost / CO_2-e	• Range of costs used	• Assume constant in real terms (conservative)

4.1.1 Discount rates

There is debate about how to choose the appropriate discount rate in benefit-cost analysis, to best reflect how the net costs of public policy or program displace investment, consumption, or a combination of the two. Harrison (2007), in a presentation to the OBPR workshop on choosing the discount rate, noted that:

- central agencies choose around 7-10% real (approximately before-tax return on investment – reflecting the opportunity cost of displaced investment)
- line agencies choose around 3-3.5% real (before-tax real government rate)

Various Australian and state government regulatory agencies provide guidelines about suggested discount rate for benefit-cost analyses. For example, consistent with the observations by Harrison (2007):

- the OBPR suggests an annual real discount rate of 7% (OBPR 2007), which includes a premium for risk, but that sensitivity analysis should be conducted at higher and lower discount rates
- the Victorian Competition and Efficiency Commission recommends the use of the risk-free opportunity cost of capital, which the Victorian Government Department of Treasury and Finance estimates at 3.5% real (VCEC 2007).

The recent *Stern Review Report on the Economics of Climate Change* used real discount rates of between 1.6% and 2.1%, derived from different economic scenarios. This choice of discount rates has been criticised, because they are significantly lower than those commonly used in public policy evaluation (see, for example, Baker et. al. 2008). However, Quiggen (2006, p.18) in a review of the criticisms of Stern's discounting, concludes that:

> "Stern's choice… is primarily the result of applying the standard utilitarian view that all people count equally. If this view is accepted, the pure rate of time discount, reflecting the probability of social extinction, must be close to zero".

In consultation with DEWHA, all results of cost-benefit analysis are reported at five different discount rates, to reflect the range described above: 1.6%, 3.5%, 4%, 7% and 10%.

4.2 WELS ADMINISTRATION COSTS

There are a number of activities undertaken by DEWHA to develop and administer WELS. Costs identified in the 2004 RIS (George Wilkenfeld and Associates 2004) include those resulting from:

- ongoing promotion and awareness, awards, updating information materials
- development of technical standards
- regulatory, compliance and enforcement activities
- database website and administration
- staffing and overheads.

The key source of data for identifying administration costs is the *Review of Cost*

Recovery under the Water Efficiency Labelling and Standards (WELS) scheme, conducted by KPMG (2007) for DEWHA.

The accounting of costs differs slightly for cost-recovery and cost-effectiveness analysis. When assessed from a cost-recovery perspective, not all elements of policy and program design are included in the assessment of total administration costs. However, for the purposes of cost-effectiveness analysis (which is based on assessing whole-of-society costs), these have been included. Other elements required for cost recovery purposes but not included in the cost-effectiveness analysis are interest payments (which are effectively taken into account using the NPV approach for all costs and benefits), and adjustments for inflation (which is not necessary as all analysis is conducted assuming real values – 2007 prices).

The actual costs (nominal terms) incurred since the commencement of the scheme in 2003-2004 until 30 September 2007 were $2 332 357. A breakdown of scheme costs by activity type (measured or projected) was not available at the time of the study (KPMG 2007).

The ongoing administration costs of the scheme, as projected in the 2004 RIS, are $790 000 per year. However, KPMG (2008) noted that in future years, costs are likely to be higher than those estimated in the RIS because the RIS estimates do not allow for enforcement activities (eg. check-testing of laboratory certificates), which have not yet commenced. DEWHA (January 2008, pers. comm.) estimates that enforcement activities are likely to cost $100 000 per year from the financial year 2008-2009.

Administration costs into the future will also depend on registration numbers and any changes to the existing scheme. The projected costs for scheme administration, including breakdown of cost components, is shown in Table 4-2. The activity contributing most to expected costs is an increase in staffing and overheads, which are expected to increase from 4.0 ASL (average staffing level) in 2007-2008 to 12.0 ASL in 2008-09.

Table 4-2: Summary of estimated WELS administration costs for 2008-2009.

Administration cost component	Amount
Ongoing promotion and awareness, awards, updating information materials, etc	$70 000
Development of technical standards	$85 000
Regulatory, compliance and enforcement activities - monitoring, inspections, etc	$60 000
Regulatory, compliance and enforcement activities - investigations, prosecutions, etc	$40 000
Database and website and administration	$95 000
Staffing and overheads @ 12.0ASL	$1 320 000
Total Year 2008-2009	**$1 670 000**

A summary of the NPV of administration costs of the scheme, from its commencement in 2003-04 to 2020-21, are in Table 4-3.

Table 4-3: Summary of Net Present Value of administration costs for WELS (2007 dollars)

	Costs incurred to date	Projected (2004 RIS estimates)	Projected (2008 DEWHA estimates)	Total
Source	KPMG (2007). Includes estimation of costs for period Oct 2007 to June 2008.	*RIS assumptions (at 2003)*	DEWHA estimates (at 2008)	Based on DEWHA estimates
Period	2003-2004 to 2007-2008	*2008-2009 to 2020-2021*	2008-2009 to 2020-2021	2003-2004 to 2020-2021
$	$406 084 (2004 - 2005) $656 095 (2005 - 2006) $1 051 521 (2006 - 2007)	*$790 000 per year*	$1 670 000 per year	
NPV ($000) at discount rate				
1.6%	$2 137	*$9 921*	$20 015	**$22 152**
3.5%	$2 165	*$8 708*	$17 468	**$19 633**
4%	$2 173	$8 425	$16 875	**$19 048**
7%	$2 218	*$6 987*	$13 861	**$16 079**
10%	$2 218	*$5 896*	$11 578	**$13 843**

4.3 REGISTRATION COSTS

Suppliers (manufacturers and importers) undertake a number of activities to register products under WELS. These include:

- **Testing to determine star rating**: Suppliers must provide laboratory test reports demonstrating that the water consumption of the products has been tested in accordance with relevant standards. Costs associated with testing for WELS are those incurred *in addition* to testing required or undertaken for other purposes, such as energy testing and testing for WaterMark certification.

- **Online registration:** Plumbing and sanitary ware products are registered through the WELS online registration system, and washing machines and dishwashers registered through the online energy rating database. Online registration requires the preparation of various attachments and filling in online forms.

- **Payment of registration fee**: The registration fee payable is $1500 per applicable registration.

The analysis of registration costs depends on:

- How many registrations have occurred to date.
- Projections of future registration numbers.
- The type of registration – only single models, family registrations or sets of minor products require a separate test and attract registration fees. However, although family additions do not generally require separate testing or certification to the original family or single registration, there would be some costs associated with document preparation.
- The time taken to successfully complete the registration process, which also depends on the extent of amendments required after the original online submission.

4.3.1 Registration numbers

Information about all models currently registered is available from the online WELS product registration database. However, this database is not used by WELS administrators to track the registration process (eg. returns and amendments) for each individual model. Instead, WELS administrators track registration activities on a separate data system. DEWHA (pers. comm.) has indicated that although this internal system provides accurate records about number and date of successful registrations, the record of returns required is partial and likely to under-report returns and amendments required. Nevertheless, this system is the best available source of information about model registration history and has thus been used for this study.

From July 2005 to November 2007, DEWHA received 2683 registrations. The breakdown of the registrations by registration type, product type and year is shown in Table 4-4.

Table 4-4: WELS Registrations by type

Registration type	Year	CWM	DWM	FC	LE	S	TE	UE	Total
Test load (requires test and fee) (single, family, set of minor products)	2005-2006	92	100	2	51	136	230	11	622
	2006-2007	119	82	17	73	120	176	25	612
	2007-2008*	37	28	12	25	20	54	11	187
	SUBTOTAL	**248**	**210**	**31**	**149**	**276**	**460**	**47**	**1421**
Additions (do not require test or fee)	2005-2006	1	3	0	81	139	184	5	413
	2006-2007	4	8	20	66	132	192	4	426
	2007-2008*	3	0	8	42	33	87	0	173
	SUBTOTAL	**8**	**11**	**28**	**189**	**304**	**463**	**9**	**1012**
Other (withdrawn, incorrect, not recorded)	2005-2006	9	4	1	9	35	85	0	143
	2006-2007	19	26	2	18	10	24	2	101
	2007-2008*	1	0	0	0	1	4	0	6
	SUBTOTAL	**29**	**30**	**3**	**27**	**46**	**113**	**2**	**250**
TOTAL	2005-2006	102	107	3	141	310	499	16	1178
	2006-2007	142	116	39	157	262	392	31	1139
	2007-2008*	41	28	20	67	54	145	11	366
	TOTAL	**285**	**251**	**62**	**365**	**626**	**1036**	**58**	**2683**

* to 30 November 2007 Acronyms as in list of Abbreviations on page ix (for Clothes Washing Machine; Dish Washing Machine; Flow Controller; Lavatory Equipment; Showers; Tap Equipment; Urinal Equipment respectively).
Source: analysed from WELS registration tracking spreadsheets

Unsurprisingly, the rate of registrations increased in the months prior to July 2006, when the scheme commenced (see Figure 4-1). These trends in registrations were used to project the number of registrations in the future, updating the RIS assumptions where appropriate:

- For toilets, showers, urinals and tapware, registrations are assumed to continue at a rate equivalent to that of the period July – November 2007, as the grace period for these products ended in December 2006. This effectively assumes that during this period suppliers were registering new models only, and not unlabelled models available for sale prior to December 2006.

- For washing machines and dishwashers, registrations are assumed to continue at the rate indicated by the 2004 RIS. As the grace period for these products applied until December 2007, recorded registrations to November 2007 are an indication of the initial test load, not of ongoing trends.

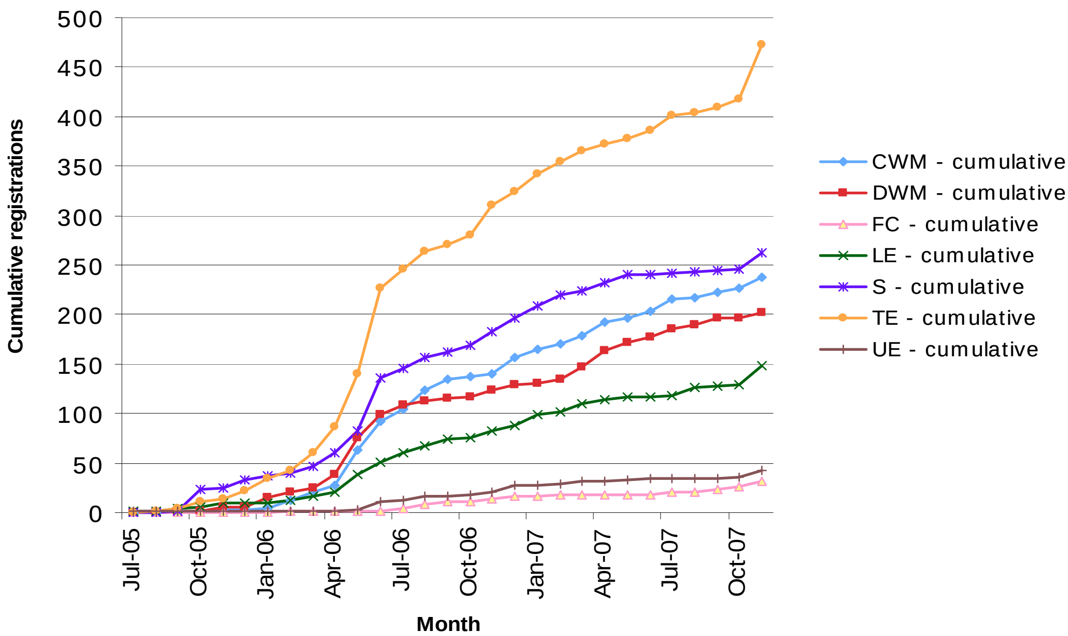
The original RIS assumptions, selected recorded registration numbers and projections of registration numbers used in this analysis are provided in Table 4-5. For plumbing products and sanitaryware (LE/UE), the conservative approach to projections has been to use the higher of that indicated by trends and the RIS assumptions. Where possible, the projected registration numbers have been checked with suppliers or supplier groups. The exact number of future registrations by product type is uncertain, and will depend at least in part on the incentives posed by current or future registration fee structures.

Table 4-5: Comparison of WELS registrations, projections from RIS and used in this study

Source	Year	CWM	DWM	LE	S	TE	UE	Total
RIS assumptions	Initial test load[a]	300	200	100	200	35[b]	23	985
	Annual test load	45	30	15	30	12	23	155
Recorded registrations 2005-2006 to 2007-2008	Test load 2005-2006 to 2006-2007	156	129	88	199	351	27	966
	Annualised test load from Jul -Nov07	79	48	34	19	89	7	79
	Annualised additions from Jul-Nov07	n/a	n/a	91	65	139	0	10
Projections used in this study	Annual test load	45	30	34	30	89	23	
	Annual additions	0	0	91	65	139	0	

n/a: not applicable due to insufficient data points; highlighted areas indicate assumptions used for projections in this study (whether RIS assumptions or recorded observations over the initial period of WELS).
[a] Number of registrations that are singles, families, or sets of minor products. [b] Included flow controllers. See list of Abbreviations on page ix for acronyms.

Figure 4-1: WELS cumulative registration numbers over time



4.3.2 Testing costs

WELS requires testing of models in addition to that which is required or would have been undertaken due to other standards, regulations, programs or as part of the general process of model development.

Interviews conducted for this study revealed that not all testing is conducted by external laboratories. Manufacturers of clothes washers and dishwashers indicated that they operate their own laboratories as part of model testing and development, with a sample of models sent to external labs in order to calibrate and verify their own internal testing processes. Some testing laboratories suggested that often the same model would be returned for testing several times, with minor changes each time, until the desired star rating is achieved. A proportion of toilets, particularly those supplied by larger manufacturers, are also tested in-house as part of usual product development processes. However, it is likely that the majority of taps and showerheads are tested by external laboratories.

In the analysis of testing costs, it has been assumed that only those models which are tested externally result in additional costs for suppliers. Although there may be some initial costs required to establish WELS testing processes in internal laboratories, WELS test requirements are unlikely to add significantly to the ongoing running costs of internal labs.

Estimates of the testing cost per model are provided in Table 4-6. Key differences in assumptions from the 2004 RIS include:

- The 2004 RIS assumed testing costs of $1500 per model across all other product types. However discussions with suppliers indicated that these were an overestimate of how much testing laboratories charged per test per model, for plumbing products and sanitaryware.
- The 2004 RIS assumed zero testing costs for clothes washing machines and dishwashers, additional to that which is already required by energy labelling schemes. However, industry participants and laboratories have reported that in practice, there are additional testing costs for clothes washing machines due to the specific characteristics of water testing requirements.

Based on the testing costs provided in Table 4-6 and projections of registration numbers provided in Table 4-7, the NPV of testing costs associated with WELS to 2020-2021 are estimated at a total of $2m (7% discount rate). This estimate is an analysis of direct testing costs only, as industry stakeholders interviewed for this study did not report any specific issues or time delays with dealing with external testing laboratories.

Table 4-6: Testing costs for equipment types

		CWM	DWM	LE	S	TE	UE
RIS assumptions	Additional testing costs $/model	$0	$0	$1500	$1500	$1500	$1500
Estimates used in this study	Testing costs – external	$3000	$0	$800	$500	$500	$800
	% of models tested externally	50%	50%	70%	100%	100%	100%

See list of Abbreviations on page ix for acronyms.

Table 4-7: Projected costs associated with testing (NPV at 1.6%, 3.5% and 7% discount rates)

NPV ($000) total		CWM	DWM	LE	S	TE	UE	Total
Costs to 2005 to Nov 2007 based on actual registration numbers		$354	$0	$73	$127	$230	$30	**$813**
Costs from Dec 2007 to 2020—2021 based on projected registration numbers	1.6%	$813	$0	$221	$124	$513	$77	**$1747**
	3.5%	$710	$0	$192	$109	$445	$68	**$1524**
	4%	$686	$0	$185	$106	$430	$66	**$1472**
	7%	$564	$0	$152	$88	$350	$55	**$1209**
	10%	$472	$0	$126	$74	$290	$47	**$1009**
Total	1.6%	$1,167	$0	$294	$251	$742	$106	**$2560**
	3.5%	$1,064	$0	$265	$236	$675	$97	**$2338**
	4%	$1,040	$0	$259	$233	$659	$95	**$2286**
	7%	$918	$0	$225	$215	$580	$85	**$2022**
	10%	$826	$0	$199	$201	$519	$77	**$1822**

See list of Abbreviations on page ix for acronyms.

Parameter sensitivity: testing costs per unit

Estimations of testing costs depend on assumptions about testing costs per unit. For example, if not only showers and tapware but also all clothes washers and toilets were tested by external laboratories (or if the cost of testing externally was the same as testing internally), the total testing costs (2005—06 to 2020—21) would be in the order of NPV $2.8m (at 10% discount rate) to $4.0m (at 1.6% discount rate), compared to $1.8m to $2.6m as calculated above.

4.3.3 Registration fees payable

This analysis has assumed that registration fees will remain payable at $1500 (2007 dollars) per model, family or set of minor products. It has been assumed that a registration fee for additions will not be introduced during the period to 2020—2021. The NPV of registration fees/revenue (excluding flow controllers) is estimated to be $4.7m to 2020—2021 as shown in Table 4-8.

Table 4-8: Actual and projected registration fee costs/revenue

NPV ($000) total		CWM	DWM	LE	S	TE	UE	Total
Costs to 2005 to Nov 2007 based on actual registration numbers		$354	$296	$197	$381	$689	$56	**$1,971**
Costs from Dec 2007 to 2020—2021 based on projected registration numbers	1.6%	$813	$542	$591	$372	$1,538	$144	**$4,000**
	3.5%	$710	$473	$514	$327	$1,336	$127	**$3,488**
	4%	$686	$457	$497	$317	$1,289	$123	**$3,369**
	7%	$564	$376	$406	$264	$1,050	$103	**$2,763**
	10%	$472	$314	$337	$223	$870	$88	**$2,304**
Total	1.6%	$1,167	$837	$788	$753	$2,227	$199	**$5,971**
	3.5%	$1,064	$769	$711	$708	$2,025	$182	**$5,459**
	4%	$1,040	$753	$693	$698	$1,978	$179	**$5,340**
	7%	$918	$672	$602	$645	$1,739	$159	**$4,734**
	10%	$826	$610	$534	$604	$1,558	$144	**$4,275**

See list of Abbreviations on page ix for acronyms.

Parameter sensitivity: fees per registration

Estimations of registration fees / revenue depend on the structure and size of the registration fee. In turn, the registration fee structure could influence the number of registrations. It is beyond the scope of this study to analyse all possible future fee structures.

However, to illustrate the sensitivity of fee costs/revenue to the registration fee amount, if the registration fee per original registration was $2500, family additions remain free of charge, and the projected number of registrations remain as above, then the total registration fee costs/revenue (2005—2006 to 2020—2021) would be $7.8m (at 10%) to $11.0m (at 1.6% discount rate).

4.3.4 Registration process costs

In addition to the registration fee, suppliers also incur costs in terms of the resources required to successfully complete the registration process. The majority (but not all) suppliers interviewed for this study suggested that the online registration process has been problematic for several reasons, including that registration requirements, including for additional documentation, are not clearly specified.

The WELS online database structure was developed and maintained by consultants (EES and WorthIT), who initially adopted the system from energy labelling registrations. DEWHA and industry participants contacted for this study indicated that the initial online registration form was problematic and allowed suppliers to submit non-compliant applications. However, data screening has always been a feature of the registration system, and this feature (amongst others) has been continually revised and upgraded over the past three years. Nevertheless, it is not possible to make all online fields verifiable.

Consequently, not all registration applications successfully meet the registration requirements when first submitted. Registration applications are returned for a number of reasons, including incomplete completion of online fields that cannot be validated electronically, incorrect or insufficient documentation (eg. test reports that are incorrect), and non-payment (see section 4.3). DEWHA's internal registration tracking system indicates that since registrations commenced, approximately 29% of applications required returning at least once.

However, the percentage of applications requiring returning does not appear to have decreased since the scheme commenced (see Figure 4-2). Although increased familiarity with registration requirements and further improvements in the online system are expected to increase the rate of compliant applications, for the purposes of this study a conservative approach was adopted, to not underestimate costs. In the future, it is estimated that the percentage of applications requiring returning remains the same as for the period of the scheme to November 2007 as shown in Table 4-9.

Figure 4-2: Percentage of application that required returning by type

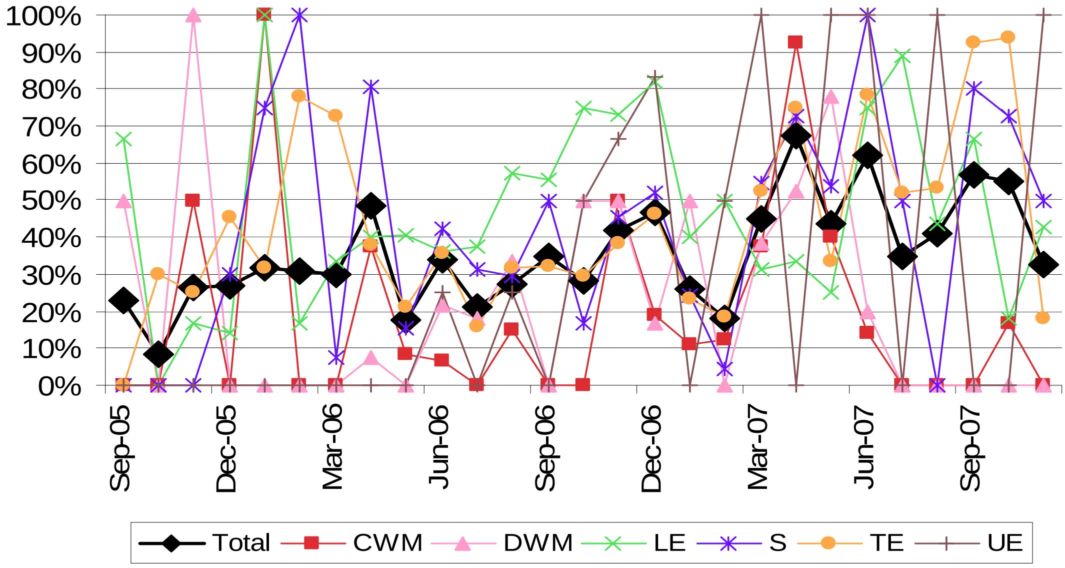


Table 4-9: Average percentage of applications Jul 2005 to Nov 2007 that required returning

	CWM	DWM	LE	S	TE	UE	Total
Percentage of applications requiring returning at least once, July 2005 to Nov 2007 (of approved registrations)	13.4%	17.3%	35.9%	32.9%	31.4%	35.1%	29.1%

See list of Abbreviations on page ix for acronyms.

It is difficult to conclusively estimate the supplier staff time attributable to WELS registration tasks. A representative survey was not conducted for this study, and the stakeholders contacted reported a range of time requirements. For the first registration application of singles, families or sets or minor products, conservative (low) estimates of 7 hours for washing machines and dishwashers and 14 hours for toilets, taps and showerheads have been adopted (the lower hours for washing machines and dishwashers reflecting possible overlaps with energy labelling requirements for whitegoods). Each application for registration of additions is estimated to take a further 3 hours. Applications which are not successful the first time are estimated to take a further 4 hours each to resubmit. The time costs of registration are summarised in Table 4-10.

Table 4-10: Time cost of registration process to suppliers - actual to November 2007, and projected to 2020—2021

NPV ($000) total		CWM	DWM	LE	S	TE	UE	Total
Costs to 2005 to Nov 2007 based on actual registration numbers		$67	$58	$107	$194	$335	$23	$785
Costs from Dec 2007 to 2020-21 based on projected registration numbers	1.6%	$155	$106	$320	$187	$748	$58	$1574
	3.5%	$135	$93	$278	$165	$649	$51	$1372
	4%	$130	$90	$269	$159	$627	$50	$1324
	7%	$107	$74	$219	$132	$510	$42	$1085
	10%	$90	$62	$182	$112	$423	$36	$903
Total	1.6%	$222	$164	$427	$382	$1,083	$81	$2359
	3.5%	$203	$151	$385	$359	$985	$74	$2156
	4%	$198	$148	$375	$354	$962	$73	$2109
	7%	$175	$132	$326	$327	$845	$64	$1869
	10%	$157	$120	$289	$306	$758	$58	$1688

Note: These estimated using an average time cost rate of $25/hour (based on data from ABS 6302.0 on the average weekly earnings of the Manufacturing Industry for the four quarters ending August 2007) and an overhead rate of 0.5. See list of Abbreviations on page ix for acronyms.

Parameter sensitivity: time spent on registration process

Estimations of the total cost to suppliers and manufacturers of registration depends on various factors, including the cost of staff time spent on registration processes.

For example, if on average 28 hours of staff time are required for an initial registration, 6 hours for each addition and 8 hours to process each returned registration to completion (rather than 7-14, 3 and 4 hours estimated as above), the total time cost of registration process to suppliers and manufacturers (2005—2006 to 2020—2021) would be NPV $4.2m (at 10% discount rate) to $6.0m (at 1.6% discount rate), compared to $1.7m to $2.4m as estimated above.

4.3.5 Other potential registration issues and costs

Suppliers interviewed for this study identified a number of other, indirect costs associated with the registration process.

In addition to the staff time taken to complete registration process, suppliers noted that delays and uncertainties about how long the approval process would take hampered product advertising and marketing opportunities. They noted that waiting for feedback (claims range from weeks to several months) from WELS administrators is problematic, particularly if there are several rounds of amendments required for each registration. In contrast, DEWHA (pers. comm.) noted that registrations requiring amendments are usually returned to applicants within 2 or 3 weeks. However, because data on the number of returns for each application or the time periods between application receipt, return and approval are not collected, it has not been possible to quantify or verify this issue in this study.

Another concern raised by many industry stakeholders is the lack of cohesion between WELS and the WaterMark scheme, the latter of which aims primarily to safeguard public health and safety. In particular, stakeholders were concerned that the validity and effectiveness of both schemes are compromised because WaterMark certification is currently not required for WELS registration approval. Industry stakeholders are concerned that as a result, some suppliers are obtaining WELS registration for products that would not pass the WaterMark standard. They argued that, as per the recommendation made by the recent House of Representatives Standing Committee on Environment and Heritage inquiry into regulation of plumbing product quality in Australia, "the Australian Government [should] act to make the necessary legislative changes to establish WaterMark Certification as a prerequisite for compliance with the Water Efficiency Labelling Standards Scheme". Nevertheless, although this issue was raised by many industry stakeholders, it was beyond the scope of this study to quantify the potential costs associated with the inconsistency between the WELS and WaterMark certification schemes.

A third area of concern noted by industry stakeholders is the lack of enforcement and compliance activities undertaken to date. Lack of clarity about expected enforcement can potentially inhibit innovation. Furthermore, if compliance levels are low, both the costs and effectiveness of WELS will be lower than estimated above.

Industry stakeholders also noted an earlier lack of flexibility in method of payment. Initially, payments could be made by cheque only and several stakeholders reported difficulties (and consequently delays in registration) in raising cheques without invoices. More recently, however, online credit card payment facilities have been implemented.

4.4 LABELLING COSTS

WELS requires that each unit sold to customers carries a specified water efficiency label. The assumptions about labelling costs per unit made in the RIS (10c for washing machines and dishwashers and 20c for other products) were checked with a small sample of industry stakeholders who confirmed the labelling costs of were generally realistic. However, labelling costs per unit vary between suppliers, with some reporting higher labelling costs (for example, due to more than one label requiring affixing to toilets comprising different parts) or lower labelling costs (if productions scales are large). Labelling costs are summarised in Table 4-11.

Table 4-11: Net Present Value labelling costs

NPV ($000)		CWM	DWM	LE	S	TE	UE	Total
Total (based on estimated sales numbers)	1.6%	$1184	$499	$2096	$2061	$3092	$186	$9119
	3.5%	$1045	$437	$1847	$1816	$2725	$164	$8033
	4%	$1013	$422	$2258	$1760	$2639	$159	$8250
	7%	$848	$349	$2258	$1471	$2206	$133	$7265
	10%	$725	$295	$2258	$1253	$1879	$113	$6522

See list of Abbreviations on page ix for acronyms.

Parameter sensitivity: labelling costs per unit

Estimations of the total labelling cost to suppliers and manufacturers depends on the labelling cost per unit. Some industry stakeholders reported that the 10c to 20c per label estimated in the RIS were high estimates, whereas others reported that the estimates are low, and do not take into account the additional labour costs of labelling. Some stakeholders reported labelling costs, including labour, closer to 50c or $1 per label. If each model sold cost 50c to label, the estimated total NPV labelling costs (2005—2006 to 2006—2007) at 2007 dollars would be $19m (at 10% discount rate) to $27m (at 1.6% discount rate).

4.5 Retailers' costs

Limited information was available from retailers for this study, and therefore costs have not been quantified. However, the retailers contacted for this study indicated that due to an unexpectedly lengthy registrations and approvals process, when unlabelled stock was sold off by the end of 2007, there were insufficient new products and models eligible to be sold, leading to a gap in product availability. They also noted reduced margins during the period prior to the introduction of WELS due to selling unlabelled stock at lower prices.

4.6 Additional purchase costs

There are two ways in which WELS could increase purchase costs for customers:

- encouraging a higher rate of turnover of stock, resulting in greater sales numbers.
- if customers choose, due to WELS (and interrelated programs) to purchase higher star rating products, and these products are relatively more expensive, their purchase cost would be higher.

4.6.1 Sales numbers

As discussed in chapter 3, it is possible that providing information to potential customers about the water efficiency of products may encourage them to replace their existing products sooner than what would otherwise be the case. However, there are a number of reasons why WELS may have short-term but not substantial long-term impacts on overall sales numbers:

- There are many product characteristics which influence customer decision in addition to, and possibly priority over, water efficiency. To date there are no studies available which assess the relative influence of water efficiency in customer purchase decisions.
- As discussed in chapter 3, confounding factors such as the drought and rebates may have had a greater influence on purchase decisions than WELS. Although the combination of WELS and these other factors and programs may have slightly increased the rate of turnover of existing stock, any increase is unlikely to be sustained over time.
- Sales numbers may be increasing due to a number of independent factors, such as increased product range of models at different prices with different features (due to overseas supply chains), or rising household incomes. The extent to which WELS further encourages replacement of existing stock is likely to be negligible.

Reflecting the above issues, this study has not assessed purchase cost increases associated with any increases in the total number of sales of products attributable to WELS.

4.6.2 Retail price premiums

It is possible that more water-efficient products are, on average, more costly to manufacture than less water-efficient products (George Wilkenfeld and Associates 2004). Although price relativities between products do not necessarily reflect underlying costs, if higher star rating products are most costly to produce, then this costs could be passed through to customers.

However, WELS is only one factor that influences retail prices, or the availability of models at different prices. For example, several industry respondents suggested that the shifting of manufacturing operations to low cost-base countries has had, and will continue to have, a far greater influence on product prices than WELS or other Australian standards. Furthermore, even if more water-efficient models introduced in response to labelling are initially sold at a price premium, this premium is likely to diminish as the production and/or import of newer and more water-efficient models increases (George Wilkenfeld and Associates 2004).

Taps, showerheads, toilets and urinals

Sales data is not available for taps, showerheads, toilets and urinals. However, for these products, all industry stakeholders contacted suggested that price premiums for higher star rated models were zero or negligible, and that models were available for purchase at a range of prices at each star rating. Other reasons why there are unlikely to be higher product purchase costs due to price premiums include:

- For showers, over 80% of currently approved single, family or sets of minor products are rated 3 star (the highest star rating). Stakeholders interviewed for this study also suggested that most showerheads available and purchased are 3 star. For example, in Western Australia, rebates for 3 star showerheads have recently been removed due to widespread availability and uptake (ref web). Therefore even if price premiums existed, product purchase costs are likely to be insignificant for showers.
- The majority of toilet and cistern combinations currently available on the market are 3 and 4 star. For toilets, industry stakeholders and DEWHA (pers. comm.) suggested that there are no price premiums for 4 star toilets over 3 star toilets, because one of the major market suppliers in Australia was also a leader in developing a 4 star product range.

Washing machines and dishwashers

The original RIS noted that for more complex products such as clothes washing machines and dishwashers, the correlation between water efficiency and manufacturing costs is weak, especially at the beginning of the improvement process (George Wilkenfeld and Associates 2004). However, the RIS assumed a small initial price premium ($15) for more water-efficient clothes washers and dishwashers.

Sales data from 2006 (EES 2008) indicates that the average price of models sold was greater for higher star-rated washing machines and dishwashers (see Figure 4-3 and Figure 4-4; Figure 4-5 and Figure 4-6). However, a range of evidence indicates that higher product costs due to price premiums would be negligible:

- Washing machines and dishwashers are available at a range of star ratings (Figure 4-7) and at a range of prices within each star rating (see Figure 4-8 and Figure 4-9).
- In 2006, on average buyers paid more for 2.5 star machines than 4 or 3 star

machines (see sales-weighted price in Figure 4-3). As illustrated in Figure 4-3, average purchase price at each star rating depends on the number of models available at that star rating, rather than the star rating itself.

- As illustrated in Figure 4-5, there are few top-loading models available at higher star ratings (3.5 and above) and few front-loading models available at lower star ratings (3 and below). There are a range of models available at each star rating at each price band, except for the cheapest models (less than $500). However, it is likely that price, rather than water efficiency, is a major influencing factor in the decisions made by purchasers or suppliers of these models.

- In addition to star rating and price, a key characteristic of washing machines that influences purchaser decisions is capacity. There could be a price premium for higher star rated washing machines if the range of higher-star rated models at different capacities was constrained, and there was a price premium for greater capacity models. However, as illustrated in Figure 4-10: Washing machines – capacity of available models, this is not the case.

- There appears to be a small price premium in terms of the average price of available 4.5 and 5 star washing machines, but industry stakeholders contacted for this study indicated that this price premium is temporary and reflects the fact that there are not yet a wide range of models available at 4.5 and 5 star (possibly due to focus on introducing 4 star models in response to rebates). Stakeholders suggested that as suppliers anticipated demand for higher star rating machines to increase, model ranges would rapidly increase for these star ratings, and the price premium would reduce. Furthermore, as indicated in Figure 4-12, the price premium (sales-weighted) of front-loaders over top-loaders has been decreasing since around 2001.

- For both washing machines and dishwashers, the majority of models across all star ratings are sold at “mid” price ranges ($500-$1000). Sales-weighted prices (Figure 4-3 and Figure 4-4) indicate that customers are not generally paying more for higher star-rated washing machines (except for 5 star, which comprise a small proportion of overall sales).

As demand appears to drive the number of models available at each star rating, and the number of models appears to have a greater influence on price than does star rating, in this study, the higher product purchase costs due to price premiums for higher star rated products has been assumed to be zero.

Figure 4-3: Washing machine sales in 2006 and prices by star rating

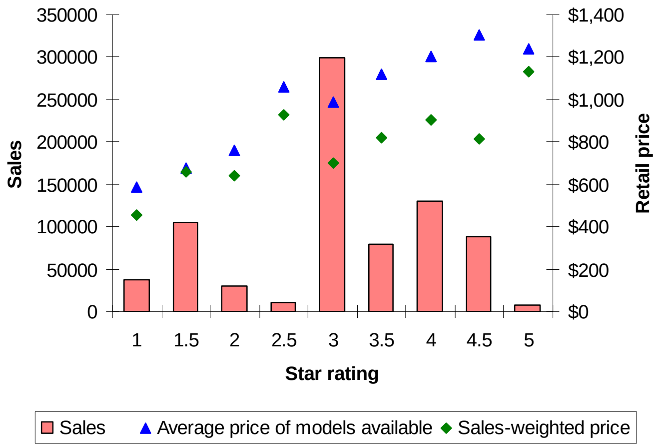


Figure 4-4: Dishwasher sales in 2006 and prices by star rating

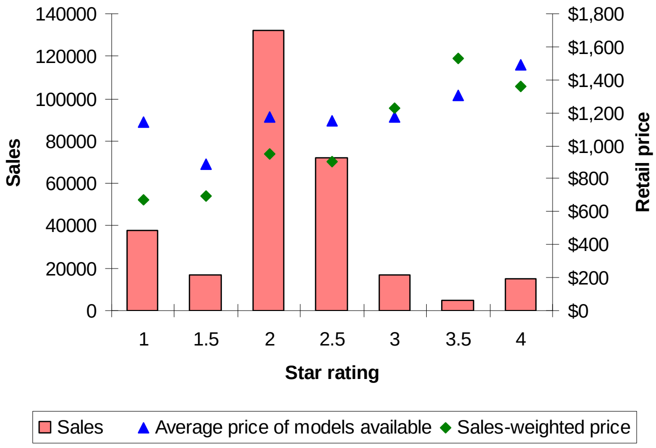


Figure 4-5: Washing machines sold in 2006 by price category

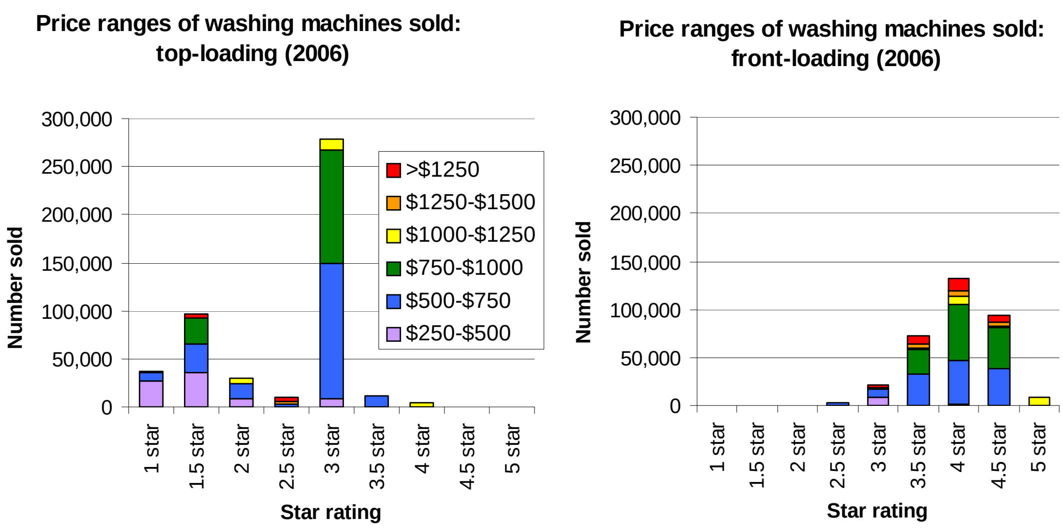


Figure 4-6: Dishwashers sold in 2006 by price category

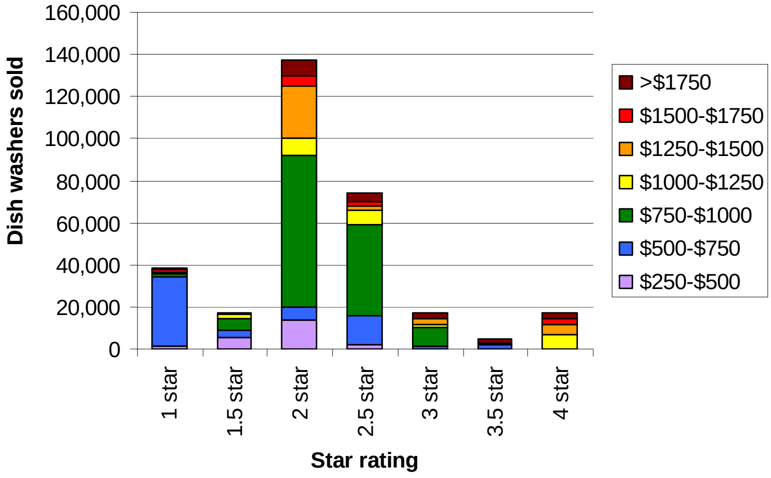


Figure 4-7: Number of models available for dishwashers (a) and clothes washers (b) in 2006

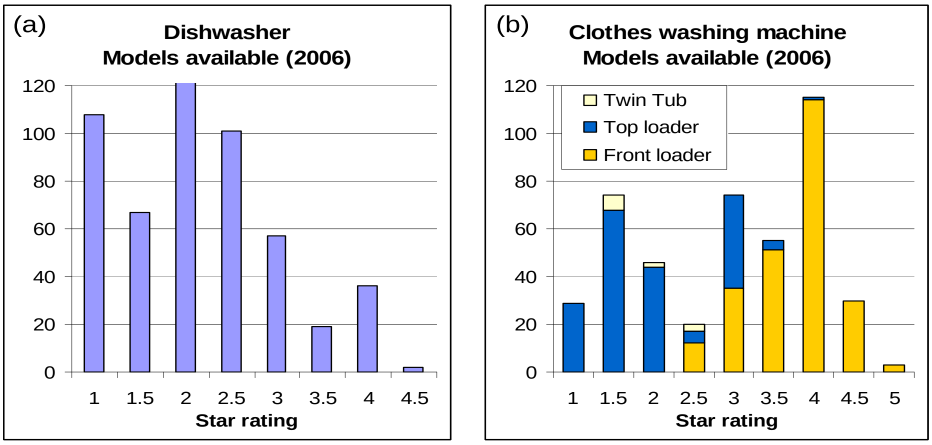


Figure 4-8: Washing machines – price ranges of available models (2006)

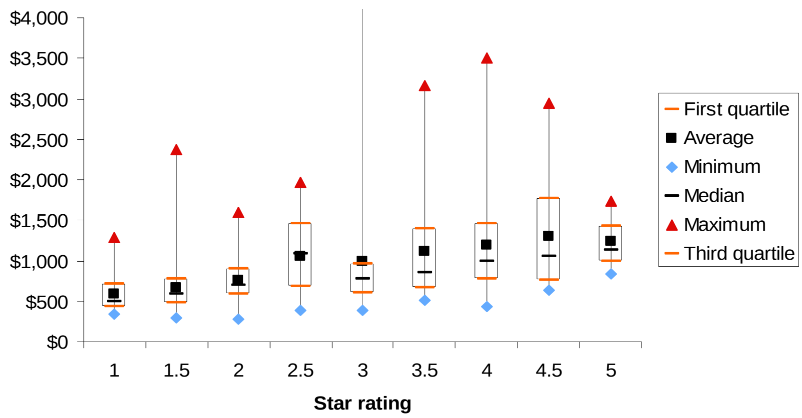


Figure 4-9: Dishwashers – price range of available models

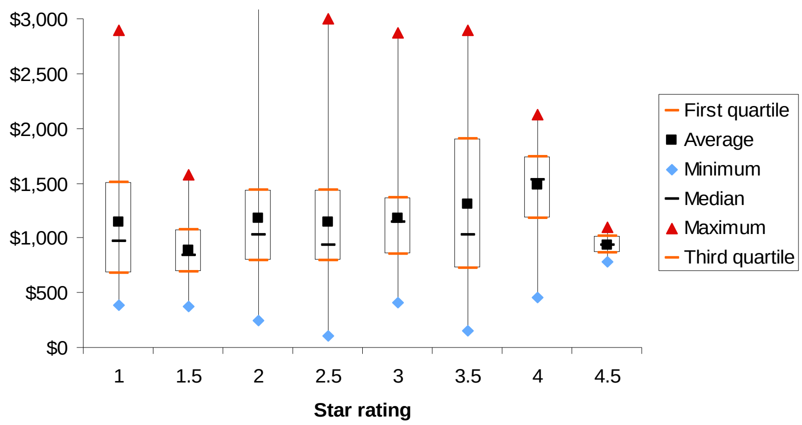


Figure 4-10: Washing machines – capacity of available models by star rating

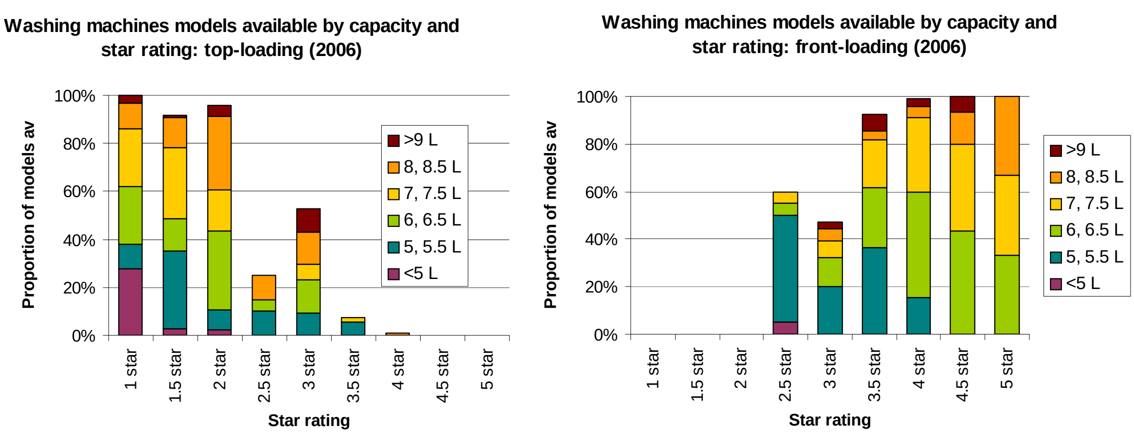


Figure 4-11: Washing machines – capacity of available models by price

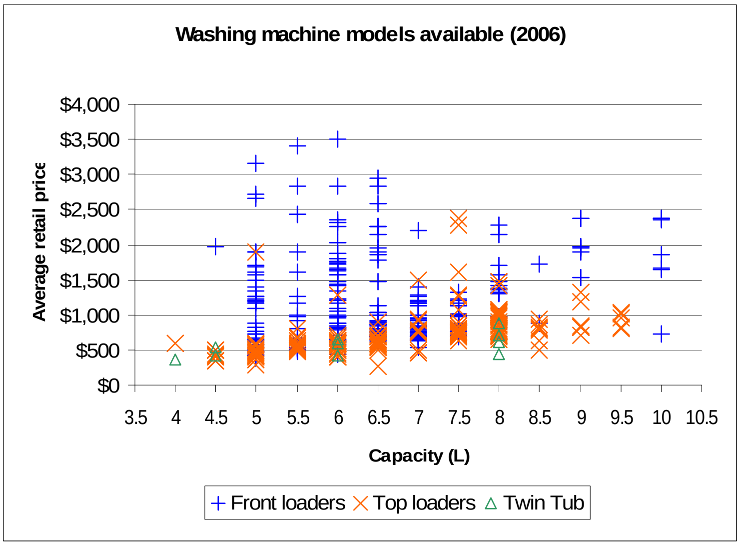


Figure 4-12: Washing machines – historical trends in average prices of models sold

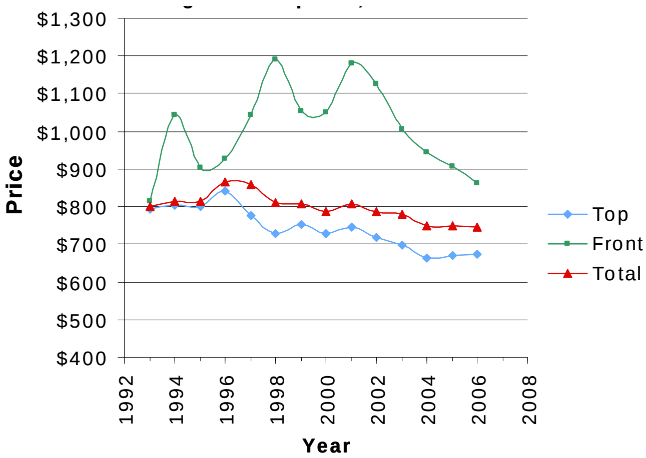
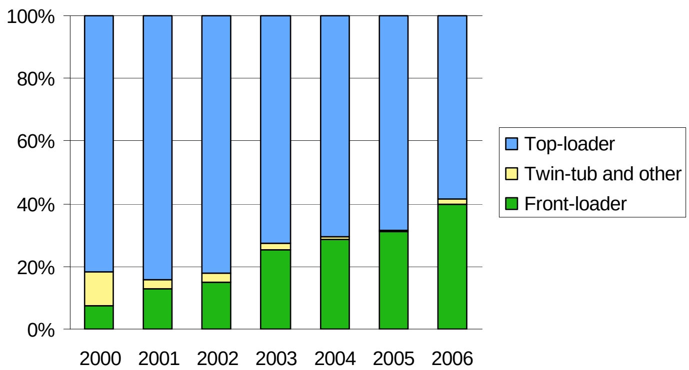


Figure 4-13: Washing machines – trends in proportion of top-loaders and front-loaders sold



Parameter sensitivity: price premiums for clothes washing machines

In the 2004 RIS for WELS, the largest cost component was calculated to be those costs associated with product premiums ($106.1million NPV, at 10% discount rate). Clothes washing machines accounted for the largest proportion of costs due to price premiums ($70.6 million, at 10% discount rate). The price premium cost estimates for washing machines alone are substantial and, if included in the overall analysis of the costs of WELS, would have significant effect on its cost and would have a significant effect on overall cost-effectiveness – increasing the levelised cost per kilolitre by a factor of two to three.

The price differential for clothes washing machines used in the RIS ($0 in 2005 rising to $15 in 2010) was based on the reasoning that that front-loaders, which are all imported, have smaller market share (particularly sales per model) and will thus carry an inherent price premium. A conservative approach was taken in assuming that the front loader share of the clothes washer market would not rise to more than 30%, from around 15% in 2002.

However, the RIS acknowledged that WELS may drive demand towards front-loaders and result in closing the price premium gap. More recent sales data has indicated that this is the case. Figure 4-12 shows a narrowing price gap between front- and top-loaders. Although in 2006 the number of sales per model in 2006 for front-loaders remains at around half that of top-loaders, Figure 4-13 illustrates a growing share of front-loader sales (to around 40% in 2006) and declining proportion of top-loader sales (to less than 60% in 2006).

Other reasons for negligible and short-term price premiums are discussed in section 4.5.2. Nevertheless, some price premium could have occurred at the commencement of WELS, decreasing over time as suppliers respond to demand. If there was an average $10 per unit sold price premium due to WELS in 2006-07, declining to $0 two years later in 2008-09, the NPV of the price premium would be $11million (1.6% discount rate) to $12.2 million (10% discount rate).

4.7 AVOIDED WATER COSTS - CONSUMERS

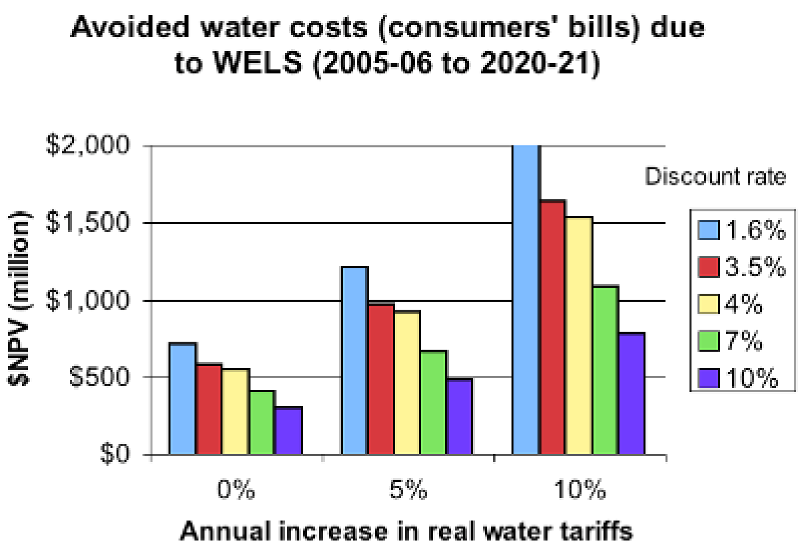
The water savings associated with WELS result in potentially substantial benefit for customers, through reduced water bills. The total magnitude of these bill savings that will be achieved in the future depend on estimates of water savings (see chapter 3) and projections about the marginal price of water.

The *National Performance Report 2005-06: Major Urban Water Utilities* (NWC and WSAA 2007) provides data on retail tariffs across Australia as at June 2006. The consumption-weighted average residential tariff from these major urban water utilities is $1.08/kL (see Appendix X). Although this average price does not reflect non-residential tariffs, as the majority of water used by WELS-related products is used by residential properties, this figure has been used as the basis for water price projections in the future.

Across many Australian states and territories, implementation of large-scale water supply infrastructure is likely to result in greater price increases in the future than experienced in the recent past. For example, price increases in metropolitan Melbourne have been around 4% per year for the last three years, but real prices will increase by 14.8% in July 2008. Although it is unlikely that the current rate of proposed infrastructure development (and hence price increases) will be sustained over the period of analysis of this study, the level and pathway of future water price increases across Australia is uncertain.

In this study, a range of annual real growth rates of tariffs (marginal price per kL) from 0%, 5% and 10% were used to analyse the potential bill savings that could be achieved by WELS. As illustrated in Figure 4-14, at a discount rate of 7%, the NPV of bill savings is between $400 million and $1 billion, depending on water prices.

Figure 4-14: NPV of avoided water costs (consumers' bills) due to WELS



4.8 AVOIDED ENERGY COSTS

4.8.1 Energy Savings

By reducing overall water usage, WELS also results in reduced hot water usage by clothes washing machines, dishwashers, showerheads and taps. Consequently, energy consumption is reduced, which leads to avoided energy costs for consumers. For washing machines and dishwashers, there may also be a correlation between water efficiency and energy efficiency of the machine itself not just that associated with heating water. However, because energy labelling is a confounding factor in the energy efficiency of electrical goods, this study focuses on analysing changes in energy consumption due to changes in **hot water requirements** across all products.

Additionally, a reduction in the overall water consumption resulting from WELS implies **energy savings for utilities** that would have otherwise been required to treat and transport water and wastewater through the reticulation system.

Avoided energy use for water heating - assumptions

WELS on washing machines has the overall effect of reducing total water used, hot water used and hence energy used to heat water. However, because overall water savings are likely to be achieved by a shift towards front-loaders, energy savings calculations have also taken into account the following differences between front- and top-loading washing machines:

- Front-loaders tend to use less water, but washes tend to be with warm or hot water, rather than with top-loaders, where users are more likely to select a cold cycle.
- On average, a greater proportion of water used by front-loaders is heated internally (ie. within the washing machine) rather than externally (eg. by household water heater). Internal water heating is assumed to use peak electricity, whereas external water heating is assumed to use a mix of peak electricity, off-peak electricity and gas.

Like for washing machines, WELS reduces energy used to heat water both internally (peak electricity) and externally (peak electricity, off-peak electricity and gas) for dishwashers.

For showerheads and taps, it has been assumed that on average half of the volume of water used is heated from 10 degrees to 50 degrees.

Avoided treatment and pumping energy use - assumptions

These ‘treatment and pumping’ energy savings are calculated based on a weighted average of the energy intensity of water utilities from across the country. The energy intensity of water utilities is dependent on a number of factors, in particular the distances over which water is required to be pumped between water treatment facilities, end users and wastewater treatment facilities. Variance in the degree of treatment that is implemented at water and wastewater treatment facilities across the country will also affect the energy intensity of water utilities. Energy intensity factors from around the country are shown below, including the weighted average figures in Table 4-12.

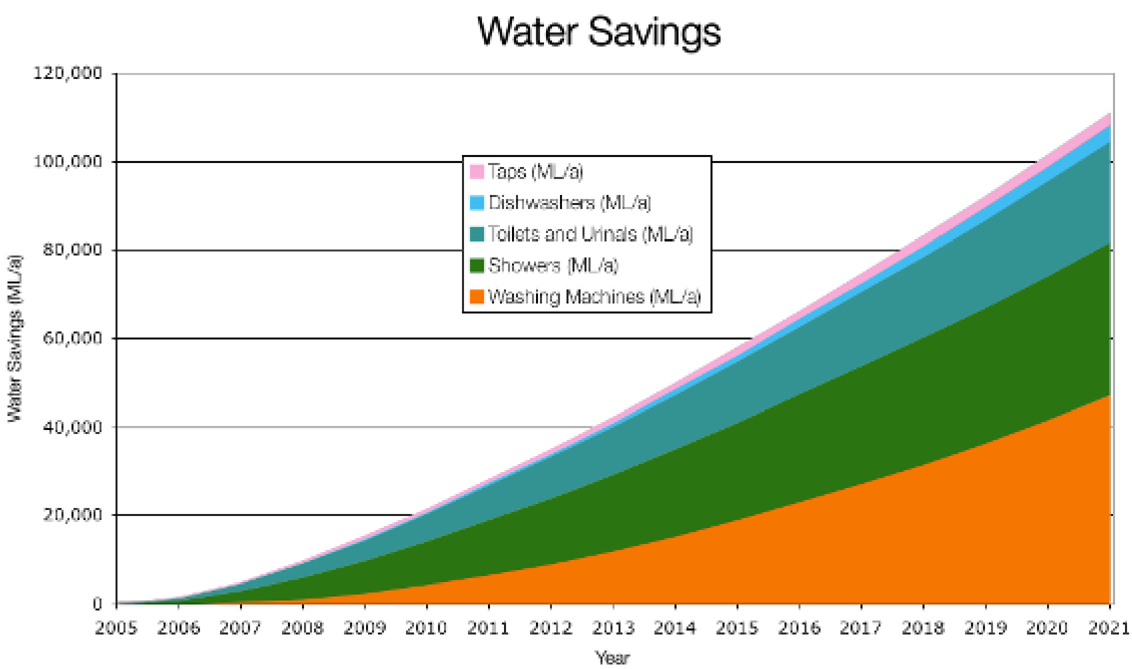
Table 4-12: Energy intensity factors

	kWh/kL supply	kWh/kL wastewater
NSW	0.31	0.35
Vic	0.16	0.71
Qld	0.33	0.61
SA	1.16	0.43
WA	0.28	0.44
Tas	0.53	0.77
NT	0.27	0.19
ACT	0.07	0.60
Weighted average	**0.32**	**0.51**

Contributions to energy savings

The analysis for energy savings by products type shows that showers and washing machines contribute the most to energy savings, with dishwashers, taps and toilets resulting in less than 10% of the energy savings. This is consistent with expectations, as showerheads and clothes washers use the greatest quantity of hot water and therefore have the potential to have the greatest impact on avoided energy for heating.

Figure 4-15 Total energy savings by product type



As discussed above, the avoided energy consumption results from both avoided heating and avoided pumping and treatment. Heating water contributes the vast majority of energy savings, approximately 95% of the total energy savings from WELS. In 2021, only 93 GWh/a of the total 1386 GWH/a of energy savings resulted from avoided pumping and treatment.

The energy savings can also be disaggregated by source, showing the proportion of energy savings from gas and electricity. For the heating of water, the split of electricity and gas use was established from ABS (2008) as 57% electricity and 43% gas. An exception to these proportions was for the internal heating of water that occurs for a proportion of the water used in clothes washers and dishwashers. Internally heated water was assumed to be supplied by electricity only.

There is an approximately even split between gas and electricity energy savings from WELS, with 51% of the energy being supplied by electricity in 2021. More detail of the source of electricity over time is shown below.

Table 4-13 Total energy savings by source

Total energy savings by source	2007	2010	2015	2021
Gas (PJ/GWh)	0.17 / 46	0.59 / 166	1.40 / 393	2.50 / 701
Electricity (GWh)	35	148	368	711

4.8.2 Avoided energy costs – consumers' water heating

As discussed above, consumers avoid energy costs by avoiding water heating.

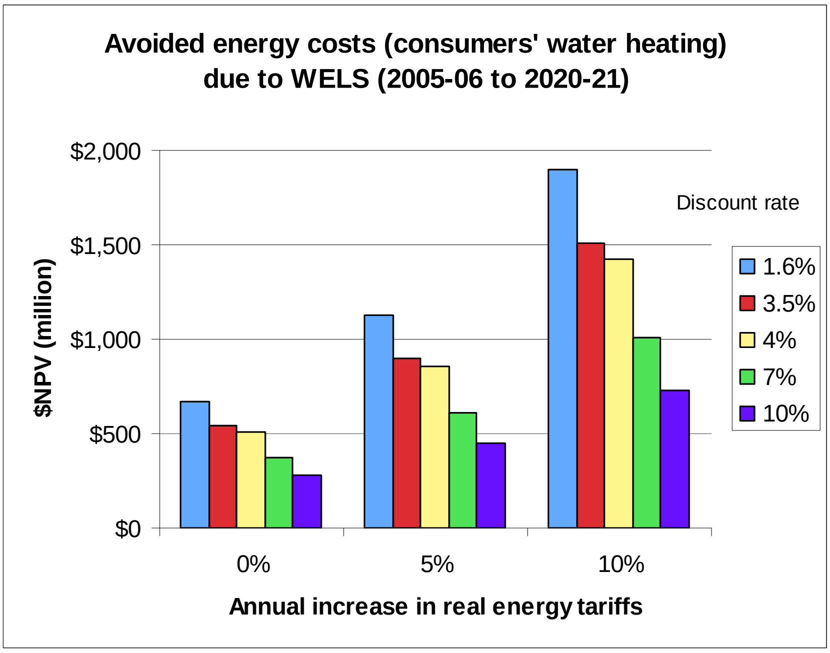
To calculate energy bill savings, an Australia-wide weighted average energy price (real) of 8.47c/kWh has been used. This figure takes into account current peak residential electricity, off-peak electricity and gas prices in each state, weighted according to relative amounts of each source of energy used to heat water in each state in 2005 (as listed in *ABS 4602.0 Environmental Issues: People's Views and Practices*). A price of 15.74 c/kWh (weighted average peak electricity) has also been used to analyse energy bill savings associated with energy use to heat water internally to dishwashers and clothes washing machines.

In reality, a small proportion of water is also heated using wood and solar energy sources, but because this overall proportion is minor (around 4%) compared to electricity (around 57%) and gas (around 43%) sources, the prices of wood and solar energy have not been included in the weighted average energy tariffs. Weighted average energy prices (weighted across residential and non-residential water heating) are not available for each state, but residential tariffs are considered a reasonable approximation.

Like for water bill savings, projections of energy bill savings are particularly dependent on assumptions about the rate of increase of energy tariffs in the future. Energy bill savings have therefore been analysed under scenarios of 0%, 5% and 10% annual increase of weighted average real tariffs.

Figure 4-16 illustrates that the NPV of energy bill savings (due to avoided water heating costs) ranges from $380 million to $1 billion, depending on future energy prices, and at a 7% discount rate.

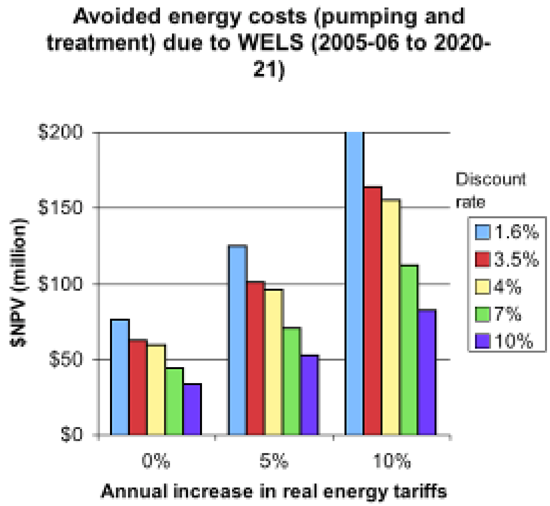
Figure 4-16: NPV of energy bill savings (consumers' avoided water heating) due to WELS 2005—2006 to 2020-21



4.8.3 Avoided operating costs (energy) for water supply and sewage treatment

The marginal cost (cost per kWh) for energy used by water businesses to pump and treat water and wastewater is inherently difficult to estimate. For illustrative purposes, the NPV of avoided energy costs associated with avoided pumping and treatment due to WELS have been calculated based on current Australia-wide average retail peak electricity price of 15.74 c/kWh. Although this may be an overestimate of energy prices paid by water businesses, the avoided energy costs from pumping and treatment are substantially lower than those associated with avoided water heating. As illustrated in Figure 4-17, the NPV of avoided energy costs due to pumping and treatment range from $44m to $112m at 7% discount rate (depending on future energy prices), which is about a tenth of the avoided energy costs due to avoided water heating.

Figure 4-17: NPV of avoided energy costs (avoided pumping and treatment) due to WELS 2005-06 to 2020-21



4.9 AVOIDED GREENHOUSE GAS EMISSIONS

Whilst the overarching objective of WELS is to achieve water savings, another major, global benefit of WELS is the reductions in greenhouse gas emissions, from avoided energy use for heating water, water supply and sewage treatment.

Estimates of avoided greenhouse gas emissions associated with reduced energy use depend upon several assumptions, including greenhouse gas emissions factors and the cost of carbon. In this analysis, Australia-wide weighted greenhouse gas emissions intensity factors of 0.9 kg tCO_2e/kwH for electricity and 64.5 kg/GJ for gas have been adopted. As discussed below, there are several ways methods to value avoided greenhouse gas emissions. In this analysis, a range of carbon prices and pathways were analysed. For the projection period (to 2020—2021), the source-mix of energy used to heat water is not assumed to change.

In total, WELS is projected to avoid the emission over 6.6 million tonnes of CO_2-e in the period 2005—2006 to 2020—2021, mainly associated with energy savings due to avoided water heating requirements. These savings are approximately 400 000 tonnes/annum averaged over the period 2005 to 2021, which is the equivalent of taking about 90 000 cars off the road every year. The value of these avoided greenhouse gas emissions, depending on assumptions about carbon prices, varies from about $61 to $307 million NPV, at 7% discount rates.

What cost carbon?

Anthropogenic greenhouse gas emissions result in what is described as a global externality, because the impacts are experienced by all people globally. A fully functioning and effective international emissions trading scheme would (in theory) set a corresponding global price for carbon which reflects these external costs.

Depending on how the scheme operated within Australia, this global price for carbon would be reflected in energy prices. However, as this international scheme does not currently exist, there are a number of techniques which could be used to monetise greenhouse gas externalities. Different techniques are based on different assumptions; including about acceptable emissions pathways and stabilisation levels, and the distribution of abatement effort between nations.

Different valuations of greenhouse gas emissions externalities include (Plant et. al, forthcoming):

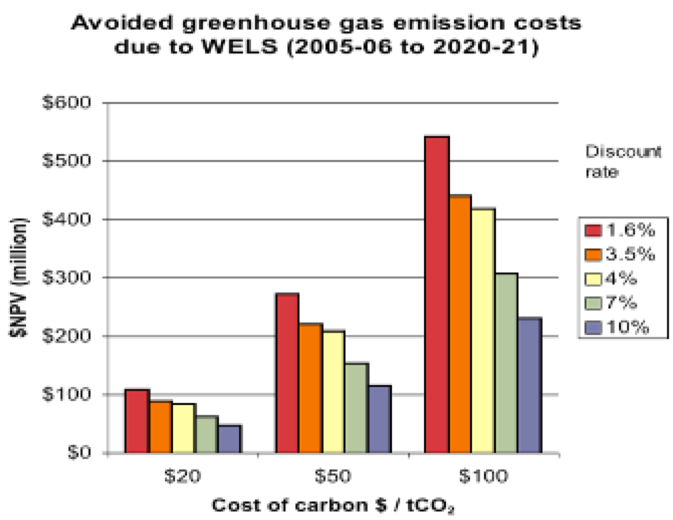
- **Damage costs -** The market and non-market values that will be affected, globally, by climate change. For example, the Stern Report estimates the social cost of carbon at BAU is around US$85/t$CO_2$-e (2000 prices).
- **Actual emissions markets** - The price of carbon in existing emissions trading schemes. For example, prices in the EU Emissions trading scheme varied from E10/tCO_2 at its inception in January 2005, rising to around E20-E30 before crashing to E10 in May 2006 (Grubb and Neuhoff 2006). The price of abatement certificates in the NSW Greenhouse Gas Reduction Scheme has also varied significantly since its inception on 1 January 2003. At July 2006, prices were around $13-$15/t (Sydney Water 2006).
- **Hypothetical carbon signal**: The price of carbon estimated to occur in a global trading scheme OR the carbon tax required to reduce emissions to acceptable levels. These are related to the costs associated with abating greenhouse gas emissions to acceptable levels. Examples include:

  - A study by ABARE in July 2006 on the economic impacts of climate change policy estimated likely globally harmonised carbon tax required under different scenarios of timing of abatement action, and types of abatement technologies and energy sources available, and global emissions pathways. Under a range of scenarios where a global carbon tax is introduced in 2010, the estimates for the globally harmonised carbon tax range from $22/tCO2e in 2020 to $99-$157/tCO2e in 2050, depending on what technologies are available (Ahammad et. al. 2006).

  - A study by MMA in July 2006 for the National Emissions Trading Taskforce found that the cost of carbon capture and storage for a brown coal IGCC plant would fall from about $32/t CO2e in 2020 to around $25 in 2030 (MMA 2006).

  - A review of the Australian Government's Mandatory Renewable Energy Target found that the cost of abatement to the economy was around $32/tonne. (AGO 2003)

Figure 4-18: Total value of avoided greenhouse gas emissions due to WELS



4.10 SUMMARY OF COSTS AND BENEFITS

4.10.1 Distribution of costs and benefits by stakeholder group

A summary of the costs and benefits from WELS divided by stakeholder group is listed in Table 4-14. These costs and benefits are based on various assumptions and projections as detailed in chapter 4.

In NPV terms (2007 dollars), WELS is estimated to result in a net cost to the Department of around $11.4m million dollars (see KPMG (2008) for more details on options for future cost-recovery requirements). Suppliers are estimated to incur a net cost of $15.9m, mainly due to labelling costs and registration fees. The cost of reduced water revenue should be viewed in the context of potentially avoided infrastructure expenditure and the broader objectives and performance indicators of water businesses beyond ensuring revenue streams.

End-users of WELS products are by far the greatest beneficiaries, estimated to save over $1 billion in water and energy bills to 2020—2021. Globally, the avoided greenhouse gas emissions associated with avoided water heating requirements are also projected to be significant, valued at around $153 million (assuming a carbon price of $50/t CO_2).

Table 4-14: Summary of costs and benefits by stakeholder group – NPV (2005—2006 to 2020—2021)

Stakeholder	Costs		Benefits		Net
	Description	NPV	Description	NPV $	NPV
DEWHA	Administration cost	$16.1m	Fee revenue	$4.7m	**– $11.4m**
Suppliers	Registration fees	$4.7m	Increase in revenue from increased prices	Assumed negligible	**– $15.9m**
	Registration process	$1.9m			
	Testing costs	$2.0m			
	Labelling costs	$7.3m			
Retailers	Costs of selling unlabelled stock	Not estimated	Increase in revenue from increased prices	Assumed negligible	Estimation not possible
	Ongoing costs associated with checking labels and training staff	Assumed negligible			
Customers	Increased product cost increase due to price premium	Assumed negligible*	Avoided water bill costs	$660m	+ $1273m
			Avoided energy bill costs	$613m	
Water businesses	Reduced water revenue (to public)	$660m	Avoided energy costs	$70m	– $590m
Global	Life cycle costs	Not estimated	Avoided greenhouse gas emissions	$153m	

Notes: DEWHA administration costs are reported net of appropriations and state government funding. All estimates of NPV based on 7% discount rate. Bill savings based on assumptions of real growth rate of water, electricity and gas tariffs of 5%. Avoided cost of greenhouse gas emissions estimated at $50 /t$CO_2$.

4.10.2 Parameter uncertainty – upper limiting costs

The parameter assumptions and estimations detailed throughout chapter 4 have reflected a conservative approach – that is, avoiding understating costs and overstating benefits. Nevertheless, the value of some key parameters is very uncertain. Table 4-15 summarises the assumptions and sensitivity testing of parameters behind the "upper" cost estimates to suppliers. There are interactions between some key parameters (eg. registration costs) and registration numbers. However, these influences have not been explicitly modelled, because the projected registration numbers (Table 4-15) are a conservative upper estimate of future registrations.

Table 4-15: Summary of upper estimates of costs to suppliers NPV (2005—2006 to 2020—2021)

Cost	Estimate	*Upper estimate*	Description of parameter sensitivity	
			Estimate	*Upper estimate*
Registration fee	$4.7m	*$7.9m*	Registration fee $1500/model	*Registration fee $2500/model with no impact on reducing registration numbers*
Registration process	$1.9m	*$4.3m*	7-14 hours of staff time per model registration	*28 hours per model registration*
Testing costs	$2.0m	*$3.0m*	A proportion of models for some product types tested internally in supplier laboratories at negligible additional cost	*100% of model testing costs at external laboratory testing costs*
Labelling costs	$7.3m	*$21.2m*	10c to 20c per label	*50c per label*
TOTAL	**$15.9m**	***$36.4m***		

Note: All estimates of NPV based on 7% discount rate.

Another key source of uncertainty is the extent to which consumers will pay a price premium for products. As detailed earlier in this section, price premiums are likely to be negligible for plumbing products, and substantially short-term and lower than that estimated for washing machines and dishwashers in the 2004 RIS. A conservative (upper) estimate of costs due to price premiums across all products (assuming that the washing machine price premium accounts for 66% of overall cost due to premiums, as in the 2004 RIS), is $17m NPV.

Future energy and water bill savings are particularly dependent on future water and energy prices. The range of estimates of bill savings for customers under different future prices is shown in Table 4-16.

Table 4-16: Range of estimates of customer bill savings NPV (2005-06 to 2020-21)

Benefit	Annual increase in real water and energy prices		
	0%	5%	10%
Avoided water bills	$403 million	$660 million	$1087 million
Avoided energy bills	$376 million	$613 million	$1007 million
TOTAL	$779 million	$1273 million	$2094 million

Note: All estimates of NPV based on 7% discount rate.

4.10.3 Whole of society net costs

As detailed in section 2, the net costs to society (Australia) do not include transfer costs between stakeholders. For example, water and energy bill savings are benefits for consumers, but equivalent costs to water and energy businesses. Similarly, registration fees are a cost to suppliers but a source of revenue to DEWHA. These type of costs/benefits are considered transfer costs rather than net costs.

To estimate Australia-wide cost-effectiveness of WELS, the following costs are included:

- DEWHA's administration costs
- suppliers' time costs, testing costs and labelling costs
- consumers' costs due to price premiums (estimated negligible as a base case).

The whole-of-society (Australia) net cost of WELS, NPV 2005—2006 to 2020—2021 at 2007 dollars, are detailed in Table 4-17. Estimates are provided for both base case and "upper limiting" costs.

Table 4-17: Net cost of WELS, whole-of-society (Australia) NPV (2005—2006 to 2020—2021)

Discount rate	Net cost	Upper estimate
1.6%	$36.2m	$76.9m
3.5%	$32.2m	$69.9m
4%	$31.7m	$69.4m
7%	$27.2m	$61.8m
10%	$23.9m	$55.9m

5 Comparative cost-effectiveness analysis

5.1 RESULTS OF COST EFFECTIVENESS ANALYSIS FOR WELS

Compared to the majority of other current or planned demand and supply options in Australia, the WELS option is a significantly more cost-effective option to achieve the objective of water security. The cost effectiveness of WELS at various discount rates is depicted in Table 5-1, in each case showing WELS as a cost-effective option.

This result was corroborated by a previous estimate of the *cost-effectiveness* of WELS which reports a figure of $0.05/kL (White *et al.,* 2006). In this previous analysis, the costs and water savings were based on projections prior to the scheme being implemented.

Table 5-1: Net Present Value and Unit Cost of WELS

Discount Rate	Unit Cost ($/kL)	Unit Cost – upper estimate ($/kL)
1.6%	0.05	0.12
3.5%	0.06	0.13
4%	0.06	0.14
7%	0.07	0.17
10%	0.09	0.20

Although this figure depends on different assumptions about discount rate, price premiums and water savings, WELS remains cost competitive compared to other water security options.

Varying the discount rate between 1.6% and 10%, and under different assumptions about costs, results in unit costs for WELS of between $0.05 and $0.20/kL. Previous analysis with different assumptions about costs and water savings demonstrate that the relative cost-effectiveness of WELS is preserved across a range of assumptions.

The cost-effectiveness figure is sensitive to assumptions regarding likely price margins for more efficient products, but remains relatively cost-competitive across these different assumptions. More efficient appliances may have a price margin over less efficient products, which may be in part offset by the presence of rebate programs. However these price margins are an extra cost to the consumer and should therefore be accounted for in the assessment of the costs of WELS to society.

However, cost premiums due to more efficient products are not constant. In fact as an increasing number of efficient appliances come onto the market and demand for these products increases, it is likely that the price margins will decrease. In this study, these market adjustments have been taken into account by assuming a margin of zero for more efficient products. This approach was also taken by White *et al.,* (2006).

When price margins factored into the cost calculations, the unit cost of WELS is still competitive compared with other water security options. In George Wilkenfeld and Associates (2004), the price premium formed the largest component of cost, in excess of labelling costs and testing. In-house calculations used these figures in a calculation of unit cost and reported the cost-effectiveness of WELS to be $0.39/kL.

5.2 COMPARISON OF COST-EFFECTIVENESS WITH OTHER WATER SECURITY OPTIONS

The relatively good cost-effectiveness of WELS in comparison to other options demonstrates that WELS is likely to be part of the package of options that form a least cost strategy for achieving water security in Australian jurisdictions.

In comparison to other water security options on the supply side, options range from $1.19-2.55/kL for cheaper desalination alternatives, up to $3.58/kL for surface water supply and $5.50/kL for the more expensive recycling options. By comparison, demand options are generally cheaper at approximately $0.10/kL for outdoor water efficiency and $0.50- 0.60/kL for rebates and home retrofits. In this study, the relative cost-effectiveness of WELS compared to increases in water prices has not been modelled. However, mandatory labelling could (at least theoretically) help enable water users to respond to water price increases (see box 5-1).

Options	Approx. levelised unit cost ($/kL)
Demand Reduction Options	
Outdoor water efficiency [a]	$0.10 – $0.20
Indoor water efficiency (shower head exchanges, rebates, and retrofits) [a]	$0.50 – $0.60
Building regulations (5 Star in Victoria, BASIX NSW)[e]	$0.30 – $4.00
Supply Augmentation Options	
Desalination [c]	$1.19 – $2.55
New storage [b]	$1.26 – $3.58
New recycling schemes in Sydney [d]	$1.00 – $5.50
Residential Raintank [a, b]	$3.00 - $4.00

a Estimate from Review of the Metropolitan Water Plan (White *et al.*, 2006).
b Estimate from Review of Water Supply-Demand Options for South East Queensland (*Turner et al.*, 2007).
c Minimum from WA Water Corporation desalination media release (The Perth Seawater Desalination Plant, April 2005) and maximum from Review of Water Supply-Demand Options for South East Queensland (Turner *et al.*, 2007).
d Committed and approved recycling schemes in the review of the Sydney Metropolitan Water Plan (White *et al.* 2006).
e BASIX from (White *et al.*, 2006) and 5 Star from in-house calculations

Whilst WELS appears to be more cost-effective than other low cost demand options, it is unrealistic to infer that WELS would achieve the same cost-effectiveness if implemented in isolation from other options. As discussed in chapter 4, the success of WELS is context-dependent, relying in part upon rebate programs, building regulations and a water efficiency ethic emerging in response to protracted drought.

As discussed throughout this report, the projections of water savings, costs and benefits of WELS are uncertain and based on a number of assumptions. Nevertheless, a comparison of the cost-effectiveness of WELS to that of other urban water options should also acknowledge that the water savings, costs and benefits of these other options are also uncertain, and in some cases could be more exposed to other risks. For example, the costs of some supply options may be particularly uncertain in terms of environmental impacts, or future rising energy costs.

Box 5-2 Water pricing and WELS

In recent debates about the importance of different measures (supply augmentation, source substitution, and efficiency) for achieving urban water security, the role of *pricing* has been widely discussed. In Australia, water pricing is intended to meet several objectives and criteria including: full cost recovery and consumption-based pricing, as reflected in the principles of COAG's 1994 strategic framework for water reform; financial viability for water utilities; and distributional and equity issues.

More recently, scarcity-based drought pricing has been proposed as an alternative to urban water restrictions (see for example, Edwards (2006), Kompas and Grafton (2008)). By reducing demand during droughts, cost-effective and equitable drought response measures have substantial implications in terms of the extent and mix of longer-term supply- or demand-side measures required to maintain water security.

The effect of water prices on demand has also been raised in the context of recent proposed increases in the urban water price paths, which in many locations reflect upcoming infrastructure costs. Cost-recovery pricing should take into account the possible influence of price rises on demand, both in terms of determining the additional yield or savings required and in setting the price paths.

The extent to which pricing will meet its objectives, or be an effective conservation measure, depends on consumer responses to price changes. However, the effect of proposed prices on water use is uncertain:

- **Residential** studies of price elasticity of demand internationally and in Australia reveal certain patterns in terms of *relative* elasticities – for example, that demand is more responsive in summer than in winter, in the long run than in the short run, and for outdoor 'discretionary' water uses than for indoor uses (Hoffman and Worthington forthcoming). Some studies indicate that residential customers are more responsive to average prices or changes in total bill amounts, than marginal prices. However there is uncertainty about what exact *absolute* price elasticity of demand applies in a specific current Australian situations. For example, empirical studies of residential price elasticities of demand in Australia, such as Dandy et. al (1997), KPMG (2004) and Hoffman et al (2006), have not explicitly analysed demand elasticity during prolonged drought.
- There are far fewer studies of **non-residential** responsiveness to water pricing, either by sector or in aggregate. A review of studies which estimate price-elasticity of non-residential demand for water did not identify any Australian analyses (ACIL Tasman (2007)).

In terms of the relevance of urban water pricing to the cost-effectiveness of WELS:

- In Australian states and territories, raising water prices have not been implemented as a water conservation instrument, ie. with the explicit objective of reducing water use. Therefore in this study, the cost-effectiveness of "water pricing" as an urban water management option has not been assessed.
- As noted above, there is uncertainty about the effect of prices on water use – and it is likely that, at least historically, other influences such as the drought and general concern about water shortages have been stronger drivers of residential water conservation. However, WELS may theoretically (at high enough price ranges) enable some users who, wishing to save money through saving water, to do so by using more water-efficient products. This will however also depend on the extent to which improvements in the efficiency of the existing stock have already taken place.

6 OPPORTUNITIES

Although WELS in general leads to mutually-reinforcing demand- and supply-driven water savings, several issues have been raised by stakeholders about the extent to which particular features of WELS drive (or inhibit) innovation in water efficiency, or regarding the operation of the scheme in general. These are discussed in this section.

6.1 INNOVATION

Some elements of current technical standards specifications provide disincentives (or perverse incentives) for innovation of more water-efficient technologies. For example:

- The highest star rating for showers is currently 3 stars, although provision has been made in the standards to provide guidance for “likely” 4, 5 and 6 star ratings (AS/NZS 6400:2005). Where uncertainty remains as to when and if these higher star ratings will be introduced, there is no strong incentive for suppliers to develop or market showerheads with maximum flow rates less than 9.0L/minute. Similarly for taps and toilets, the potential for introduction of more water efficient showerheads depends at least in part on the feasibility of reducing minimum flow requirements.
- For clothes washing machines, water star rating testing is based on full loads, although in practice many loads conducted are part loads. Models with load sensing capabilities have the potential to reduce water use, however current standards do not provide an incentive for manufacturers to design or implement these capabilities. This could be rectified by introduction of part load testing requirements for water star rating (similar to the commitment made for energy labelling).
- A small proportion of dishwasher models can be operated on a setting which adjusts water use automatically, in response to soil load testing. Operating a dishwasher on this setting is likely to use substantially more water (and energy) than operation on normal settings, however current standards do not include testing of water use on soil load testing.
- A small proportion of clothes washer models also have a dryer facility. It has been reported that these washer-dryers use a significant amount of water in the drying cycle that separate dryer machines do not use. However, as this water is part of the drying cycle, it has not to date been included in the technical standards for WELS on washing machines. A future revision of the standards should include a provision for washer dryers that penalises these machines for the extra water used in the drying cycle even through the washing cycle may be water efficient.

Concerns have also been raised about features of the registration process and system that could inhibit innovation:

- The registration fee and structure could also act as inadvertent barriers to innovation. The initial registration fee ($1500 per model) is likely to be sufficiently high to encourage suppliers to consider ways to register family additions (which incur no extra charge), rather than developing and registering new models.

- For clothes washing machines and dishwashers, concerns have also been raised about the 5-year registration period for WELS products, and the extent to which lack of coordination in implementing changes to technical standards across energy and water labelling inhibits innovation in water and energy efficiency. For example, the energy labelling scheme introduced a new rinse test requirement for clothes washing machines, but for a period of time WELS continued to accept partial testing for rinse performance.
- Industry stakeholders have also expressed concerns about a lack of clarity around what enforcement and compliance activities will take place. Without compliance monitoring, the incentive to develop new technologies in response to WELS is dampened. To date, check testing of registrations had not occurred, however the Department expects to spend approximately $100 000 per year on enforcement and compliance activities from 2008—2009 (DEWHA, pers. comm.)

6.2 STREAMLINING WITH OTHER PROGRAMS

Although it was beyond the scope of this study to conduct detailed analysis of the interactions between WELS and other programs, opportunities exist to streamline the integration and leverage the complementarities between WELS and other programs. For example, from the perspectives of industry stakeholders, the issue of consistency with other plumbing regulations is particularly related to the costs incurred (or perceived) due to WELS - and hence the likely acceptability of any future changes or additions to the scheme.

Stakeholders interviewed for this study suggested that the product rebates and building regulations linked to WELS have driven both the supply and demand for higher star-rated products. Although programs and policies associated with WELS are key to pushing the boundaries of innovation, a streamlined, integrated approach to implementation and staging, in consultation with industry, will help minimise any propagation of adjustment costs through the supply chain. This relates not only to costs to suppliers or changing product, but also ensuring availability of product ranges for potential consumers.

There has also been anecdotal evidence from that there could be opportunities for long-term "lock-in" of the water efficiency savings achieved under rebate and retrofit schemes, by supporting WELS with minimum standards on all products.

6.3 FURTHER DATA AND ANALYSIS

This study has also revealed many opportunities for **improved data-collection** to assist future evaluations. Although this study represents the first detailed cost-effectiveness analysis of WELS that has been conducted using data and information drawn directly from the operation of the scheme, as the scheme has been operating for less than two years, the evaluation undertaken was only partial. The review of available data conducted in order to model estimates of future savings, costs and benefits revealed data gaps in terms of residential and non-residential end-uses, particularly for taps, showers, toilets and urinals. As industry-wide sales data was not available for these product types, and due to the nature of these sectors and markets would be difficult to comprehensively collect, **this study recommends focussing on surveying end-users** (rather than suppliers or retailers) to increase understanding of the components, patterns, trends and drivers of water use. This will enable better evaluation and hence assist in the improved design and implementation of water efficiency programs in the future.

As noted throughout this report, the analysis, particularly the projections of water savings and the projections components of benefits and costs, have been based on various **assumptions about customer behaviour**, including customer responses to labelling. Although some of these have been inferred from previous patterns of labelling and consumer responses, and general increases in awareness of WELS, these relationships have not been empirically tested nor has the extent of causality been robustly (in the statistical sense) established. This study recommends **customer surveying and research** to examine:

- the interrelationship between the drivers of water use efficient purchase decisions, particularly the incentives provided by rebate and retrofit programs, and information on water use efficiency
- whether some consumers do not respond to WELS because the labels provide information about water use efficiency, but not about dollar savings
- the difference in responsiveness to WELS between residential and non-residential sectors, and further opportunities in the non-residential sector
- the extent of split incentives affecting landlords/renters, or (in apartments) body corporates/residents.

7 Summary of key findings

The over-arching objective of this project was to establish the cost-effectiveness of WELS, relative to other water management options. The analysis undertaken for this study demonstrates that WELS cost-effectively contributes to water security across Australian cities and towns.

By ensuring access to information about the water efficiency of taps, showers, toilets, urinals, washing machines and dishwashers, WELS enables consumers to choose their purchases on the basis of water efficiency. This affects the choices made by those residential and non-residential users of water who are also motivated by a wide range of other factors to improve water efficiency including the recent education, promotion and awareness campaigns about the drought, water security situations and water efficiency options such as rebates and retrofits.

The key findings of this report are:

- At a unit cost of $0.07/kL, WELS is the most cost-effective option to achieve water savings. Net costs of the program totalled $27 m (at 7% discount rate) and the water savings from 2005 to 2021 are approximately 800 GL.

- The unit costs of these other water management options ranged from $0.10/kL to $5.50/kL. These water management options include rebates, retrofits, desalination, recycling and new storages. The unit costs of these options were calculated using examples from around the country of both ex-ante assessment and ex-post evaluation of these options.

- Under a range of scenarios, WELS is cost effective compared to other water management options, and compared to the current marginal cost of water. A sensitivity analysis was conducted on a range of key input parameters, including price premiums, suppliers' costs, and projections of water and energy prices. The results of the sensitivity analysis showed a range for the cost effectiveness, with an upper bound at $0.17/kL, assuming a discount rate of 7%. Varying the discount rate between 1.6% and 10% resulted in a range of unit costs from $0.07/kL to $0.20/kL.

- The water savings achieved by WELS are likely to be substantial, totalling approximately 800 GL Australia wide, between 2005 and 2021. Modelling undertaken in this study indicates very different potential for water saving from different product types. Approximately 36% of all savings derive from showers, and 34% from washing machines. Toilets and urinals contribute approximately 23% of water savings, and approximately 6% from taps and dishwashers combined.

- While on a per house basis the tap savings may be minimal, the large quantity of taps expected to be sold every year (1 000 000 in 2021) mean that overall the savings are non-trivial at 23 GL between 2005 and 2021. However, without more detailed data from further end-use surveys it is difficult to assess the extent of these savings, because there is a great variability in behaviour relating to tap use.

- Of the key stakeholder groups, consumers are the main beneficiaries of WELS. The expected water and energy bill savings, even assuming a modest real growth rate of energy and water tariffs of 5%, could yield total bill savings for customers of around $1 billion NPV to 2020—2021. Suppliers, the stakeholder group bearing the largest proportion of the total cost burden, are estimated to incur costs due to WELS of over $15 million NPV to 2020—2021. The largest component of this is labelling costs at around $7 million NPV assuming a discount rate of 7% (directly proportional to expected sales), but a highly uncertain cost component is the magnitude of cost associated with the staff time spent on the registration process.

- This study did not find conclusive evidence of that there would be sustained increases in retail prices due to WELS. The range of price and product attributes available at each star rating appears to be demand-driven, at least for most product types. Therefore, when consumers increased the demand for water-efficient appliances and fittings in response to labelling, rebates, and the drought in general, suppliers have generally responded by expanding product ranges at higher water star ratings - this most likely facilitated by factors external to WELS, such as flexibility in and extent of overseas supply chains and manufacturing operations.

- The sustainability outcomes of WELS are also significant, in terms of water savings, energy savings, and avoided greenhouse gas emissions. The total greenhouse gas saved by WELS is approximately 400 000 tonnes/annum averaged over the period 2005—2006 to 2020—2021. This is the equivalent of taking 90 000 cars off the road every year.

- Depending on the cost of carbon, the value of CO2-e emissions avoided, is estimated at between $60 to $300 million NPV. This analysis excludes water, energy or greenhouse impacts associated with the lifecycle of the products, focussing only on the use phase.

- WELS products and end-uses consume energy through the heating of water (excluding toilets) and through the pumping and treatment of water by the utility to and from the location of the end user. Heating of water is the largest component, at over 90% of total energy use. The remaining 10% is pumping and treatment of water by the utility.

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Appendix A – Organisations contacted

	Organisation
Government agencies and consultants	Australian Government Department of the Environment, Water, Heritage and the Arts
	Energy Efficient Strategies
	Hobart City Council
	Department of Natural Resources and Water, Qld
Manufacturers, importers and supplier associations	CESA
	PPI – Plumbing Products Industry
	GWACaroma
	Argent Australia
	Electrolux
	Fisher & Paykal
	Bridge Castings
	Enware
Plumbers' association	Master Plumbers Association
Retailers and vendors	Bunnings
	Tradelink
Testing laboratories	SGS Australia Limited
	VIPAC Engineering and Scientists
	Enertech Australia Pty Ltd

Appendix B – WELS registration data

WELS Registrations approved

Note that these refer to original registrations, not subsequent additions to families.

Month Received	CWM	DWM	FC	LE	S	TE	UE	Total
Jul-05	0	0	0	1	0	1	1	3
Aug-05	0	0	0	0	0	1	0	1
Sep-05	1	2	0	3	1	3	0	10
Oct-05	0	0	0	1	23	7	0	31
Nov-05	2	3	0	4	1	3	0	13
Dec-05	0	1	0	0	8	8	0	17
Jan-06	1	9	0	1	4	12	0	27
Feb-06	8	5	2	2	4	8	0	29
Mar-06	8	5	0	5	7	19	0	44
Apr-06	8	13	0	3	13	25	0	62
May-06	35	38	0	18	24	56	2	173
Jun-06	29	23	0	13	54	95	8	222
Jul-06	12	10	2	10	10	21	2	67
Aug-06	20	3	4	6	10	21	3	67
Sep-06	11	3	3	7	6	7	0	37
Oct-06	3	2	0	2	7	11	2	27
Nov-06	2	6	3	6	14	33	3	67
Dec-06	16	6	2	6	13	20	6	69
Jan-07	9	2	0	11	13	18	0	53
Feb-07	6	3	2	3	11	14	2	41
Mar-07	8	13	0	8	4	14	2	49
Apr-07	13	17	0	4	8	6	0	48
May-07	5	8	0	3	8	8	2	34
Jun-07	6	5	0	0	0	9	1	21
Jul-07	12	9	3	1	2	15	0	42
Aug-07	2	3	0	8	1	4	1	19
Sep-07	6	7	3	2	2	5	0	25
Oct-07	4	1	2	1	1	9	1	19
Nov-07	9	0	4	2	2	4	1	22
Dec-07	0	0	0	0	3	2	0	5
Total	236	197	30	131	254	459	37	1344

WELS additions approved

Month Received	CWM	DWM	FC	LE	S	TE	UE	Total
Jul-05	0	0	0	0	0	0	0	0
Aug-05	0	0	0	0	0	0	0	0
Sep-05	0	0	0	0	0	0	0	0
Oct-05	0	0	0	0	0	3	0	3
Nov-05	0	0	0	0	1	3	0	4
Dec-05	0	0	0	20	0	1	0	21
Jan-06	0	1	0	14	2	3	0	20
Feb-06	0	1	0	0	0	10	0	11
Mar-06	0	0	0	10	0	1	0	11
Apr-06	0	0	0	4	19	4	0	27
May-06	0	0	0	2	23	20	0	45
Jun-06	0	1	0	19	42	55	1	118
Jul-06	1	0	0	12	52	84	4	153
Aug-06	1	1	0	6	6	19	2	35
Sep-06	0	0	5	2	24	23	1	55
Oct-06	0	0	0	2	8	21	1	32
Nov-06	0	0	0	2	11	8	0	21
Dec-06	0	0	9	9	17	25	0	60
Jan-07	0	0	0	5	14	15	0	34
Feb-07	0	2	0	4	24	25	0	55
Mar-07	2	2	3	5	11	15	0	38
Apr-07	0	0	0	7	7	9	0	23
May-07	0	2	0	2	3	6	0	13
Jun-07	0	1	0	18	5	9	0	33
Jul-07	1	0	3	4	2	17	0	27
Aug-07	1	0	3	8	4	8	0	24
Sep-07	0	0	0	8	1	12	0	21
Oct-07	0	0	3	9	9	9	0	30
Nov-07	2	0	1	9	11	12	0	35
Dec-07	0	0	1	8	8	46	0	63
Total	8	11	28	189	304	463	9	1012

WELS approved applications that required returning at least once

Month Received	CWM	DWM	FC	LE	S	TE	UE	Total
Jul-05								
Aug-05								
Sep-05		1		2				3
Oct-05						3		3
Nov-05	1	3		4		1		9
Dec-05				2	3	5		10
Jan-06	1			1	3	7		12
Feb-06				2	3	7		12
Mar-06				3	2	16		21
Apr-06	3	1		2	29	17		52
May-06	3			15	10	23		51
Jun-06	2	5		9	45	61	3	125
Jul-06		2	2	6	5	6		21
Aug-06	3	1		4	10	13	1	32
Sep-06			3	5	7	9		24
Oct-06		1		3	3	5	1	13
Nov-06	1	3		11	14	21	2	52
Dec-06	3	1		9	14	13	5	45
Jan-07	1	2		6	9	10		28
Feb-07	1		2	4	1	5	1	14
Mar-07	3	5		5	6	11	2	32
Apr-07	12	10		2	8	9		41
May-07	2	7		5	7	5	2	28
Jun-07	1	1	2	3	2	18	1	28
Jul-07				8	3	12		23
Aug-07				7		8	1	16
Sep-07			3	6	8	12		29
Oct-07	1		1	2	8	15		27
Nov-07			4	3	2	2	1	12
Dec-07								
Total	**38**	**43**	**17**	**129**	**202**	**314**	**20**	**763**

Appendix C – WELS water savings

Year	CWM	DWM	UE + LE	S	TE
2006	38	30	446	850	158
2007	430	81	1651	2465	317
2008	1185	153	3185	4791	479
2009	2490	249	4743	7228	644
2010	4254	372	6304	9794	813
2011	6476	522	7825	12 473	985
2012	8971	700	9319	15 000	1157
2013	11 877	909	10 819	17,446	1333
2014	15 197	1149	12 323	19 821	1512
2015	18 931	1424	13 820	22 132	1694
2016	23 082	1735	15 310	24 366	1879
2017	27 168	2081	16 804	26 518	2066
2018	31 619	2467	18 304	28 601	2257
2019	36 444	2892	19 802	30 617	2450
2020	41 653	3339	21 289	32 572	2646
2021	47 255	3822	22 718	34 460	2845
Total	**277 072**	**21 925**	**184 662**	**289 133**	**23 234**

Appendix D – WELS costs and benefits

Projections of units labelled

	CWM	DWM	LE	S	TE	UE
2007	820000	283255	737003	681528	1022293	62081
2008	850000	296002	762852	696185	1044278	63135
2009	850000	309322	788253	709258	1063888	64213
2010	850000	323242	811499	726005	1089008	65318
2011	850000	337787	809297	739869	1109803	66396
2012	850000	349610	783580	741449	1112173	67395
2013	819567	361846	793885	754112	1131169	68406
2014	844154	374511	805877	767919	1151879	69431
2015	869478	387619	813904	783293	1174939	70462
2016	895563	401186	805893	794302	1191452	71458
2017	913474	413221	811343	806900	1210350	72452
2018	931743	425618	820623	818750	1228126	73454
2019	950378	438386	828742	830239	1245358	74466
2020	969386	451538	829043	842807	1264211	75475
2021	988774	465084	822747	852188	1278282	76468

Benefits of WELS (avoided costs) NPV

CUSTOMER PERSPECTIVE

Avoided water bills

		1.6%	**3.5%**	**4%**	**7%**	**10%**
Annual rate of increase real water tariff	0%	$717	$581	$551	$403	$301
	5%	$1213	$972	$918	$660	$484
	10%	$2055	$1631	$1537	$1087	$784

Avoided energy bills (due to avoided water heating)

		1.6%	3.5%	4%	7%	10%
Annual rate of increase real energy tariff	0%	$666	$541	$512	$376	$282
	5%	$1124	$901	$852	$613	$450
	10%	$1900	$1509	$1422	$1007	$727

Total avoided water and energy bills

		1.6%	3.5%	4.0%	7.0%	10.0%
Annual rate of increase real tariff	0%	$1383	$1122	$1063	$779	$582
	5%	$2337	$1874	$1770	$1273	$934
	10%	$3954	$3140	$2958	$2094	$1511

WATER BUSINESS PERSPECTIVE

Avoided energy bills (due to avoided pumping)

		1.6%	3.5%	4%	7%	10%
Annual rate of increase real energy tariff	0%	$76	$63	$59	$44	$34
	5%	$124	$101	$96	$70	$52
	10%	$203	$164	$155	$112	$82

GREENHOUSE PERSPECTIVE

Avoided GHG Costs due to avoided water heating

		1.6%	3.5%	4%	7%	10%
$/tCO2	$20	$100	$81	$77	$56	$42
	$50	$249	$202	$192	$141	$106
	$100	$498	$405	$384	$282	$211

Avoided GHG Costs due to avoided pumping

	1.6%	3.5%	4%	7%	10%
$20	$9	$7	$7	$5	$4
$50	$22	$18	$17	$13	$10
$100	$44	$36	$34	$25	$19

Total avoided GHG costs

	1.6%	3.5%	4%	7%	10%
$20	$108	$88	$84	$61	$46
$50	$271	$220	$209	$154	$115
$100	$542	$440	$418	$307	$230