Queensland

Standard Building Amendment Regulation (No. 1) 2006

Regulatory Impact Statement for SL 2006 No. 23

made under the

Building Act 1975

Purpose

The Queensland Government is investigating how new houses could be made more sustainable by using less energy and water. To assist in this investigation, the Government commissioned McLennan Magasanik Associates Pty Ltd (MMA) to prepare a report identifying the costs and benefits of various energy and water measures which could moderate the environmental impacts of new houses in Queensland under four regulatory scenarios. At this stage, the Government has not made any decision on the introduction of any of the measures.

A preliminary assessment of possible measures showed they had the potential to result in significant cost to parts of the community. Therefore, a Regulatory Impact Statement (RIS) needed to be prepared under Part 5 of the *Statutory Instruments Act 1992*.

The RIS explains why energy and water measures are necessary and sets out the benefits and costs that would flow from such measures. The RIS does not represent Government policy. Your feedback on the RIS will help the Government to decide which measures if any should be adopted and which regulatory option is preferred.

The Queensland Government has also released *Towards Sustainable Housing in Queensland: Discussion Paper*. It should be read in conjunction with this RIS.

Introduction

The Queensland Government is investigating the introduction of measures to reduce energy and water use for new houses which may involve amendments to the *Standard Plumbing and Drainage Regulation 1993* and the *Standard Building Regulation 1993*. Amendments to the regulations have the potential to result in significant costs to the community. Under section 43 of the *Statutory Instruments Act 1992* a Regulatory Impact Statement (RIS) is required. This RIS assesses the impact of the possible measures and regulatory options.

Background

Greenhouse gas emissions from human activities, most notably through energy use, are accepted by the majority of climate scientists as being the most significant cause of climate change. Electricity generation was responsible for 26% of Queensland's 1999 greenhouse gas emissions and 23% of this electricity was generated for use in homes. A breakdown of household energy use is shown in Table 1.

Table 1 – Energy use in South East Queensland homes

Use	Proportion
Hot water	34%
Kitchen	23%
Lighting	13%
Space heating/cooling	10%
Laundry	10%
Entertainment	6%
Cleaning	2%
Other	2%

Source: Energex Residential Electricity Consumption: November 2002 to December 2003.

Demand for electricity in Queensland is growing and the summer peak demand is expected to increase at an average of 3.5% a year. The increasing use of air-conditioning is contributing to this growth and the need for air-conditioning is affected by house design.

Water availability is expected to be a major limiting factor for accommodating the anticipated population growth in Queensland. Population growth will also place increasing demands on available high quality surface water and groundwater resources and require substantial investment in infrastructure to meet total water requirements.

Population projections released in 2003 indicate that by 2026 the expected population of Queensland will increase from 3,796,800 to 5,289,000. Based on these projections, the number of households is expected to increase over this period from 1,275,000 to 2,212,000.

The typical life span of a house is about 60 years. Accordingly, relatively small changes in a house's design and fittings can have significant cost benefits.

Possible measures

This RIS examines six possible measures to make new housing more energy and water efficient. The items addressed include:

- water heaters;
- shower roses;
- efficient lighting;
- rainwater tanks;
- dual-flush toilet cisterns; and
- water pressure-limiting devices.

Regulatory options

This RIS assesses four regulatory options:

1. No regulation: a status quo or business as usual scenario.
2. State regulation: a mandatory Statewide regulation scenario.
3. State regulation with local government discretion: a model code that councils could incorporate into their local requirements.
4. Planning schemes: a scenario in which local governments take local initiatives.

Option 1 No regulation

The no regulation scenario would see the continuation of a number of current initiatives for energy and water. These include rebates on solar water heaters,[1] the promotion of AAA shower roses (as carried out, for example, by the Maroochy Shire Council),[2] and information dissemination by the Environmental Protection Authority (EPA) and the Department of Housing.

A voluntary compliance approach minimises compliance costs, allowing homeowners or builders to choose the level of housing sustainability that suits their circumstances (or to choose not to comply), and reduces enforcement and management costs for local governments. However, a voluntary system could produce a weaker outcome because many homeowners or builders would be either unaware of energy and water saving measures, or reluctant to pay the generally higher capital costs.

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1 The rebates on solar water heaters are managed by the EPA.
2 Source: www.soe-townsville.org/external_atmosphere/maroochy_council.html. Last accessed: 7 June 2004.

Option 2 State regulation

Statewide regulation would mandate requirements, using the powers of the Queensland Government to set regulations. This would result in a uniform standard across the State. The political process to establish the requirements need only be done once, at State level. The uniformity of requirements would make it easy for builders and buyers to know the minimum standards.

This is the preferred approach for the measures except for rainwater tanks. For more detail refer to the 'Preferred approach' section on page 15.

Option 3 State regulation with local government discretion

A model code would establish a set of requirements, which local governments could choose to adopt in their planning scheme if it met the requirements of their constituents. Advantages of the this scenario are that it only needs to be prepared once, stakeholders only have to negotiate its contents once, and it will provide a uniform standard for those local government areas that adopt it. However, under this option Queensland would end up with a two-tiered system, making it more difficult for builders and buyers to know the minimum requirements.

Option 4 Planning schemes

In this option, each local council could develop its own sustainable housing elements and code provisions or potentially choose to disregard the issue altogether. This is likely to result in considerable duplication of effort in preparing the codes, and would make it more difficult for builders and buyers to know what is required across jurisdictions.

The housing industry has expressed concerns about having to construct houses to different standards in different, particularly neighbouring, local government areas. It has been suggested that this would cause confusion amongst builders, and potentially increase construction costs and timeframes in having to conform to inconsistent standards.

Authorising law

Under Option 1, no regulatory change is involved.

Under Options 3 and 4, no change to State regulation is involved. Local governments would include requirements in their planning schemes made under the *Integrated Planning Act 1997*. Under Option 3, the State would develop a model code for local governments to adopt, while under Option 4, the local government would develop its own requirements.

Under Option 2, amendments would be required to the *Standard Plumbing and Drainage Regulation 1993* and the *Standard Building Regulation 1993*. The *Standard Plumbing and Drainage Regulation 1993* is authorised by the *Plumbing* *and Drainage Act 2002*. The *Standard Building Regulation 1993* is authorised by the *Building Act 1975*.

The *Plumbing and Drainage Act 2002* states in section 145(2) that:

"A regulation (the "Standard Plumbing and Drainage Regulation") may be made about plumbing and drainage work and the inspection of the work."

The *Building Act 1975* states in section 4(1) that:

"A regulation (the "Standard Building Regulation") made under this Act may be made about the following–

(a) building work, the certification of building work and the occupation of buildings;
(b) matters relating to the accrediting of building certifiers."

Policy objectives

The primary objectives of the proposed legislation are to:

- increase water efficiency;
- increase energy efficiency; and
- reduce greenhouse gas emissions.

A secondary objective of the proposed legislation is to:

- reduce infrastructure costs.

What is the problem that needs to be solved?

The increasing demand for more energy and water for use in houses is contributing to an increase in greenhouse gas emissions and is placing pressures on energy and water infrastructure.

What are the risks that need to be controlled?

The increasing greenhouse gas emissions attributed to household energy use poses risks in terms of potential impacts from global warming. These impacts include risks of increased frequency and severity of storms, floods and droughts, rising sea levels, loss of biodiversity and the spread of tropical diseases. Although Queensland's contribution to this problem is relatively small, the Queensland Government has made a commitment to reducing greenhouse gas emissions in recognition that this is an internationally shared problem.

The growing population in Queensland, and associated demand for new housing, will lead to further increases in greenhouse gas emissions if housing does not become more energy efficient. The increasing population growth also presents risks to Queensland's water supplies. Water availability is expected to be a major limiting factor for accommodating the anticipated population growth in Queensland.

In some areas, it is becoming apparent that, in the near future, if we continue to adopt a 'business as usual' approach, we will not have sufficient water to meet the needs of the increased population which is expected to move to Queensland. It is expected current water supply will be fully utilised in some parts of Queensland by 2025, unless we become more efficient with the water we use.

What has the Government already done and why should the Government continue to be involved?

The Queensland Government has already taken steps to ensure that new homes make long-term efficient use of our natural resources and provide a safe and affordable home for future generations of occupants. This issue requires Government intervention, as it is too important to leave solely to market forces. Any further requirements will build on past achievements.

In September 2003, the Queensland Government adopted the energy efficiency provisions of the Building Code of Australia. These provisions address the building fabric, which influences the amount of energy needed for heating and cooling, but do not address the efficiency of appliances and fixtures used in houses. They include requirements for new housing to achieve minimum energy efficiency performance. In conjunction with the national body responsible for the Building Code, the Government is investigating further improvements to the standards contained in the Building Code.

The Government (through the Environmental Protection Agency) provides a number of energy initiatives aimed at the household level, including the Solar Hot Water Rebate Scheme. Since 1998, the Government has provided rebates to more than 30,000 homeowners, providing an estimated saving of around 1.3 million tonnes of greenhouse gas emissions over the life of the hot water systems. The EPA also operates the Queensland Energy Advisory Service, which provides impartial, free advice on energy efficiency. In 2003/04 the Call Centre responded to approximately 4,500 queries.

A key program for promoting best practice in sustainable housing is the Department of Housing's Smart Housing initiative, with its focus on building industry and community education. Using the expertise of various Queensland Government agencies, Smart Housing has been able to produce a number of information tools and practical examples demonstrating how to achieve more socially, economically and environmentally-sustainable housing.

Local governments also play a critical role in encouraging sustainable development through a range of mechanisms such as water pricing, incentives, waste recycling, land use planning and community education.

What are the consequences of Government inaction?

If the Government fails to legislate to improve housing sustainability, energy use from new housing will continue to increase. This negatively impacts on the environment and on the wellbeing of future generations. There is also a more urgent concern that we will not have sufficient water to meet the needs of the increased population that is expected to move to Queensland. Increasing energy and water demand will also require more infrastructure, such as power plants and water storage facilities, which will increase costs to the community and generate their own environmental harm.

Legislative analysis

Legislative intent

The aim of amending the *Standard Plumbing and Drainage Regulation 1993* and the *Standard Building Regulation 1993* is to make houses more energy efficient and more sustainable and thereby reduce the environmental impacts of new houses in Queensland.

What rights, obligations or circumstance does the proposed amendment to legislation change or establish?

Amendment of the *Standard Plumbing and Drainage Regulation 1993* and the *Standard Building Regulation 1993* to make Queensland houses more sustainable will only apply to new houses. Under the current regulatory framework, buildings need only comply with the building standards in force at the time of construction, or when there is a building re-classification.

What is the overall effect of the proposed amendment to legislation likely to be?

The likely overall effect of amending the *Standard Plumbing and Drainage Regulation 1993* and the *Standard Building Regulation 1993* is that new houses will be required to include a package of measures to make the houses more energy efficient and use less water.

Why are the proposed amendments to legislation reasonable and appropriate?

The legislation will introduce sensible requirements that will benefit the environment as well as benefit the homeowner in terms of reduced energy and water bills. State and local governments will also benefit from reduced pressure on the need to upgrade energy and water infrastructure.

Consistency with authorising law

The *Plumbing and Drainage Act 2002* in section 145 states that a regulation (the "Standard Plumbing and Drainage Regulation") may be made about plumbing and drainage work and the inspection of the work. Therefore, energy and water saving measures relating to plumbing and drainage work would be consistent with the Act.

The long title of the *Building Act 1975* is:

"An Act to authorise the making of standard laws about the erection of buildings and other structures, to provide for building certifying, and for other purposes."

The *Building Act 1975* allows for regulation of building work covering the construction and alteration of buildings proposed by owners of buildings.

While the objective of the Act is not stated explicitly, it can be inferred that all buildings are to be built to uniform standards and that there must be a system of building certification to ensure the provisions of the Act are met. The provisions that enabled the *Standard Building Regulation 1993* are designed to regulate building work, occupation of buildings and certification of both building work and building occupation. These regulations were created to give building occupants and the community appropriate levels of building safety and amenity.

The options proposed as amendments to the *Standard Plumbing and Drainage Regulation 1993* and the *Standard Building Regulation 1993* are consistent with authorising laws, as they relate to aspects of plumbing and building work.

The proposed amendment's contribution to the achievement of the overall objectives of the *Plumbing and Drainage Act 2002* and the *Building Act 1975*

Amending the *Standard Plumbing and Drainage Regulation 1993* and the *Standard Building Regulation 1993* would require that all new houses throughout the State achieve energy and water savings, via control over various plumbing and building appliances and fittings.

Consistency with other legislation

Housing sustainability may be influenced by the following pieces of legislation:

- the *Integrated Planning Act 1997*; and
- the *Environmental Protection Act 1994*.

The *Integrated Planning Act 1997*

The purpose of the *Integrated Planning Act 1997* (section 1.2.1) is to seek to achieve ecological sustainability by:

- coordinating and integrating planning at the local, regional and State levels;
- managing the process by which development occurs; and
- managing the effects of development on the environment (including managing the use of premises).

The *Environmental Protection Act 1994*

The objective of the *Environmental Protection Act 1994* (section 3) is to protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends ('ecologically sustainable development').

National consistency

There is no nationally consistent approach to sustainable housing.

The New South Wales Government has announced a performance-based approach to water and energy efficiency (BASIX) to be phased in across the State. From 1 July 2004, new houses in Sydney are required to reduce potable water consumption by 40%, and reduce greenhouse gas emissions by 25%. These targets will apply throughout New South Wales by 1 July 2005. By 1 July 2006, the greenhouse reduction target will increase to 40%.

From 1 July 2004, all new houses in Victoria must be 5 star energy efficient, or 4 star with a solar hot water system, or 4 star with a rainwater tank. From 1 July 2005 all new houses must be 5 star energy efficient, and be fitted with either a solar hot water system or a rainwater tank; and include major water savings devices, such as AAA-rated taps and fittings.

South Australia introduced a Sustainable Development Bill to its Parliament in July 2004. If enacted, it will introduce requirements that will make it compulsory, by July 2006, for new houses to have rainwater tanks plumbed to the house, 5 star energy rating and hot water systems that are either solar or high-efficiency gas systems.

Since 1 July 1995, the ACT has required all new residences to achieve a minimum 4 star rating and sales or leasing of existing residences to be accompanied by an energy efficiency rating assessment.

Consistency with fundamental legislative principles

The proposed options are consistent with fundamental legislative principles. The proposed provisions would apply only to new houses. The proposed requirements are not retrospective.

Regulation and its alternatives

The four approaches to achieving housing sustainability that have been considered and analysed are:

1. No regulation: a status quo or business as usual scenario.
2. State regulation: a mandatory Statewide regulation scenario.
3. State regulation with local government discretion: a model code that councils could incorporate into their local requirements.
4. Planning schemes: a scenario in which local governments take local initiatives.

For further information on the four regulatory options refer to the 'Regulatory options' section on page 2.

The main variation between the regulatory options is the penetration or adoption rate of the measures. Assumptions about adoption of each of the measures under the different regulatory options are based on a continuation of recent trends (no regulation scenario), 100% adoption (State regulation) and two intermediate levels (State regulation with local government discretion and planning schemes). While there are uncertainties for each of the scenarios, the cost-benefit impact will generally lie between the upper bound, represented by the State regulation scenario, and lower bound, represented by the no regulation scenario.

Analysis of the no regulation scenario is based on an understanding of the penetration rates under existing frameworks and government policies.

Analysis of the State regulation scenario assumes that the penetration rate in all new homes would be 100%.

The State regulation with local government discretion scenario and planning schemes scenario are intermediate penetration scenarios with analyses based on responses to a questionnaire sent to local councils in Queensland. This is tempered by considerations of what is considered achievable over the next five to ten years. In general, councils have indicated that they are more likely to introduce water efficiency measures than energy efficiency measures.

National Competition Policy

The proposed amendments to the regulation will apply equally and without discrimination to any person or entity building a new house throughout Queensland.

The extent that the proposed amendments impose or encourage restrictions

The proposed amendments are likely to increase barriers to entry in the housing market. The proposed amendments will increase barriers to entry by imposing higher capital costs for prospective homeowners. These higher set up costs would, however, be offset by lower ongoing electricity and water bills.

Do the associated benefits outweigh the costs from an economy wide perspective?

The benefits to Queensland of the proposed amendments include:

- reduced growth in greenhouse gas emissions;
- more energy efficient houses with lower water use;
- lower ongoing electricity and water bills for consumers; and
- reduced pressure on the need to upgrade or supplement existing electricity and water infrastructure.

The proposed amendments are expected to result in a $320 million net benefit to the Queensland economy (Net Present Value, mid 2004 dollars).

Risk assessment

The main risks addressed by the proposed regulations are:

- availability of adequate water supplies for a growing population;
- availability of adequate energy supplies for a growing population; and
- concerns regarding the need to reduce greenhouse gas emissions.

Water supply

Water availability has the potential to be a major limiting factor for accommodating the anticipated population growth in Queensland unless actions are taken to address this issue. The proposed regulations will help to reduce demand placed by households on water supplies. This will help to reduce the risks that limited water availability pose to Queensland's anticipated population growth.

Energy supply

Twenty-three percent of Queensland's electricity is generated for use in homes. Household electricity use is growing as households use more electrical devices and as the number of Queensland households rises. This places increasing demands on Queensland's electricity supply infrastructure. The proposed regulations will help to reduce demand placed by households on electricity supplies. They will help to reduce risks to the performance of Queensland's electricity supply infrastructure posed by increasing household energy demand.

Greenhouse gas emissions

Increasing levels of greenhouse gases are believed to be the major cause of global warming. This poses risks to Queensland through the potential for the spread of tropical diseases, loss of biodiversity, increased number and severity of severe weather events and rising sea levels. The proposed regulations will help to reduce growth in greenhouse gas emissions and thereby contribute to addressing the risks posed by this problem.

Impacts

Households

The predicted impacts on end-users are mixed, as shown in Table 2. Households are likely to benefit from solar electric water heaters, heat pump water heaters, AAA shower roses, dual-flush toilet cisterns, water pressure-limiting devices and efficient lighting. The benefits from the solar electric and heat pump water heaters derive initially from the rebates obtained from the sale of Renewable Energy Certificates (RECs) and then from the savings in operating costs over the life of the water heater. For other appliances, the savings to households derive from savings in electricity and water operating costs to the household.

Table 2 – Net benefit to individual households, $(NPV), mid 2004 dollar terms

	Zone 1 Far north $	Zone 2 Sub-tropical $	Zone 3 Western $	Zone 5 Tablelands $
Solar electric HWS	1,570	1,687	1,313	1,946
Solar gas HWS	-688	-413	-1,215	15
Gas continuous HWS	-2,050	-713	-2,268	-551
Heat pump HWS	965	1,054	767	1,451
AAA shower roses	455	538	471	539
Rainwater tanks	-1,136	-924	-1,410	-1,023
Dual-flush toilet cisterns	45	69	45	45
Efficient lighting	76	76	76	76
Water pressure-limiting devices	40	62	41	41

Other impacts

Other impacts are likely to be limited. The Queensland Government and councils are likely to incur costs to cover the administration of the scheme of between $1 million per annum for the State regulation scenario and $3 million per annum for the planning schemes scenario.

Queensland industry is neither likely to benefit nor to be adversely affected under any of the scenarios. Most of the appliances are either imported from overseas or produced in other states of Australia. A higher adoption rate for solar electric and heat pump water heaters may impact on local electric water heater manufacturers. If the rainwater tanks are adopted, then local manufacturers will benefit, as there are several based in Queensland.

Preferred approach

There are clear benefits to the community and individual households in regulating greenhouse efficient water heaters, AAA showerheads, efficient lighting, water pressure-limiting devices and dual-flush toilet cisterns on a Statewide basis.

The benefits of regulating rainwater tanks vary, being subject to local water pricing and availability, with estimates of net costs to householders ranging from $920 to $1,910 (NPV). It is therefore proposed that a decision as to whether a rainwater tank be installed with a new house be a matter for the local government.

The preferred regulatory options are summarised in Table 3. This approach has the highest net benefit to Queensland.

Table 3 – Preferred regulatory approaches for sustainable housing measures

Sustainable housing measure	Option 1 No regulation	Option 2 State regulation	Option 3 State regulation with local government discretion	Option 4 Planning schemes
Greenhouse efficient hot water systems		✓		
Energy efficient lighting		✓		
AAA shower roses		✓		
Dual-flush toilet cisterns		✓		
Water pressure-limiting devices		✓		
Rainwater tanks			✓	

Population and housing growth assessments

Queensland population growth

Medium series forecasts of projected resident population (PRP) by local government area (LGA) in five year blocks from June 2001 to June 2026 were provided by the Planning Information and Forecasting Unit (PIFU) of the (then) Department of Local Government and Planning.

The forecasts, dated October 2003, project a growth rate of Queensland's residential population of 1.5% per annum over the 25 year period. Projected growth rates are uneven across Queensland, with South East Queensland (SEQ) projected to grow at 1.7% per annum and the rest of Queensland (ROQ) at 1.2% per annum. Growth is expected to slow over time.

Projections of dwelling stock numbers

The following procedure was used to project dwelling stock numbers by LGA from population growth projections:

- councils were divided into SEQ or ROQ; SEQ contains about 65% of the population of Queensland with the remainder being in ROQ;
- the average persons per dwelling in SEQ is 2.36 and 2.29 in ROQ;[3] and
- the average persons per dwelling (ppd) is expected to continue to reduce over time. PIFU projections from 1999 predicting a reduction in household size, were adjusted to 2001 values, and used in the analysis.

The result has been a forecast dwelling growth rate over the period 2006 to 2026 of about 1.9% per annum for Queensland as a whole, 2% per annum in SEQ and 1.7% per annum in ROQ. Again, growth in the latter years of the period is expected to be slower than in the earlier years.

Projected growth in Class 1 buildings

The dwelling stock projected above includes all sorts of dwellings – occupied and unoccupied, Class 1 and Class 2 dwellings and 'other' dwellings (caravans, cabins, tents etc). In order to project Class 1 housing growth from the above stock number, this report:

- projects the 'other' component of dwelling stock;
- calculates by subtraction increases in housing stock (both occupied and unoccupied) over each five year period; and
- adds to the above number a component for demolitions.[4]

3 Australian Bureau of Statistics. 2001. *Census of population and housing,* information provided by PIFU. Total population divided by total dwellings including unoccupied, other dwellings (caravans, cabins, etc) and unstated dwellings.

4 The number of new dwellings constructed equals the change in stock plus the number demolished.

According to the 2001 census, the proportion of 'other' homes was 1.4% in SEQ and 5.4% in ROQ. However, the proportion of 'other' homes has been reducing over time. Between the 1991 and 1996 census years, the proportion reduced by about 20%, while between 1996 and 2001 the proportion reduced by about 12%. A reduction in the proportion of the 'other' category by 8% between 2001 and 2006 has been projected, reducing to 2% between 2021 and 2026. This reduces the other component to 1.1% in SEQ and 4.2% in ROQ by 2026. The dwelling stock was reduced by this 'others' proportion.

PIFU has estimated that 1,000 separate houses are demolished in Queensland each year – about 0.1% of total dwelling stock in each year. This resulted in estimated annual new housing growth of about 44,000 dwellings between 2001 and 2006, reducing to 40,000 between 2021 and 2026. Some 70% to 72% of this growth is expected to be in the SEQ region. The early years of this projection are approximately in line with recent history and with recent BIS Shrapnel forecasts.[5]

PIFU has provided dwelling approvals history for detached houses, attached houses and total dwellings in Queensland, SEQ and ROQ from 1992 to 2004. From this information the proportion of Class 1 buildings (both detached and attached houses) of total new dwellings has been estimated.[6] Trend analysis suggests that the proportion of Class 1 buildings is reducing slightly in SEQ and increasing slightly in ROQ – although the correlation coefficients are low (r^2 of about 0.23 in both cases). The proportion of new dwellings that are flats or apartments is expected to increase over time. Trend-line estimates are assumed for Class 1 buildings in SEQ, with this proportion reducing from 77% in 2006 to 68% in 2026. In ROQ it is assumed that the proportion of Class 1 buildings will remain at 89%, the average over the past 12 years.

The projected Class 1 housing constructions for SEQ, ROQ and Queensland as a whole are shown in Table 4.

Table 4 – Forecast average annual new Class 1 building constructions

	2001-2005	2006-2010	2011-2015	2016-2020	2021-2025
SEQ	24,552	22,896	21,769	20,376	18,815
ROQ	10,911	11,213	11,409	11,194	10,747
Queensland	35,463	34,108	33,178	31,570	29,562

MMA is forecasting that 30,000 to 35,000 Class 1 buildings will be constructed each year to 2026; of these 65%–70% will be in SEQ.

5 BIS Shrapnel in its *Building Industry Prospects*, March 2004, has estimated underlying demand growth for new dwellings as 44,900 dwellings for Queensland for the period 2004/05 to 2008/09.

6 Excluding 'other'.

Distribution by climate zone

Each of the LGAs are classified into climate zones according to the BCA climate map as discussed in the section titled 'Climate zones' on page 21. The proportion of the total of new Class 1 buildings forecast in each of the zones is shown in Table 5.

Table 5 – Proportion of new Class 1 buildings by climate zone

Zone	Reference city	% of new Class 1 buildings
1 Far north Queensland	Cairns/Townsville	12%–14%
2 Sub-tropical coastal	Brisbane	79%–82%
3 Western	Longreach	2%–3%
5 Tablelands	Toowoomba	4%
Total		100%

The distribution is dominated by the sub-tropical coastal zone, which includes all of SEQ and much of the statistical divisions (SDs) of Wide-Bay Burnett, Fitzroy and Mackay.

Greenhouse gas and water savings: evaluation of measures considered

The study requires the evaluation of savings due to various water and energy/greenhouse gas efficiency measures if adopted for new Class 1 buildings by climate zone. In order to assess the water and energy savings it has been estimated, for the period in question:

- how many new Class 1 buildings will be built;
- the distribution of these buildings between the four climate zones assessed;
- energy usage and greenhouse gas emissions for the energy efficient appliances by climate zone;
- energy usage and greenhouse gas emissions for typical appliances currently used in new houses, by climate zone;
- water usage for the relevant appliances by climate zone;
- water usage for typical appliances currently used in new houses, by climate zone;
- proportion of new houses which already incorporate the energy/water efficient appliances; and
- operating cost savings from applying the measures.

The definitions and framework for the evaluation are provided in this section. The actual parameter calculations and evaluations are contained in the following sections.

Class 1 buildings

Class 1 buildings are defined as including all separate houses and all semi-detached row or terrace houses and townhouses. The only major categories of housing excluded are flats, apartments and 'others' such as caravans, tents etc.

Population and housing data for Queensland, SEQ and ROQ produced by the Australian Bureau of Statistics (ABS) from the 2001 census are provided in Tables 6, 7 and 8.

Table 6 – 2001 Census data for all dwellings

	Population	% of total	All dwellings	% of total
SEQ	2,274,357	66%	961,855	65%
ROQ	1,193,954	34%	521,057	35%
Total	3,468,311	100%	1,482,912	100%

Source: ABS. 2001. Census of population and housing. Selected social and housing characteristics, Queensland.

Table 7 – 2001 Census data for Class 1 dwellings

	Population	% of total	Class 1 dwellings	Persons per dwelling
SEQ	2,031,399	66%	746,313	2.72
ROQ	1,062,374	34%	390,803	2.72
Total	3,093,773	100%	1,137,116	2.72

Source: ABS. 2001. Census of population and housing. Selected social and housing characteristics, Queensland.

Table 8 – Types of dwellings as a percentage of total dwellings

	Class 1 dwellings	Class 2 dwellings	Other	Total
SEQ	78%	13%	10%	100%
ROQ	75%	8%	17%	100%
Total	77%	11%	12%	100%

Source: ABS. 2001. Census of population and housing. Selected social and housing characteristics, Queensland.

In 2001 66% of the Queensland population and 65% of Queensland dwellings were located in the Brisbane and Moreton statistical divisions. The rest of Queensland made up 34% of the population and 35% of the dwellings.

Class 1 buildings (both separate and semi-detached) made up some 78% of total dwellings in south-east Queensland and some 75% in the rest of the State.

Persons per dwelling in Class 1 buildings

Energy and water usage and savings were assessed on a per household (HH) basis. However, assessments of energy and water usage and savings often require consideration of the number of people in a dwelling as well. The average number of ppd in Class 1 buildings[7] is 2.72 in both SEQ and ROQ.

Climate zones

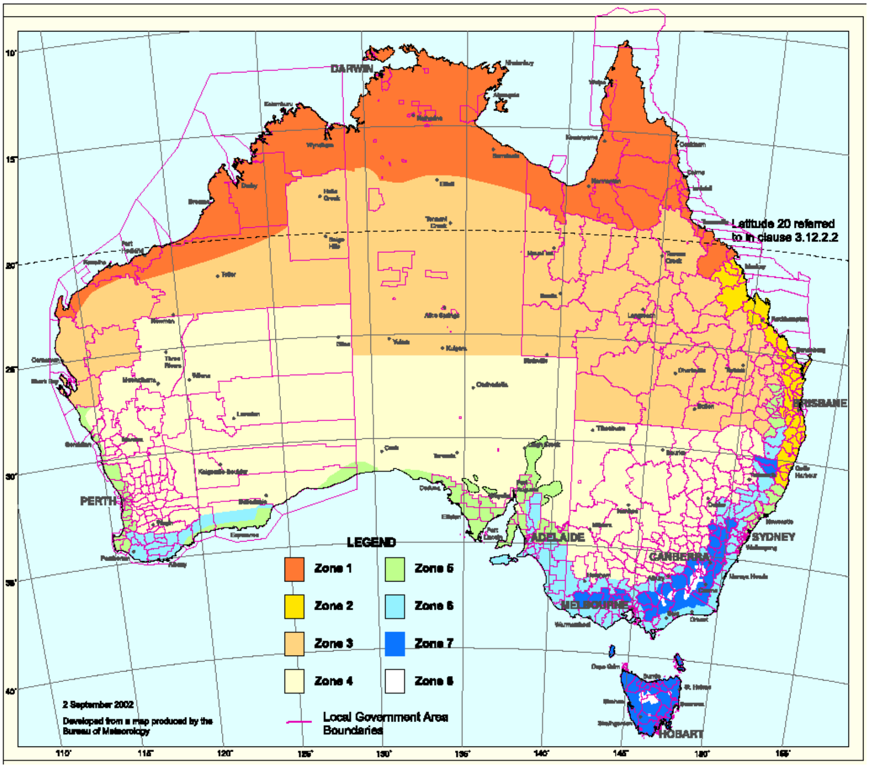
Some of the water and energy savings measures being examined, and the benefits and costs attributable to them, will have different values in different locations. As climatic differences are likely to play a significant part, evaluations were carried out for four of the different climate zones in Queensland based on the Building Code of Australia climate map (Figure 1). The zones and some of the major population centres are provided in Table 9. The reference cities are those used in order to evaluate some of the climatic parameters required for the assessment.

7 Here defined as the persons per occupied dwelling.

Table 9 – Zones assessed

Zone	Major centres/LGAs	Reference City
1 Far north Queensland	Cairns, Townsville, Thuringowa	Cairns/Ingham
2 Sub-tropical coastal	Brisbane, Moreton, Bundaberg, Hervey Bay	Brisbane
3 Western	Calliope, Banana, Emerald	Longreach/Emerald
5 Tablelands	Toowoomba, Warwick	Toowoomba

Figure 1 – Climatic zones for thermal housing design



Map reproduced with permission of Australian Building Codes Board.

Note: This is the current reference map for Australia's climatic zones, however it is subject to annual assessment, and therefore local governments' climate zone classification may differ with additional information in the future.

Measures evaluated

The greenhouse gas savings (measured as carbon dioxide equivalents, CO_{2-e}) and/or water savings that can be achieved by displacing current practice in new buildings with the items examined have been evaluated.

These measures have previously been evaluated in two earlier MMA reports: *Social, Economic and Environmental Implications of Proposed Energy Efficiency Amendments to BCC's City Plan House Code*, and *Economic, social and environmental analysis of the draft Sustainable Housing Code*. Where changes to the assumptions have been considered necessary, the evaluations have been revised for this report.

As noted above, the potential savings will vary across Queensland's climate zones. The benefits have been analysed by zone to build up a total picture for Queensland.

Period assessed

The evaluation covered new homes constructed over the period 2006 to 2016, and the period of the benefits allowed a life of the measure of 15 or 20 years.

Greenhouse gas emission factors

The full cycle greenhouse gas emissions for fuels were used which are contained in the *Australian Greenhouse Office Factors and Methods Workbook*.[8] These factors are listed in Table 10.

Table 10 – Assumed full fuel cycle greenhouse gas emissions

Assumption	Kg CO_{2-e}*	Source
Emission factors for electricity purchased/ used/delivered in Queensland	300	Workbook Table 26
Full fuel cycle emissions from combustion of natural gas, smaller users, Queensland	74.8	Workbook Table 27
Full fuel cycle emissions from combustion of automotive diesel oil (ADO)	77.6	Workbook Table 24
Full fuel cycle emissions from combustion of LPG (transport)	68.2	Workbook Table 29

** To convert GJ to kWh, multiply GJ by 278.*

8 Version 3, March 2003.

Cost-benefit background

Constraints on the cost-benefit assessments

This assessment was constrained in a number of important ways. The assessment is restricted to new Class 1 buildings.[9] Energy efficiency related to the building fabric is excluded because this is covered by the Building Code of Australia. The Building Code addresses the fabric of the overall building structure, and includes factors such as orientation, insulation, ventilation, glazing and shading. These measures became effective for new homes and significant alterations to existing homes in Queensland on 1 September 2003.

The assessment was restricted to three items for greenhouse emissions, namely water heaters, shower roses and energy efficient lighting. Water heaters may also have implications for water use, but recent assessments suggest that this will be negligible.

The greenhouse efficient water heaters have been defined as high-efficiency gas, solar with electric boost, solar with gas boost or heat pump.

The energy efficient lighting has been defined as fluorescent tube fittings, circular fluorescents or compact fluorescent light fittings with efficiencies of 75 lumens per Watt. It is assumed that they are used in one main living area.

The assessment is limited to three water using items and one water storage item. The water using items are shower roses, toilet cisterns and water pressure-limiting devices. Shower roses are to be AAA-rated, which is a clearly defined standard. If AAA shower roses reduce the use of hot water, this will also reduce the energy required to heat water and therefore will have the potential to reduce greenhouse gas emissions.

The toilet cisterns are defined as dual-flush, which has been further defined to be cisterns with a flushing capacity of 6 or 3 litres.

A water pressure-limiting device is designed to reduce the flow of water through taps and other outlets by reducing the pressure in the pipes. It is assumed that the device reduces the pressure to 3 bar (300 kPa).

The water storage item, rainwater tanks, was defined as a tank with a capacity of 3,000 litres. For SEQ[10] the greatest potential use for water from rainwater tanks is

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9 Class 1 buildings are further divided into Class 1a and Class 1b. Class 1a means a single dwelling which is a detached house; or one or more attached dwellings, each being a building, separated by a fire-resisting wall, including a row house, terrace house, townhouse or villa unit. Class 1b includes all boarding houses, guest houses, hostels or the like with a total floor area not exceeding 300 m^2 and in which not more than 12 persons would ordinarily be resident. All Class 1 buildings are not located above or below another dwelling or another Class of building other than a private garage.

10 South-east Queensland is defined as the statistical divisions of Brisbane and Moreton.

outside of the house where 51% of water is used.[11] Therefore, it is assumed that the water from the rainwater tank will be used in the garden.

Assessment criteria

The analyses required for this assessment can be separated into analyses of the efficiency measures and analyses of the regulatory scenarios.

Efficiency measures

Table 11 shows the seven assessments required for the efficiency measures. The criterion for water heaters will be reductions in CO_{2-e}. Efficient water heaters might influence behaviour and encourage reduced water use, but there is no convincing evidence of this. Shower roses have the potential to reduce the use of hot water, and as a consequence reduce CO_{2-e} emissions, so they have been assessed on both CO_{2-e} and water. Rainwater tanks, dual-flush toilet cisterns and water pressure-limiting devices have the potential to reduce water use only.

Table 11 – Assessment of efficiency measures

Efficiency measure	Assessment criteria	
	CO_{2-e} emissions	Water use
Water heaters	✓	–
Shower roses	✓	✓
Efficient lighting	✓	–
Rainwater tanks	–	✓
Dual-flush toilet cisterns	–	✓
Water pressure-limiting devices	–	✓

Regulatory scenarios

The focus of this cost-benefit assessment is to tease out the differences in social benefits and costs from the four regulatory options and to detail the characteristics of sustainable appliances and equipment that best suit a particular form of regulation.

Table 12 shows the 12 assessments required for the four regulatory impact scenarios, that is, all scenarios will need to be assessed in terms of their costs to government, industry and the community. In this context, State and local governments are included in government. All the building trades and construction service providers are included in the industries that are likely to be affected. The community includes both the buyers and occupiers of Class 1 buildings.

11 McLennan Magasanik Associates. 2004. *Economic, social and environmental analysis of the draft Sustainable Housing Code*, Volumes 1 and 2. Report to Queensland Department of Housing. Page 44.

Table 12 – Assessment of regulatory scenarios

Scenario	Assessment criteria		
	Cost to government	Cost to industry	Cost to community
No regulation	✓	✓	✓
State regulation	✓	✓	✓
State regulation with local government discretion	✓	✓	✓
Planning schemes	✓	✓	✓

Under benefits, the operating cost savings, the long-run marginal cost savings of reduced water use (including avoided capital costs for dams and pipes) and the estimated value of CO_{2-e} savings are considered. MMA's model of the electricity market was used to determine the savings in capital, fuel and operating costs in electricity generation. The amenity benefits of deferring the construction of dams in pristine areas, using standard values for the amenity loss was estimated.

Under costs, the incremental costs of appliances and the indicative costs of the regulatory options were considered. The economic costs to industry, the impact of reduced demand for electricity, gas and water, which will have the effect of increasing the relative contribution of fixed costs to overall costs, were also considered.

A key cost component for the different regulatory regimes is compliance and administration costs. Data on these costs were sourced from similar programs in Australia and overseas.

Limitations and uncertainties

Data limitations and uncertainties exist in three main areas of the analysis and report:

- assumptions about energy and water savings from adopting energy efficiency measures;
- penetration rates of efficient appliances in new homes currently, and under the different regulatory scenarios; and
- the value of societal benefits from reduced energy and water use and greenhouse gas emissions.

These uncertainties have been handled in a variety of ways in the analysis, including the use of transparent methodologies and assumptions and assessments of sensitivity to key variables.

Energy and water savings

There is some uncertainty about the quantum of water and energy savings attributable to almost all of the measures. This can be seen, for example, in the analysis of water savings from adopting AAA shower roses. Analyses based on differences in theoretical flow rates suggest levels of water savings that are significantly higher than actually experienced in trials where proper measurements have been carried out. Where possible, estimates are based on studies which have estimated actual savings in Australia.

Where this was not possible, assumptions are based on modelling by credible parties and the latest credible data available. Thus, for example, the assessment of efficiencies of solar electric heaters in Brisbane was based on information supplied by the Queensland Sustainable Energy Industry Development Group.

Where credible sources have not been available, more general sources were used, for example, information from the USA in the estimation of the efficiency of heat pump water heaters.

Where even this was not possible, for example in the case of the impact of rainwater tanks, MMA carried out modelling. In these cases, MMA have provided details about the modelling methodology and key assumptions made.

Penetration rates

Current penetration rates of the efficient appliances in new houses have been estimated based on a combination of available survey data and discussions with quantity surveyors. Where information about penetration in new houses was not available, it was assumed that this will be the same as the penetration rate in Queensland houses as a whole.

Assumptions about adoption of each of the measures under the different regulatory options have been based on a continuation of recent trends (no regulation scenario), 100% adoption (State regulation) and two intermediate levels. While there are uncertainties for each of the scenarios, the cost-benefit impact will generally lie between the upper bound, represented by the State regulation scenario, and lower bound, represented by the no regulation scenario.

Valuation of benefits

Energy, water and greenhouse gas emission savings have been valued according to the current estimation of the long-run marginal values/costs of these items. Sensitivity analyses were conducted where a wide range of values is possible, for example, the value of avoided carbon dioxide emissions has been varied from $10 to $30/t to test its effect on the outcomes.

Costs of appliances

Data for the materials and installation costs of appliances were drawn from MMA's study of the draft South East Regional Organisation of Councils (SEQROC) Sustainable Housing Code, which was compiled for that assessment by the Brisbane office of the quantity surveyors Wilde and Woollard. For each appliance they costed:

- current practice, that is, the way buildings are currently constructed; and
- a new dwelling cost, substituting the new appliance for that used in current practice.

This was supplemented by collecting materials and labour costs for water heaters and shower roses for this assessment. These appliances were not covered in previous MMA assessments. The assumptions used in calculating these costs include the following:

- dual-flush toilet cisterns are used in 95% of new dwellings;
- AAA shower roses are now standard practice;
- rebates for shower roses provided by some local governments have not been incorporated;
- solar water heaters receive a rebate of $1,100;[12] and
- the cost of the heat pump water heater is based on advice from the Department of Local Government, Planning, Sport and Recreation (DLGPSR) that the installed cost will be similar to the cost of solar electric water heaters.

Methodology for costs

Table 13 summarises the costing data that was collected for SEQ. The implementation cost is the difference between the current practice and its proposed replacement. If the currently used appliance has the same materials and installation cost as its proposed replacement, then the implementation cost is zero.

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12 Data supplied by the EPA for Solahart models 302L and 302J, which were taken as typical solar water heaters. Both of these models earn 30 RECs, which have been paying in the range of $36 to $38 per REC.

Table 13 – Implementation costs

	Item used in current practice	Current practice cost	Compliance cost	Implementation cost
Solar electric water heater	Electric off-peak storage, 250 L, Dux	$1,000	$2,208	$1,208
Solar gas water heater	Electric off-peak storage, 250 L, Dux	$1,000	$4,177	$3,177
Natural gas storage water heater	Electric off-peak storage, 250 L, Dux	$1,000	$1,806	$806
Continuous gas water heater	Electric off-peak storage, 250 L, Dux	$1,000	$1,264	$264
Heat pump water heater	Electric off-peak storage, 250 L, Dux	$1,000	$2,208	$1,208
AAA shower rose	AAA shower rose	$47	$47	$0
Rainwater tank 3,000 L	No equivalent	$0	$1,352	$1,352
Dual-flush toilet cisterns	6/3 litre flush	$940	$940	$0
Efficient lighting*	Incandescent lamps	$99	$99	$0
Water pressure-limiting device	No equivalent	$240	$240	$0

** Efficient lamps cost approximately the same as incandescent lamps in materials and labour costs when purchased in the volumes bought by project home builders.*

As was noted earlier, this costing data was collected for SEQ. Multipliers from Cordell's were used to convert these values to estimates for the four reference locations, as shown in Table 14.[13]

Table 14 – Implementation costs for reference locations

	Warm humid summer, mild winter	Hot dry summer, warm winter	High humidity summer, warm winter	Warm temperate
Climate zone number	2	3	1	5
Reference location	Brisbane	Longreach	Cairns	Toowoomba
Cordell's multiplier	1.00	1.14	1.03	0.91
Solar electric water heater	$1,208	$1,377	$1,244	$1,099
Solar gas water heater	$3,177	$3,621	$3,272	$2,891
Natural gas storage water heater	$806	$919	$830	$733
Continuous gas water heater	$264	$441	$302	$150
Heat pump water heater	$1,208	$1,377	$1,244	$1,099
AAA shower rose	$0	$0	$0	$0
Rainwater tank 3,000 L	$1,352	$1,542	$1,393	$1,231
Dual-flush toilet cisterns	$0	$0	$0	$0
Efficient lighting	$0	$0	$0	$0
Water pressure-limiting device	$0	$0	$0	$0

13 Cordell Building Publications. 2004. *Building cost guide, Housing, Queensland*. May 2004.

Efficient hot water systems

Measure proposed

The measure proposed is the requirement that greenhouse efficient hot water systems (HWS) are used in new Class 1 buildings in Queensland. The greenhouse efficient HWS under consideration are:

- solar electric;
- solar gas;
- efficient gas (here taken to mean either 5 star gas storage or instantaneous/continuous gas); and
- heat pump.

Current average electricity usage

The two Queensland electricity retailers to households, Energex and Ergon Energy, were asked to estimate the average annual energy consumption by domestic electric hot water systems. Energex estimated this to be 3,078 kWh while Ergon Energy estimated it to be 2,930 kWh. In the case of Energex, the calculation was based on the average consumption of consumers on the T31 and T33 domestic tariffs.

While there are some uncertainties about this estimate,[14] an average value 3,000 kWh is used for the Energex customer base in SEQ.

Average usage by Class 1 buildings

The estimated 3,000 kWh for average usage in SEQ takes into account usage by householders in both Class 1 buildings and Class 2 dwellings as well as in other dwellings.

In order to estimate the energy used for hot water in Class 1 buildings in SEQ, the value was multiplied by the ratio of ppd in occupied Class 1 buildings (2.72) over the ppd in all occupied Class 1 and Class 2 dwellings in SEQ (2.57).[15]

This results in an estimated 3,170 kWh used for hot water per Class 1 building in SEQ.

All else being equal, one would expect energy usage for water heating in colder climates to be greater than that in warmer climates, largely because of the difference in the amount of heating required to reach the reference hot water

14 The off-peak tariffs are understood to contain a component of uses other than hot water systems, for example pool heating. This would tend to reduce the average usage for hot water below that estimated from the off-peak tariff calculation. On the other hand, the average usage will also include a component for 'other' dwellings and those which are unoccupied for much of the year, as well as some solar electric hot water systems which utilise these tariffs.

15 Data provided by DLGPSR. Data includes separate and semi-detached dwellings, flats and apartments.

temperature of 60°C. The expected usage by Class 1 building users in other climate zones was based on the Brisbane estimate (3,170 kWh) multiplied by the ratio of:

(60°C – average temperature in the city)/(60°C – average Brisbane temperature)

The expected electricity usage in the other climate reference cities is shown in Table 15.

Table 15 – Estimated electricity usage for hot water in Class 1 buildings in reference cities

Zone	Reference city	Electricity used (kWh)	Electricity used (GJ)
1 Far north Queensland	Cairns	2,840	10.2
2 Sub-tropical coastal	Brisbane	3,170	11.4
3 Western	Longreach	2,960	10.6
5 Tablelands	Toowoomba	3,460	12.5

Because the occupancy rate of Class 1 buildings in both SEQ and ROQ is very close to 2.72 the ppd differences has not been further corrected between regions.

Average efficiencies of greenhouse efficient hot water systems

The average efficiency of various hot water systems was previously provided by MMA in a report to the Queensland EPA and Brisbane City Council (BCC).[16] These details are provided in Table 16. MMA has subsequently been advised that the efficiency of the solar hot water systems assumed at the time significantly understates that likely to be obtainable in Queensland.

The Queensland Sustainable Energy Industry Development Group (QSEIDG) has assessed the solar contribution factor (SCF) of the most commonly sold solar hot water system in Brisbane. Using the F chart simulation method, it was found to be 86%. QSEIDG has advised that this is the appropriate number to use in calculating the electric boost energy requirement,[17] and that this value may even be somewhat conservative.

This means that the amount of electricity used by solar systems boosted with electricity is assumed to be only 14% of the electrical energy used by electric hot water systems in SEQ.

16 McLennan Magasanik Associates. 2002. *Social, Economic and Environmental Implications of Proposed Energy Efficiency Amendments to BCC's City Plan House Code*. Report to the Queensland EPA and BCC, September 2002.

17 Queensland Sustainable Energy Industry Development Group. 2004. *Modelling of Solar Contribution and Energy Savings of Domestic Solar Hot Water Systems in Brisbane*, 21 July 2004 and *Clarification of Solar Fraction and Service Efficiency*, personal communication, 22 July 2004.

The solar efficiencies for other climate zones have been changed commensurately, based on relative solar contribution factors, resulting in estimated SCF contributions of 96% for Cairns, 78% for Toowoomba and 92% for Longreach. Solar systems with gas boosting are estimated to increase the amount of energy required by some 6%.

The values for Brisbane used in the current study are shown in Table 16. The efficiencies provided are on an 'energy factor' basis which measures the useful energy output divided by the fossil fuel input.

Table 16 – Energy factor efficiencies* assumed for the previous and current studies in SEQ

System	Efficiency assumed	
	Previous study	Current study
Off-peak electric storage	80%	80%
Standard gas storage	52%	52%
High-efficiency gas storage	65%	65%
Standard gas instantaneous	70%	70%
High-efficiency gas instantaneous	82%	82%
Solar with electric boost	250%	571%
Heat pumps	250%	200%

** Energy factor efficiency is the useful energy output divided by the fossil fuel input.*
Sources: Derived from Table 3.1 in MMA's report Social, Economic and Environmental Implications of Proposed Energy Efficiency Amendments to BCC's City Plan House Code and more recent evaluation discussed above.

The assumed 80% efficiency for current off-peak electric storage is estimated to result in the average electricity usage of 3,170 kWh per year. The solar electric efficiency of 571% shown in Table 3 results in an assumed electricity usage of 444 kWh.[18] This is 14% of the electricity currently used by electric hot water systems.

There is little accurate information available about the efficiencies of heat pump water heaters (HPWHs). According to the literature, the energy factor of HPWHs is of the order of 2 to 3,[19] meaning the heat output is two to three times as great as would be achieved from a resistance electric heater. A 200% energy factor has been assumed in Brisbane and Toowoomba, meaning that the electrical energy required for hot water heating would be 40% that of an off-peak hot water system and 240% in Cairns and Longreach, about one-third that required from off-peak electric hot water systems.

18 Calculated as 3,170 x 80%/571% = 14%.

19 See, for example, Washington State University Energy Program. 2000. *Energy efficiency fact sheet, Heat pump water heaters – Residential.* It suggests energy factors of 2.0 to 2.5 for HPWHs.

Current hot water supply by zone

Based on a survey carried out for the Queensland Department of Public Works in 2001,[20] the distribution of hot water systems has been estimated by zone, as shown in Table 17.

Table 17 – Distribution of existing hot water systems by zone

Zone	Main LGAs	Electric	Solar	Gas
1 Far north Queensland	Cairns, Townsville, Thuringowa, Ingham	82.3%	8.7%	9%
2 Sub-tropical coastal	Brisbane, Moreton, Bundaberg, Hervey Bay	77.1%	8.8%	14.1%
3 Western	Calliope, Banana, Emerald	77.6%	10.7%	11.7%
5 Tablelands	Toowoomba, Warwick	75%	7%	17.9%

It is assumed that all the solar is solar electric and that all the gas in zones 2 and 5 is natural gas,[21] while all gas in zones 1 and 3 is LPG.

Current energy use and greenhouse gas emissions

The energy consumptions of current HWS and more efficient systems are shown in Table 18, and the corresponding greenhouse gas emissions are shown in Table 19.

Solar and heat pump water heaters use less energy than the current mix of water heaters.

Gas, solar and heat pump water heaters produce less greenhouse gas than the current mix of water heaters.

Table 18 – Energy usage of current average HWS and potential, kWh per unit pa

Zone	Current*	Solar electric	Solar gas	High-efficiency gas**	Heat pump
1	2,712	107	274	3,244	946
2	3,124	444	611	3,626	1,269
3	2,817	232	399	3,380	986
5	3,538	768	932	3,953	1,384

** Based on estimated current market share.*

*** The standard continuous gas has been used as the proxy for high-efficiency gas systems, as these are estimated to use less energy than the high-efficiency storage systems.*

20 Queensland Government Office of Economic and Statistical Research. 2002. *Survey results of energy use and efficiencies in Queensland homes.* Summary report prepared for the Department of Public Works, August 2002.

21 Although there is undoubtedly LPG used in the Tablelands and SEQ, the impact of this consumption on energy usage and greenhouse gas emissions is low.

Table 19 – Greenhouse gas emissions of current average HWS and potential, kg CO_{2-e} per unit pa

Zone	Current*	Solar electric	Solar gas	High-efficiency gas**	Heat pump
1	2,623	115	67	797	1,022
2	2,855	480	165	976	1,371
3	2,629	251	98	830	1,065
5	3,100	829	251	1,065	1,494

** Based on estimated current market share.*
*** The standard continuous gas has been used as the proxy for high-efficiency gas systems, as these are estimated to use less energy than the high-efficiency storage systems.*

Current and forecast penetration rates

The ABS publication titled *Environmental issues: people's views and practices*, March 2002, provides a Statewide overview of changes in water heaters between 1994 and 2002. Over this period there appears to have been a slight reduction in the proportion of households using electricity and a slight increase in the proportion using gas, but no clear trend is apparent. The proportion of households using solar appears to have held steady or even reduced. As there is no clear indication of trends, it is assumed in the no regulation scenario that these proportions stay constant over time.

It is assumed that the relative proportion of greenhouse efficient water heaters increases by two percentage points per annum under the planning schemes scenario, and four percentage points per annum under the State regulation with local government discretion scenario. Under the State regulation scenario it is assumed that the penetration of greenhouse efficient water heaters is 100% from 2006.

Table 20 shows the penetration rates for greenhouse efficient water heaters in new Class 1 buildings under each of the four scenarios.

Table 20 – Relative penetration rate of greenhouse efficient HWS

Regulatory scenario	2005	2006	2011	2016	2021	2026
No regulation	0%	0%	0%	0%	0%	0%
Planning schemes	0%	2%	12%	22%	32%	42%
State regulation with local government discretion	0%	4%	24%	44%	64%	84%
State regulation	0%	100%	100%	100%	100%	100%

Shower roses

Measure proposed

The measure proposed is that shower roses in new Class 1 buildings in Queensland comply with AAA or better efficiency standards.

Water savings compared to standard shower roses

AAA shower roses use at most 9 litres of water per minute. Standard shower roses are generally considered to have the capacity for flow rates of 15 to 25 litres per minute. However, there is evidence that the actual flow rates from both standard and water efficient shower roses are less than the theoretical calculations based on capacity.[22]

Significant uncertainty surrounds the expected water and energy savings from AAA shower roses. Some analyses have based expected savings on theoretical flow rates and estimated that shower water savings from converting standard shower roses to AAA shower roses will be of the order of 40% to 60%.[23]

While such assumptions appear theoretically reasonable, they must be tested against observed savings. Actual water or energy savings often fall far short of those expected for reasons which are not always clear, and may differ between studies and predictions. For example, the theoretical flow rates of standard shower roses may not be those actually applied during showering or the time spent showering may change with a different shower rose.

The most relevant applicable comparison of water savings from AAA shower roses and aerators/regulators appears to be that by Sarac, Day and White of the Institute of Sustainable Futures (ISF), at the University of Technology, Sydney. In their comparison group analysis study of three New South Wales water savings programs,[24] they found that programs with efficient shower roses resulted in statistically significant savings of about 14.5 kL per household per annum.

It would be expected that the retrofits taking place in these programs would have been applied largely to standard shower roses and fittings. Therefore, the savings seen by Sarac et al are likely to be greater than those that would occur if there is already a significant penetration of AAA shower roses.

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22 See, for example Figure 1 in Cordell, Robinson and Loh. *Collecting residential end use data from primary sources: do's and dont's.* Source: www.isf.uts.edu.au/publications/Cordell_Robinson_Loh.pdf. Last accessed: 27 July 2004.

23 Flow rates of 15–25 L/minute with standard shower roses and 9 L/minute (maximum) with AAA shower roses are assumed.

24 Sarac, Day and White. 2002. *What are we saving anyway? The results of three water demand management programs in NSW.* Proceedings of the International Water Association Congress, Melbourne, April 2002.

The savings in Class 1 buildings are likely to be slightly higher than the 14.5 kL average discussed above.[25] It is assumed that the AAA shower roses would save some 15 kL per Class 1 building per annum compared to standard shower roses.

Penetration of AAA shower roses in new Class 1 buildings

The share of households with reduced flow shower roses in Queensland was estimated by the ABS to be some 37% in 2001, having grown by about one percentage point per annum between 1998 and 2001. It is assumed that the current penetration rate of reduced flow shower roses in Queensland will be about 40% in 2005.

Although the reduced flow shower roses in existing homes are not necessarily AAA shower roses, there is a preponderance of AAA models available on the market,[26] and according to evidence from New South Wales, an even greater preponderance of AAA units in sales.[27] Given the emphasis being placed on AAA products, it is assumed that all sales of reduced flow shower roses are AAA.

The penetration of efficient shower roses in new homes is more difficult to estimate. Wilkenfeld et al have assumed that only 10% of new homes have flow controlled shower roses, on the assumption that in cases where the shower rose selection is made by a builder, the proportion is likely to be lower than where the householder has a say (for example, in renovations).[28] Given the recent emphasis on water saving devices across Australia and the small price differential between standard and AAA shower roses, it is assumed that new homes already use AAA shower roses in the same ratio as in the general population – 40% in 2005.

Calculated water savings for Class 1 buildings in 2005

The annual water saving calculation for new Class 1 buildings in 2005 if all were to convert to AAA shower roses is, therefore:

15 kL per household savings over standard fittings multiplied by 60% of the new Class 1 buildings that are not already constructed with AAA fittings

= 9 kL per new Class 1 building in 2005.

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25 This may not necessarily be limited to increases associated with the higher ppd because of issues related to a higher uptake of rebates by homeowners and the higher rental rate in apartments.

26 According to the study by Wilkenfeld et al (George Wilkenfeld and Associates et al, *A mandatory water efficiency labelling scheme for Australia*. Study for Environment Australia, Final Report, June 2003), of the 93 models identified as having water efficient labelling 64 were AAA-rated.

27 According to a study by Ellis and White, (M Ellis and S White, *The water efficient shower market in NSW*. A scoping study for SEDA, 1 December 1997), and according to returns from manufacturers and bulk distributors, about 90% of water efficient sales were AAA, with most of the remainder being AA.

28 George Wilkenfeld and Associates, *Proposed national system of mandatory water efficiency labelling for selected products*. Regulation Impact Statement prepared for the Department of Environment and Heritage, May 2004. Page 26.

Calculated energy and greenhouse gas savings for Class 1 buildings in 2005

The energy savings attributable to AAA shower roses have been calculated to be only that required to heat the water. The standing energy contribution has been assumed to remain unchanged. The saving has been estimated based on a saving of 9 kL per household per annum[29] from a total current hot water usage of 55 kL per annum. The saving in energy usage is estimated at about 20% of total energy. This has been multiplied by the average energy usage in each zone to calculate both the kWh and greenhouse gas savings.

The results of estimated energy and greenhouse gas savings are provided in Table 21.

Table 21 – Savings in energy usage, and greenhouse gas emissions, compared to current average usage per annum

Zone	Energy savings in 2005 kWh/HH/pa	Greenhouse gas savings in 2005 kg CO2-e/HH/pa
1 Far North Queensland	543	525
2 Sub-tropical coastal	625	571
3 Western	564	526
5 Tablelands	708	620

Current and forecast penetration rates

As discussed above, the estimated penetration of AAA shower roses is currently some 40%. The penetration rate has been increasing over recent years. In the no regulation scenario, it is assumed that the penetration increase continues, albeit at a slower rate over time. It is also assumed that this rate of change will apply until 2006 in the planning schemes and State regulation with local government discretion scenarios.

It is assumed that the absolute proportion of AAA shower roses increases after 2006 by 2% per annum under the planning schemes scenario and 4% per annum under the State regulation with local government discretion scenario; in both cases it is capped at 90%. Under the State regulation scenario, it is assumed that the penetration of AAA shower roses is 100% from 2006. Assumed penetration rates for different regulatory scenarios are shown in Table 22.

29 Only 60% of the 15 kL per household per annum is saved by converting from a standard shower rose to a AAA shower rose, as 40% of shower roses are assumed to already be AAA-rated.

Table 22 – Penetration rate of AAA shower roses

Regulatory scenario	2005	2006	2011	2016	2021	2026
No regulation	40%	41%	45%	48%	50%	51%
Planning schemes	40%	41%	51%	61%	71%	81%
State regulation with local government discretion	40%	41%	61%	81%	90%	90%
State regulation	40%	100%	100%	100%	100%	100%

Toilet cisterns

Measure proposed

The measure proposed is the requirement that dual-flush 6/3 litre toilet cisterns be used in new Class 1 buildings in Queensland.

Current practice

The 6/3 dual-flush toilet cistern is already a plumbing requirement in most places and is now standard in new homes in most of Queensland. It is assumed that current practice for new homes is 95% 6/3 dual-flush toilet cisterns and 5% 9/4.5 dual-flush toilet cisterns.[30]

The measure would thus act to ensure that there is 100% uptake, through ensuring the requirement is applied across all authorities and jurisdictions.

Water savings

There is evidence to suggest that the introduction of low volume and dual-flush toilet cisterns results in an increase in flushes compared to high volume flush toilet cisterns, although the impact of this is far less than the water saved by reducing flush volumes.

It is assumed that:

- current practice in new Queensland homes is 95% 6/3 litre dual-flush toilet cisterns and 5% 9/4.5 litre dual-flush toilet cisterns;
- there are on average 5.3 flushes per person per day with both the 6/3 and 9/4.5 toilet cisterns;[31] and
- the ratio between the frequency of large and small flushes is 1:3.5.

As it is understood that almost all toilets in new homes are already the 6/3 cisterns, the incremental savings from this measure are limited to only the 5% of toilets that are currently assumed to be 9/4.5 litre dual-flush cisterns. Under this item, only the 9/4.5 litre toilets are assumed to be displaced by 6/3 cisterns and the number of flushes is assumed to remain constant.

If all new homes currently used 9/4.5 litre toilet cisterns, the savings from converting to 100% 6/3 cisterns would be about 9.6 kL per HH per annum. As only 5% of new homes currently do not use the 6/3 toilet cisterns, potential water savings over current practice are only 0.5 kL per new home.

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30 This is the same penetration assumption for new homes as made in Wilkenfeld, G. et al. 2004. *Proposed national system of mandatory water efficiency labelling for selected products.* Page 30 for Australia as a whole.

31 Aquacraft Inc. *Results from the Seattle home water conservation study.* Source: www.aquacraft.com/Publications/seattle.htm. Last accessed: 26 July 2004.

Difference between zones

It is assumed that there are no zone differences in penetration rates or water saved.

Current and forecast penetration rates

As discussed in the section titled 'Current practice' on page 38, the estimated penetration of 6/3 toilet cisterns in new homes is currently estimated at some 95%. It is assumed that the absolute proportion of 6/3 toilet cisterns increases to 96% under the planning schemes scenario, to 97% under the State regulation with local government discretion scenario and 100% under the State regulation scenario. Assumed penetration rates for different regulatory scenarios are shown in Table 23.

Table 23 – Penetration rate of 6/3 dual-flush toilet cisterns

Regulatory scenario	2005	2006	2011	2016	2021	2026
No regulation	95%	95%	95%	95%	95%	95%
Planning schemes	95%	96%	96%	96%	96%	96%
State regulation with local government discretion	95%	97%	97%	97%	97%	97%
State regulation	95%	100%	100%	100%	100%	100%

Rainwater tanks

Measure proposed

The measure proposed is the requirement that new Class 1 buildings have a 3,000 litre rainwater tank, which is used for garden purposes.

As the measure is proposed for outside use, it is assumed that pumps are not needed. Hence, the installation, operating costs, energy use and greenhouse gas emissions associated with pumps have not been included in the analysis. These matters may be relevant and require consideration if the tank is located at ground or subsurface levels.

Estimated average water usage by zone

In order to estimate the water savings from the proposed measure, current usage of water by residential customers in each of the zones has been estimated.

Brisbane

According to the Brisbane City Council, the average Brisbane family uses 699 litres of water per day.[32] Information provided in *Water Facts 2001*[33] shows an average daily residential water usage in the year 2000/01 of about 747 litres. This was, however, a drier than average year. A figure of 745 litres has been used as the average daily usage per dwelling across SEQ.

Brisbane Water has provided the estimated break-up of residential usage by category, as shown in Figure 2.

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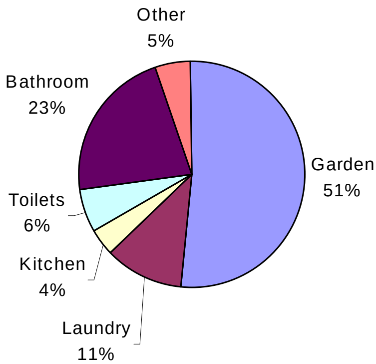
32 Brisbane City Council website. Source: www.brisbane.qld.gov.au/residential_services/water_sewerage/water_conservation.shtml. Last accessed: 26 July 2004.

33 Water Services Association of Australia. 2001. *The Australian Urban Water Industry, WSAAfacts 2001*.

Figure 2 – Distribution of residential water usage in Brisbane



Source: Brisbane Water.

Applying the above information to the average 745 litres per property per day, and taking into account the patterns for single-residential and multi-residential usage estimated in the domestic water use study in Loh and Coghlan's Perth report,[34] the following average daily usage for Class 1 buildings in SEQ is estimated in Table 24.

Table 24 – Typical water usage patterns estimated for Class 1 buildings in SEQ, (litres/HH/day)

Dwelling type	Garden	In-house	Total
Single-residential	420	400	820

Source: MMA estimates.

Toowoomba, Ingham and Emerald

Reliable information about residential usage, especially by end-use category, for reference cities in other zones has been more difficult to source. The estimated residential demand, both external and internal, is derived by Montgomery Watson in a report to the Queensland Department of Natural Resources in November 2000,[35] provided in Table 25.

34 M. Loh and P. Coghlan. 2003. *Domestic water use study in Perth, Western Australia, 1998 – 2000.* Report for the WA Water Corporation, March 2003.

35 Montgomery Watson. 2000. *Improving water use efficiency in Queensland's urban communities.* Report to the Queensland Department of Natural Resources, November 2000, Chapter 4.

Table 25 – Estimated daily residential water usage, (litres/account/day)

Zone and reference city	Internal demand	External demand	Total demand
1 Ingham	502	325	827
2 Brisbane	400	420	820
3 Emerald	482	665	1,147
5 Toowoomba	410	164	574

Source: Montgomery Watson, Table 4.6, except for Brisbane which is based on MMA estimates.

As can be seen, the main source of variation in water demand is understood to be that used for external purposes, mainly in gardens. While the expected internal demand varies between 400 and 500 L/HH/day, the external demand is estimated to range between 164 and 665 L/HH/day.

The data from Montgomery Watson has not been modified to account for different household sizes between Class 1 buildings and average dwellings.

Key assumptions

The potential contribution of rainwater tanks to household water supply has been indicatively modelled on a daily basis using the simple assumptions made in Table 26. The results are indicative only and could vary considerably on a case-by-case basis.

The analysis does not consider any potential costs associated with the control of mosquito borne disease outbreaks which could be incurred by government, the health system (treatment and hospitalisation costs) the tourism industry and affected members of the public.

Water savings

Table 26 – Assumptions used in modelling rainwater tank usage

Parameter	Assumption for Class 1 buildings
Rainfall pattern	Daily rainfall at Brisbane airport over period 1970 to 2000 and in the other reference cities between 1974 and 1996
Roof area for collection	200 m^2
Efficiency of rainfall collection	67% to take into account collection efficiency and possibility of connection to only one downpipe
First-flush elimination	First 0.5 mm in any day*
Size of tank	3,000 L
Total water usage	According to Table 25
Average total garden usage	According to Table 24
Daily pattern of water usage in the garden	Linear depending on rainfall, it is assumed that accessibility allows the entire external water demand to be met through the tank if tank water is available
In-house usage	None

** This could be reduced to zero as only garden use is anticipated, however, the difference in water savings is small.*

Source: Daily precipitation data from the Australian Bureau of Meteorology and Rainman. Many of the assumptions in the simple MMA rainwater tank model were derived from Rainwater tank sizing by D. Keenan. Source: www.uq.net.au/~zzdkeena/RainwaterTankSizing.htm. Last accessed: 27 July 2004.

Results

The results of the above modelling are presented in Table 27.

Table 27 – Total annual water usage and estimated contribution from rainwater tanks

Zone and reference city	Household usage kL/HH/pa	Tank usage kL/HH/pa	Tank usage as % of total demand	Tank usage as % of external demand
1 Ingham	302	55	18%	46%
2 Brisbane	299	60	20%	39%
3 Emerald	419	28	7%	11%
5 Toowoomba	210	44	21%	74%

As can be seen, the modelled savings resulting from the use of a 3,000 litre rainwater tank vary widely across the reference locations in the zones. The modelling results in expected water savings in the order of 30 to 60 kL per household per annum. This constitutes between 7% and 21% of total residential demand. The main determinant of savings is the pattern of rainfall. Increasing the size of the rainwater tank to 10,000 litres would result in savings increasing to 43 to 90 kL per household per annum.

Current and forecast penetration rates

In 2001 about 17.5% of homes in Queensland cited rainwater tanks as a source of water.[36] This proportion has changed very little over the past ten years.

In the 2001 survey, rainwater tanks were cited as the main source of garden water by about 3% of the Queensland population, of drinking water by about 13.9% of the population and of water used for bathing/showering/washing by 7.6% of the Queensland population. In all cases, the proportion of homes using rainwater tanks as the main source for these end-uses has reduced over the past decade.

Very few homes with access to mains water in SEQ currently install rainwater tanks. In the absence of better information, it is assumed that the proportion is 3% across all the zones in Queensland.

There has been some local government interest in increasing rainwater tank penetration over time. It is assumed that the penetration rate will increase at 0.5% per annum under the no regulation scenario, increase at 2.5% per annum under the planning schemes scenario and increase at 4.5% per annum under the State regulation with local government discretion scenario. In the latter two cases it is capped at 90%. Under the State regulation scenario, it is assumed that the penetration of rainwater tanks is 100% from 2006. These penetration rates are used to estimate the additional costs of water tanks for new houses built over the ten year period from 2006 to 2015. However, the benefits are estimated for the expected life of the water tanks. Estimated penetration rates for different regulatory scenarios are shown in Table 28.

Table 28 – Penetration rate of rainwater tanks

Regulatory scenario	2005	2006	2011	2016	2021	2026
No regulation	3%	4%	6%	9%	11%	14%
Planning schemes	3%	6%	18%	31%	43%	56%
State regulation with local government discretion	3%	8%	30%	53%	75%	90%
State regulation	3%	100%	100%	100%	100%	100%

Operating cost savings from water savings

The operating cost saving to householders of a water saving of 1 kL is estimated to be $0.84/kL for Brisbane and $0.55/kL for the other locations. This results in annual operating cost savings from the rainwater tanks of $50 in Brisbane and SEQ, and $15 to $30 per annum in the other zones.

36 ABS publication 4602.0. *Environmental issues: people's views and practices*, March 2001.

Efficient lights in living areas

Measure proposed

The measure proposed is the requirement that new Class 1 buildings have fluorescent tube fittings, circular fluorescent or compact fluorescent light fittings (or alternative energy efficient fittings with lamp efficiencies of 75 lumens per Watt or better) as main lights installed in at least one main living area.

Energy savings

It is assumed that, in living rooms, two x 20 W compact fluorescent lamps displace two x 60 W incandescent lamps and that the lamps are used for 1,400 hours each.[37]

The energy saving of a move from incandescent to energy efficient lights is thus estimated as 112 kWh/HH/pa with associated greenhouse gas savings of 120 kg/HH/pa. Taking into account current practice with 15% penetration, the savings would be 95 kWh/HH/pa and 103 kg CO_2/HH/pa.

Differences between zones

Market research by the Queensland Government's Office of Economic and Statistical Research[38] shows relatively small differences in penetration rates of energy efficient lighting between zones.

Current and forecast penetration rates

According to the ABS Environmental Issues survey,[39] about 75% of Queensland households used fluorescent lamps as the main source of light in at least one room.

Most fluorescent lamps are located in garages, kitchens, bathrooms and laundries, rather than main living areas. However, energy efficient lamps (implying compact fluorescent lamps), as surveyed by the ABS, are more likely to be used in living rooms. It is assumed that the proportion of houses with efficient lighting in living areas is the average of those where there are three or more rooms mainly lit with energy efficient lamps or four or more mainly lit with fluorescent lamps.[40] This was approximately 13% in 2002 and it is estimated the penetration rate is 15% in 2005.

There is evidence that the penetration rate of energy efficient lighting is increasing, although the extent to which this extends to use in living areas is unclear. It is assumed that the penetration rate under the no regulation scenario will increase at

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37 This is based on Energy Information Administration, Office of Energy Markets and End Use, Forms EIA-457A-C, E, and H of the *1993 Residential Energy Consumption Survey*, Table 4.18.

38 Queensland Government Office of Economic and Statistical Research. 2002. *Survey results of energy use and efficiencies in Queensland homes*. Summary report prepared for the Department of Public Works, August 2002.

39 ABS publication 4602.0 2002. *Environmental issues: people's views and practices*, March 2002.

40 As defined by ABS survey data.

0.5% per annum, at 1.5% per annum under the planning schemes scenario and at 2.5% per annum under the State regulation with local government discretion scenario. In the latter two cases it is capped at 90%. Under the State regulation scenario, it is assumed that the penetration of energy efficiency lighting is 100% from 2006. Estimated penetration rates for different regulatory scenarios are shown in Table 29.

Table 29 – Penetration rate of energy efficient lighting in living areas

Regulatory scenario	2005	2006	2011	2016	2021	2026
No regulation	15%	16%	18%	21%	23%	26%
Planning schemes	15%	17%	24%	32%	39%	47%
State regulation with local government discretion	15%	18%	30%	43%	55%	68%
State regulation	15%	100%	100%	100%	100%	100%

Pressure reduction to internal taps

Measure proposed

The measure proposed is the requirement that in new Class 1 buildings, through system design or water pressure-limiting devices, water pressure to all internal taps and water consuming appliances shall be limited to 3 bar (300 kPa) or less, irrespective of variations in supply pressure. Water pressure-limiting devices are currently required on water heaters under the Australian Standard 3500 series and they typically have a rating of 500 kPa. This measure could be achieved by changing the water pressure-limiting device from the water heater to the inlet pipe for the house and changing the rating to 300 kPa.

Water savings

Water pressure-limiting devices are expected to produce water savings through reduced flow rates in free-flow or non-volumetric applications. Because the flow rate through pipes is related to the square of the pressure, reducing pressure by 20% would be expected to reduce the flow rate by some 10.6%, while reducing pressure by 50% will reduce flow rate by about 29%.

However, reducing the flow rate does not necessarily translate into water savings. Use in indoor 'volumetric applications' such as clothes washing, baths, cooking and toilets is likely to remain unchanged, while patterns of use in non-volumetric applications, such as showers, hand-basins and sinks may be changed by householders because of reduced flow rates.

Wilkenfeld[41] has assessed that within the home some 35% of water use is free-flow.

It is assumed that:

- the water pressure-limiting devices result in supply pressure dropping from 500 kPa[42] to 300 kPa, that is, by 40%;
- only in-house applications are affected;
- reduced flow rates are available in only free-flow devices which constitute 35% of water in-home water uses; and
- 75% of the theoretical in-house savings are realised.

Estimated water savings from installing water pressure-limiting devices for in-house use is indicatively estimated at 8,600 litres per household in Class 1 buildings.

41 Wilkenfeld, G. et al. 2003. *A mandatory water efficiency labelling scheme for Australia*. Draft report prepared for Environment Australia, April 2003, Appendix 1.

42 Ibid, page 49 gives an average mains supply pressure of 500 kPa.

Differences between zones

Although some differences in in-house water usage have been identified across zones (see the section titled 'Estimated average water usage by zone'), the differences are relatively small and the above estimates of water savings are only indicative.

Current and forecast penetration rates

The penetration rates are modelled as 0% under the no regulation scenario, increasing at 2% per annum under the planning schemes scenario and 4% per annum under the State regulation with local government discretion scenario. In the latter two cases it is capped at 90%. Under the State regulation scenario, it is assumed that the penetration is 100% from 2006. Estimated penetration rates for different regulatory scenarios are shown in Table 30.

Table 30 – Penetration rate of water pressure-limiting devices

Regulatory scenario	2005	2006	2011	2016	2021	2026
No regulation	0%	0%	0%	0%	0%	0%
Planning schemes	0%	2%	12%	22%	32%	42%
State regulation with local government discretion	0%	4%	24%	44%	64%	84%
State regulation	0%	100%	100%	100%	100%	100%

Household operating cost savings

Basis of valuation

The operating cost savings to households from adopting each of the efficient devices are based on current retail prices for fuels and water.

Energy savings

Electricity savings have been calculated from the amount of electricity saved multiplied by the price of electricity applicable to the appliance as detailed in published 2004 retail tariffs for Queensland.

For gas and solar gas, the average gas and LPG prices are used, as hot water is likely to make up the bulk of usage for gas supply.

Water savings

The marginal prices of $0.84/kL for SEQ and $0.55/kL for the other zones have been used. These are the volumetric prices charged to householders for water usage in Brisbane and Cairns.

Consideration of existing penetration rates

The penetration rate in new houses as it is anticipated to change over time has been used in calculating the operating cost savings applicable to households. For example, the water savings from AAA shower roses was estimated at 15 kL/HH/pa compared to standard fixtures. However, the current penetration rate of AAA shower roses in new homes in Queensland is estimated at 40%. Thus the water saving is estimated at 9 kL /HH/pa (15 kL x (1–40%)) and the saving in SEQ is $7.60/HH/pa (9 kL x $0.84/kL).

Estimated operating cost savings

The estimated operating cost savings, compared to current practice, are provided in Table 31 and Table 32.

Table 31 – Estimated annual operating cost savings from adopting efficient hot water systems, ($/HH/pa)

Zone	Solar electric	Solar gas	High-efficiency gas*	Heat pump
1	211	188	-195	143
2	200	189	-60	131
3	218	187	-198	154
5	204	196	-54	154

** Standard continuous gas has been used as the proxy for high-efficiency gas systems, as these are estimated to use less energy than the high-efficiency storage systems. The negative sign means that this option is more expensive than the current average system.*

Table 32 – Estimated annual operating cost savings from adopting other measures, ($/HH/pa)

Zone	AAA shower roses		Toilets	Rainwater tanks	Lighting*	Water pressure-limiting devices
	Water	Energy				
1	5.0	29.1	0.3	29.1	11.1	4.8
2	7.6	31.3	0.4	48.6	11.1	7.3
3	5.0	31.3	0.3	14.9	11.1	4.8
5	5.0	35.6	0.3	23.5	11.1	4.8

** Efficient lighting cost savings estimated for one main living area.*

Interaction between measures

Savings in water, energy and greenhouse gas emissions have been estimated separately for each of the above measures. The savings from each of the measures are clearly not all additive. Thus, for example, it is not correct to assume that the greenhouse gas savings from switching to an energy efficient solar electric hot water system plus that from using a AAA shower rose are additive.

This section of the report touches on the issue of interactivity.

Hot water systems

The benefits from using hot water systems are not additive with those from AAA shower roses. If an efficient hot water system is used, then the greenhouse gas savings will be significant. The additional savings from moving to a AAA shower rose can be estimated as 20% of the actual energy usage/greenhouse gas emissions of the energy efficient appliance.

Thus, if the energy efficient appliance uses 500 kWh, the additional saving from moving to AAA shower roses may be 100 kWh.

The current practice is to install a water pressure-limiting device for the water heater with a typical rating of 500 kPa whereas the proposed water pressure-limiting device is rated to 300 kPa. This will act to reduce the use of both hot and cold water. However, the impact is relatively minor on the water heater and has not been assessed.

Shower roses

In addition to the interaction between shower roses and water heaters – discussed above – there is also an interaction between shower roses and water pressure-limiting devices. The use of regulators will tend to reduce the savings achieved by AAA shower roses.

Water used in showers is estimated to make up some 30% of indoor water usage across Australia but around 80% of all the free-flow applications.[43] Assuming that AAA shower roses will act to reduce the rate of flow in showers to the same level as the water pressure-limiting devices, calculations including both AAA shower roses and water pressure-limiting devices should reduce the benefits of water pressure-limiting devices by 80%.

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43 Wilkenfeld, G. et al. 2003. *A mandatory water efficiency labelling scheme for Australia.* Final report prepared for Environment Australia, June 2003, page 19 gives average indoor use of 430 L/HH/day of which 125 L/HH/day is for showers.

Dual-flush toilet cisterns

There is no interaction between dual-flush toilet cisterns and other measures unless rainwater tanks are used indoors. This has not been assessed in this report.

Rainwater tanks

There is no interaction between rainwater tanks and other measures as it is assumed that rainwater tanks are not used for indoor applications.

Energy efficient lights

There is no interaction between energy efficient lighting and other measures.

Water pressure-limiting devices

The interaction with AAA shower roses has been discussed above. The small interaction with water heaters has not been assessed in this study.

Cost-benefit estimates

In this section, the benefits and costs of the appliance programs are estimated under different regulatory regimes. Both pecuniary and non-pecuniary benefits and costs are considered. The benefits and costs are estimated for each appliance group and for the integrated package of all appliances.

Method

The purpose of the cost-benefit assessment is to estimate the net benefits of different regulatory approaches. As described previously, the four regulatory approaches are:

1. No regulation scenario, where the purchase of the appliances depends on their costs and their appeal to consumers relative to other appliances (this is the base for the cost-benefit assessment).
2. State regulation scenario, where State-based laws require the mandatory use of the efficient appliances in all new homes.
3. State regulation with local government discretion scenario, in which the Queensland Government designs a model code and local governments can elect to adopt this code as part of their planning laws for new homes.
4. Planning schemes scenario, where local councils can design and impose their own obligations as part of local planning laws.

The benefits and costs are likely to differ between the regulatory approaches for several reasons.

First, the rate of uptake of more efficient appliances will differ with each regulatory approach. The State regulation approach will obviously have the highest uptake, but voluntary codes may also have high uptake rates where benefits exceed the costs to end-users.

Second, the cost of administration and compliance will differ with each regulatory regime. Costs of administration include the costs to local councils and the State Government to administer the programs. Compliance costs are those costs incurred by manufacturers, home builders and end-users in complying with local and/or State regulations.

The analysis of benefits and costs proceeds by assuming an adoption rate for each appliance in new homes. This rate differs for each regulatory regime. The analysis of adoption is carried out over a ten year period commencing with 2006 and ending in 2015. As the appliances have long lives, they are likely to incur ongoing benefits beyond the ten year period. Benefits are thus calculated for the period to the last year of operation of appliances bought in 2015.

The social benefits and costs are summarised in Table 33. Adopting more efficient appliances will result in lower energy usage and/or lower water usage compared with conventional appliances. Because of the lower energy usage, there will also be a reduction in greenhouse gas emissions and emissions of other air pollutants during energy production.

These benefits are offset by a number of costs. The most significant cost is the cost of purchasing the more efficient appliance. The efficiency is achieved at a cost of more embedded capital in the appliance. Governments would also incur costs in administering and running the programs. Manufacturers and builders would also incur costs in complying with the measures.

Table 33 – Social benefits and costs

Benefits	Costs
Lower energy usage	Higher capital costs
Lower emissions of greenhouse gases	Higher administrative costs
Lower water usage	Higher compliance costs
Lower emissions of other pollutants	

The benefits are calculated as follows:

- Energy savings are calculated from multiplying the lower energy usage per unit by the number of households adopting the new appliance. Both gas and electricity savings are calculated. The energy saving is then multiplied by the long-run marginal cost of energy supply. In the case of electricity, the long-run marginal cost of supply is assumed to equate to the long-run marginal cost of generation, avoided transmission costs and some avoided retail costs. Distribution costs are not included as these are likely to be minimal. In the case of gas, the saving is equal to the commodity cost of gas plus some avoided gas transmission charges. Because some regions in Queensland use LPG, the cost used in this study is the weighted average of the costs of natural gas and LPG, with the weighting depending on the relative usage of both fuels in each zone.
- Emissions savings are calculated by applying an emission intensity rate to each unit of energy saved. The emission intensity rate represents a weighted average of the emission intensities of the fuels avoided. A carbon price on a \$/t CO_{2-e} basis is then applied to obtain the total estimated savings. Because there is no carbon market at present, a range of potential prices is used in this analysis. The prices are obtained from previous studies on the cost of abatement in Australia.
- Water savings are calculated by multiplying the lower water usage per unit by the number of households adopting the new appliance. The value of these savings is calculated by multiplying the savings with the long-run marginal cost of water supply. This includes a component for reduced waste disposal costs in all cases except the rainwater tank, as indoor water usage leads to an increased level of wastewater that needs to be treated.

Capital costs are calculated by multiplying the number of appliances with the difference in the purchase cost between the conventional appliance and the more efficient appliance.

Administration and compliance costs are estimated based on costs for other schemes that have been adopted in Australia.

The benefits and costs are calculated for the net uptake of the appliances. Some households would adopt the more efficient appliances even without further Government regulation. Thus, only the benefits and costs from the additional uptake are calculated.

Assumptions

Many of the assumptions underpinning the cost-benefit assessment have been described in previous sections of the report. Other assumptions include:

- benefits and costs are calculated in mid 2004 dollar terms (that is, net of inflation);
- a real pre-tax social discount rate of 4% is applied to calculate the net present value of the benefits and costs, equivalent to the current interest rate for the ten year Commonwealth Bonds after inflation is deducted;
- the long-run marginal cost of electricity supply is assumed to be $40/MWh for generation, being the levelised cost of a new base-load plant operating in Queensland, while marginal losses during transmission (3% on the long-run marginal generation costs) are also added;
- avoided retail costs are assumed to be $5/MWh and avoided transmission costs are assumed to also be $5/MWh;
- as stated above, no savings in distribution costs are assumed as the configuration of the distribution system is unlikely to change with the adoption of more efficient appliances;
- avoided gas costs are assumed to be $22/GJ, and avoided LPG costs are assumed to be $39/GJ;
- the long-run marginal cost of water supply is assumed to be $1.50/kL in urban areas and $1.80/kL in non-urban regions;
- a carbon credit of $10/t CO_{2-e} is assumed to value the benefits of greenhouse gas abatement, which is similar to the current price of carbon permits under the New South Wales Greenhouse Gas Abatement Scheme, and is also the minimum of the range of estimates for carbon prices in the event of the adoption of a national carbon abatement policy (a sensitivity to $30/t CO_{2-e} is also undertaken);
- administration costs vary with the regulatory regime; for each appliance, the cost is assumed to be:
    - $500,000 for the State regulation scenario;
    - $750,000 for the State regulation with local government discretion scenario; and
    - $1,000,000 for the planning schemes scenario;
- the cost is lower for the mandatory scenario, because the scheme is assumed to be administered by one Government department;
- compliance costs are assumed to be equal to:
    - $1 million for the State regulation scenario;

- $2 million for the State regulation with local government discretion scenario; and
- $3 million for the planning schemes scenario (based on the assumption that a large number of councils adopt their own code, which would require manufacturers to ensure compliance with a number of different regulations).

Results

The estimated net benefits are shown in Table 34. The net benefits are calculated as the benefits and costs relative to the no regulation scenario.

Table 34 – Net benefits and costs for adoption of efficient appliances for each scenario, $m, mid 2004 dollars

	Planning schemes	State regulation with local government discretion scenario	State regulation scenario
Benefits	**NPV $m**	**NPV $m**	**NPV $m**
Solar electric water heater	52	104	508
Solar gas water heater	50	101	490
Natural gas water heater	-2	-5	-22
Heat pump water heater	36	72	348
AAA shower rose	10	26	107
Rainwater tank 3,000 L	35	70	322
Dual-flush toilet cisterns	0	1	2
Efficient lighting	1	2	18
Water pressure-limiting devices	5	11	52
All appliances	104	214	1,009
Costs	**NPV $m**	**NPV $m**	**NPV $m**
Solar electric water heater	35	67	324
Solar gas water heater	90	178	864
Natural gas water heater	11	18	88
Heat pump water heater	36	69	334
AAA shower rose	22	12	15
Rainwater tank 3,000 L	59	76	350
Dual-flush toilet cisterns	0	0	0
Efficient lighting	0	0	0
Water pressure-limiting devices	0	0	0
All appliances	116	155	689
Net Benefits	**NPV $m**	**NPV $m**	**NPV $m**
Solar electric water heater	17	38	184
Solar gas water heater	-40	-77	-375
Natural gas water heater	-13	-23	-110
Heat pump water heater	0	3	14
AAA shower rose	-12	14	92
Rainwater tank 3,000 L	-24	-6	-28
Dual-flush toilet cisterns	0	1	2
Efficient lighting	1	2	18
Water pressure-limiting devices	5	11	52
All appliances*	-13	60	320

** Calculated assuming the hot water appliance with the highest net benefit is adopted out of the range of hot water appliances.*

The net present value is calculated by discounting future benefits and costs from adoption of the more efficient appliance. Costs of purchase are assumed to occur in the year of purchase. Benefits accrue for a 15 or 20 year period after purchase of the appliance. The benefits and costs are only calculated for appliances predicted to be purchased from 2006 to 2015. Benefits include the value of water and energy savings and reduced greenhouse gas emissions. The net benefit value calculation discounts future benefits and costs over the period from 2006 to 2035, using the assumed social discount rate.

The net percent value was calculated using the assumptions listed in the previous sections of this report.

There are two key results. Firstly, net social benefits are likely for six of the appliances. Net benefits occur for AAA shower roses, solar electric water heaters, dual-flush toilet cisterns, heat pump water heaters, water pressure-limiting devices and efficient lighting. Other appliances have a net social cost for all regulatory regimes. For these appliances, the net social cost arises primarily as a result of the high capital cost of the appliance relative to conventional alternatives.

Secondly, the highest net benefit to the community for appliances with net social benefits occurs with the State regulation scenario. Adoption rates under the State regulation scenario are significantly greater than for the other regulatory scenarios. Thus, for most appliances, the State regulation approach is the preferred option. Administration and compliance costs are also lower for this approach, although this appears to be a second order effect.

This second result is reinforced by the fact that there is no obvious advantage from having local government regulation through planning schemes for the appliances with net benefits.

The only water heating appliances with net benefits are the solar electric water heaters and the heat pump water heaters. The net capital cost of solar gas is about double the cost of a solar electric appliance, but the benefits in terms of greater greenhouse savings are not sufficient to outweigh the higher capital cost. Continuous natural gas hot water systems have higher capital and operating costs than conventional models, resulting in costs that are estimated to be greater than the value estimated for their greenhouse savings.

The cost-benefit assessment of gas water heaters shows a strong net cost for natural gas hot water systems. This is due to a number of factors:

- capital costs for gas water heaters are greater than off-peak electric hot water systems, particularly in relation to plumbing costs for connection to gas reticulation networks;
- gas water heaters are typically less energy efficient than off-peak electric hot water systems and thus use more energy;

- the cost of reticulated natural gas in Queensland is high compared to the cost of off-peak electricity and, as the main use of gas by residents in Queensland is hot water, the marginal cost of the gas is the average cost;[44]
- it is assumed that LPG, at an even higher price than natural gas, is used in zones 1 and 3; and
- the only off-setting benefit is greenhouse gas savings.

Despite this, one would expect that natural gas and (to a lesser extent) LPG water heaters will continue to make in-roads where economically viable. In their favour are the greenhouse gas benefits compared to electric HWS and factors such as convenience.

The net benefits are low for dual-flush toilet cisterns and efficient lighting. In the case of dual-flush toilet cisterns, the benefits are small because there is already a high level of adoption of the 6/3 litre toilet cisterns (95% in the no regulation scenario).

With efficient lamps, the net benefits are modest because the lighting assessment is only applied to one room.

Another key result is that a measure with an integrated package of appliances would only yield net benefits under the State regulation scenario and the State regulation with local government discretion scenario.[45] This is because of the low additional uptake under the planning schemes scenario and the high net cost of some appliances, in particular rainwater tanks. Removing rainwater tanks from the integrated package would result in net benefits even under the planning schemes scenario, albeit at a lower level than with State regulation. The benefits for all appliances are lower than the sum of the total benefits from all appliances because of the interaction of some benefits. For example, reduced use of hot water with AAA shower roses reduces the benefits achieved by adopting more efficient, or less fossil fuel intensive, water heaters.

As shown in Table 35, the net benefits are higher in an integrated appliance case if only those appliances with a positive net benefit to the community are included. This analysis also indicates that the planning schemes scenario could be beneficial if it was only applied to solar electric water heaters and efficient lighting. However, the benefits are considerably less than for the State regulation or State regulation with local government discretion scenarios.

The State regulation scenario appears to be the approach with the highest net benefit. The magnitude of the benefits under the State regulation scenario is some five times higher than for the State regulation with local government discretion scenario. This is due to the significantly higher penetration rates for efficient

44 In other words, gas will not be connected to the house unless there is a gas water heater to provide sufficient load to make the connection financially viable.

45 Assuming that solar water heaters were the only water heater type included in the integrated package.

appliances. A lower or similar administrative and compliance burden also assists in increasing the benefits of a State regulation approach.

Table 35 – Net benefits and costs for adoption of efficient appliances with positive NPV for each scenario, $m, mid 2004 dollars

	Planning schemes scenario	State regulation with local government discretion scenario	State regulation scenario
Benefits	NPV $m	NPV $m	NPV $m
Solar electric water heater	52	104	508
Solar gas water heater	0	0	0
Natural gas water heater	0	0	0
Heat pump water heater	0	72	348
AAA shower rose	0	26	107
Rainwater tank 3,000 L	0	0	0
Dual-flush toilet cisterns	0	1	2
Efficient lighting	1	2	18
Water pressure-limiting devices	5	11	52
All appliances*	59	144	687
Costs	NPV $m	NPV $m	NPV $m
Solar electric water heater	35	67	324
Solar gas water heater	0	0	0
Natural gas water heater	0	0	0
Heat pump water heater	0	69	334
AAA shower rose	0	12	15
Rainwater tank 3,000 L	0	0	0
Dual-flush toilet cisterns	0	0	0
Efficient lighting	0	0	0
Water pressure-limiting devices	0	0	0
All appliances*	35	79	339
Net Benefits	NPV $m	NPV $m	NPV $m
Solar electric water heater	17	38	184
Solar gas water heater	0	0	0
Natural gas water heater	0	0	0
Heat pump water heater	0	3	14
AAA shower rose	0	14	92
Rainwater tank 3,000 L	0	0	0
Dual-flush toilet cisterns	0	1	2
Efficient lighting	1	2	18
Water pressure-limiting devices	5	11	52
All appliances*	24	65	348

** Calculated assuming the hot water appliance with the highest net benefit is adopted out of the range of hot water appliances.*

Sensitivities

A number of sensitivity analyses were performed to test the robustness of the results. The results of the sensitivity analyses are shown in Table 36. The analysis was performed on all appliances, with the net present value calculated for all appliances that showed a positive net benefit.

Table 36 – Sensitivity analysis of net present value of net benefits, $m, mid 2004 dollars

	NPV net benefit, $M			% Change in NPV from base value		
	Planning schemes	State regulation with local government discretion	State regulation	Planning schemes	State regulation with local government discretion	State regulation
Base	24	65	348			
5% Discount rate	19	53	293	-20%	-19%	-16%
3% Discount rate	30	80	412	24%	22%	19%
Carbon tax: $20/t	32	84	436	33%	28%	25%
Carbon tax: $5/t	20	56	303	-16%	-14%	-13%
10% higher energy cost	29	76	398	19%	16%	14%
10% lower energy cost	20	55	297	-19%	-16%	-14%
10% higher REC cost	27	71	377	13%	9%	8%
10% lower REC cost	21	59	318	-13%	-9%	-8%
10% higher water supply cost	25	68	362	2%	5%	4%
10% lower water supply cost	24	63	338	-2%	-3%	-3%
Avoid 100% network supply costs	70	169	850	187%	160%	145%
Avoid 50% network supply costs	47	117	599	93%	80%	72%
10% higher appliance costs	21	58	314	-14%	-10%	-10%
10% lower appliance costs	28	74	388	14%	13%	12%
10% higher administration and compliance costs	24	64	345	-1%	-2%	-1%
10% lower administration and compliance costs	25	67	350	1%	2%	1%

The sensitivity analysis shows that the relative results for the different scenarios are not sensitive to the changes in the values of the underlying variables. State regulation still provides the largest benefits.

The relative magnitude of the benefits is sensitive to the following:

- The discount rates applied to calculate the net benefits are very sensitive. Every one percentage point increase in the discount rate decreases the net benefit by 20%.
- The benefits are moderately sensitive to the carbon tax. However, there are still net benefits, even if there is no carbon tax benefit.
- The benefits are highly sensitive to the assumptions about the energy resource costs foregone as a result of a reduction in energy use, that is, avoided network and energy costs. Energy savings comprise the bulk of the savings from this program.
- The benefits are not highly sensitive to changes in the long-run marginal cost of water. This is because water benefits are less substantial under this program.

Expectations of local government

To supplement the analysis of quantitative data, a survey of local government councils was conducted in Queensland to gather information on their likely responses to either a model code or freedom to take local actions.

Methodology

One hundred and twenty-four questionnaires were sent by email to all councils in Queensland. Nineteen completed questionnaires were returned, giving a response rate of 15%. The councils that returned the questionnaires ranged from rural to urban, large to small, coastal to inland, and from far north to south-east Queensland.

The questionnaire contains two sections, the first asking about the likelihood of the council initiating its own requirements, and the second asking about the likelihood of the council adopting a model code. The time horizon for the answers was set at 2009.

To make the choices more concrete, six appliances were listed, and respondents were asked to nominate the likelihood that their council would have acted on each appliance by 2009. The appliances were:

- efficient water heaters;
- efficient lights in one living area;
- AAA-rated shower roses;
- rainwater tanks;
- dual-flush toilet cisterns; and
- water pressure-limiting devices.

Results

The results are presented separately for the planning schemes scenario and the State regulation with local government discretion scenario.

Planning schemes scenario

Table 37 summarises the results for the planning schemes scenario. It shows the average probability that the councils will take action within the next five years.

In each case, the analysis is on the full cohort of respondents.

Under the planning schemes scenario, councils are most likely to act on dual-flush toilet cisterns (70%), rainwater tanks (62%) and AAA shower roses (54%), as shown in Table 37. The data gives the impression that there is less interest in water pressure-limiting devices, but the respondents' comments reveal that a number of councils are already reducing pressure in the water mains, thus bypassing the need for household water pressure-limiting devices.

> *"This council is currently planning delivery of a major project that will involve installing pressure control valves throughout much of the city at the zone level. Pressure control at the development/neighbourhood level will also be a mandatory requirement in future development growth areas. This strategy is expected to have a major impact on water consumption through reduced leakage and on reducing infrastructure maintenance costs. Likelihood of implementation is 90%. However, flow control requirements in taps (other than showers) and at the dwelling level are not currently being contemplated because this approach is much less likely to significantly impact water consumption."*

There is also relatively high interest in the planning schemes scenario for efficient water heaters (37%) and efficient lighting (27%).

The overall average of these probabilities is 47%, indicating that about half of the respondents expect that their council would develop a local initiative under the planning schemes scenario on these issues within the next five years.

Table 37 – Results for planning schemes scenario

	Average probability
Efficient water heaters	0.37
Efficient lighting	0.27
AAA shower roses	0.54
Rainwater tanks	0.62
Dual-flush toilet cisterns	0.70
Water pressure-limiting devices	0.34
Overall average probability	0.47
Average for energy items	0.32
Average for water items*	0.55

** For this analysis we have included the AAA shower roses in water items but not in the energy items.*

State regulation with local government discretion scenario

Table 38 summarises the results for the State regulation with local government discretion scenario and the average probability of councils adopting the model code for each item.

The overall average probability is 61%, indicating that about six out of every ten councils would be likely to adopt the model code if it were available.

They are slightly more likely to take up the water items of the code (66%) than the energy items (50%).

These results also indicate that more councils are likely to adopt a model code under the State regulation with local government discretion scenario (61%) than trying to develop a local initiative under the planning schemes scenario (47%).

Table 38 – Results for State regulation with local government discretion scenario

	Average probability
Efficient water heaters	0.53
Efficient lighting	0.47
AAA shower roses	0.76
Rainwater tanks	0.74
Dual-flush toilet cisterns	0.83
Water pressure-limiting devices	0.37
Overall average probability	0.61
Average for energy items	0.50
Average for water items	0.66

High growth versus low growth areas

It is not known if this sample is biased towards those councils that are facing population pressure, which is in turn putting pressure on their energy and water infrastructure. The sample does include some of the large population and high population growth areas, but at the same time it includes a number of councils that are in rural areas with low population densities.

To test for differences between these areas, the councils were sorted into two groups, those with large populations or high growth rates (n=6), and those with low populations or low growth rates (n=12).

Table 39 summarises the results for the planning schemes scenario. It shows that the councils in the rapidly growing areas are slightly more likely to take action (54% versus 44%).

Table 39 – Planning schemes scenario by growth rate

	Not growing rapidly Average probability	Growing rapidly Average probability
Efficient water heaters	0.24	0.63
Efficient lighting	0.23	0.62
AAA shower roses	0.50	0.62
Rainwater tanks	0.61	0.63
Dual-flush toilet cisterns	0.72	0.67
Water pressure-limiting devices	0.35	0.31
Overall average probability	0.44	0.54

Table 40 summarises the results for the State regulation with local government discretion scenario. It shows that the councils in the rapidly growing areas are much more likely to adopt the model code than those in areas that are not growing rapidly (85% versus 53%).

Table 40 – State regulation with local government discretion scenario by growth rate

	Not growing rapidly Average probability	Growing rapidly Average probability
Efficient water heaters	0.35	0.89
Efficient lighting	0.34	0.73
AAA shower roses	0.68	0.93
Rainwater tanks	0.67	0.86
Dual-flush toilet cisterns	0.77	0.93
Water pressure-limiting devices	0.34	0.75
Overall average probability	0.53	0.85

Results by climate zones

To test for differences between climate zones, the sample was split into climate zones.

This gave three usable sub-samples for zone 1 (n=2), zone 2 (n=8) and zone 3 (n=6).

Table 41 summarises the results for the planning schemes scenario. It shows that the councils in zone 2 in the sub-tropical coastal areas are the most likely to develop a local initiative under the planning schemes scenario (54% versus 38% for zone 1 or 34% for zone 3).

Within the planning schemes scenario, there are clear differences in interest in the energy and water items. In the far north in zone 1, about one in three councils are interested in both energy and water (38% for both). Within the sub-tropical coastal zone 2, there is more interest in water than energy, with about one in three interested in energy (39%) and two in three in water (61%). Within the dry inland zone 3, only about one council in ten is interested in energy (11%), but close to half are interested in water (45%).

Table 41 – Planning schemes scenario by climate zone

	Zone 1 Far North probability	Zone 2 Sub-tropical coastal probability	Zone 3 Inland probability
Efficient water heaters	0.38	0.48	0.13
Efficient lighting	0.38	0.31	0.10
AAA shower roses	0.38	0.69	0.33
Rainwater tanks	0.38	0.61	0.60
Dual-flush toilet cisterns	0.38	0.77	0.67
Water pressure-limiting devices	0.38	0.37	0.21
Overall average probability	0.38	0.54	0.34
Average for energy items	0.38	0.39	0.11
Average for water items	0.38	0.61	0.45

Table 42 summarises the results for the State regulation with local government discretion scenario by climate zone. It shows that the councils in zone 2 in the sub-tropical coastal zone are the most likely to adopt a model code (75%) followed by those in zone 1 in the far north (62%).

The councils in the inland zone 3 are the least likely to adopt a model code (36%). One council explained their situation clearly.

> *"Not a priority in this area. We welcome any residential investment, and are unlikely to introduce any measures to restrict such development."*

Table 42 – State regulation with local government discretion scenario by climate zone

	Zone 1 Far north average probability	Zone 2 Sub-tropical coastal average probability	Zone 3 Inland average probability
Efficient water heaters	0.68	0.71	0.17
Efficient lighting	0.68	0.58	0.11
AAA shower roses	0.68	0.93	0.43
Rainwater tanks	0.50	0.78	0.62
Dual-flush toilet cisterns	0.68	0.91	0.68
Water pressure-limiting devices	0.50	0.60	0.15
Overall average probability	0.62	0.75	0.36
Average for energy items	0.68	0.65	0.14
Average for water items	0.59	0.81	0.47

As found for the planning schemes scenario, there are different levels of interest in the energy and water items. In the far north in zone 1, about two in three are interested in energy (68%) and slightly fewer are interested in water (59%). In the sub-tropical coastal zone 2, about two out of three are interested in energy (65%), but eight out of ten are interested in water (81%). In the dry inland zone 3, about one in seven is interested in energy (14%), but almost one in two is interested in water (47%).

Conclusions

Table 43 summarises the results of this analysis.

Table 43 – Summary of probability of adoption by climate zone

	Planning schemes probability of adoption	Model code probability of adoption
High growth areas	0.54	0.85
Low growth areas	0.44	0.53
Zone 1 Far north	0.38	0.62
Zone 2 Sub-tropical coastal	0.54	0.75
Zone 3 Inland	0.34	0.36
All respondents	0.47	0.61

About half of the respondents expect that their council would develop a planning scheme requirement within five years if this option were available to them (47%). A higher proportion of respondents expect that their council would adopt a model code if it were available (61%).

If the sample is split into high versus low growth areas, the high growth areas are more likely to develop a planning scheme requirement (54% versus 44%) or to adopt a model code (85% versus 53%).

If the sample is split into climate zones, the councils in the sub-tropical coastal zone 2 are the most likely to develop a planning scheme requirement (54% versus 38% for far north zone 1 or 34% for inland zone 3) or to adopt a model code (75% versus 62% for the far north zone 1 and 36% for the inland zone 3).

These results indicate that:

- more councils are likely to adopt the model code than to pursue a planning scheme requirement;
- councils in the high growth areas are more likely to adopt a local code or pursue a planning scheme requirement than councils in areas of low growth; and
- councils in the sub-tropical coastal zone are more likely to adopt a local code or pursue a planning scheme requirement than councils in other climate zones.

These results also suggest that:

- in zone 1 in far north Queensland there is slightly more interest in energy than water; and
- in the sub-tropical coastal zone 2 and the inland zone 3 there is more interest in water than energy.

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Glossary

ABS	Australian Bureau of Statistics
ADO	Automotive diesel oil
BCA	Building Code of Australia
Class 1 buildings	Separate and semi-detached dwellings (townhouses, villa units and terrace houses)
Class 2 dwellings	Multi-family dwellings, mainly units and apartments
CO_2, $CO_{2\text{-}e}$	Carbon dioxide, carbon dioxide equivalent (as the basis for measuring greenhouse gas savings)
EPA	Environmental Protection Agency
ERP	Estimated resident population
HH	Household
HPWH	Heat pump water heaters
HWS	Hot water systems
ISF	Institute of Sustainable Futures, University of Technology, Sydney
LGA	Local government area
MMA	McLennan Magasanik Associates
pa	Per annum
PIFU	Planning Information and Forecasting Unit of the Queensland Department of Local Government, Planning, Sport and Recreation
ppd	Persons per dwelling
PRP	Projected resident population
QSEIDG	Queensland Sustainable Energy Industry Development Group
ROQ	Rest of Queensland, all zones other than south-east Queensland
SCF	Solar contribution factor
SD	Statistical Division
SEDA	Sustainable Energy Development Authority
SEQ	South-east Queensland – the Brisbane and Moreton Statistical Divisions
SEQROC	South East Queensland Regional Organisation of Councils

ENDNOTES

1 Laid before the Legislative Assembly on . . .

2 The administering agency is the Department of Local Government, Planning, Sport and Recreation.