REGULATION IMPACT STATEMENT

For Decision

Application of Temperature Control Requirements for Heated Water

This Regulation Impact Statement (RIS) accords with the requirements of *Best Practice Regulation: A Guide for Ministerial Councils and National Standard Setting Bodies*, as endorsed by the Council of Australian Governments in 2007. Its purpose is to inform interested parties and to assist the Australian Building Codes Board in its decision making on proposed amendments to the National Construction Code.

The Australian Building Codes Board

The Australian Building Codes Board (ABCB) is a joint initiative of all levels of government in Australia, together with the building industry. Its objective is to oversee issues relating to safety, health, safety, amenity accessibility and sustainability in building. The ABCB promotes efficiency in the design, construction and performance and liveability of buildings through the National Construction Code (NCC), and the development of effective regulatory and non-regulatory approaches. The Board aims to establish effective and proportional codes, standards and regulatory systems that are consistent between States and Territories. For more information see the ABCB website (www.abcb.gov.au).

Disclaimer

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Introduction

Water supplied by water heaters for use at sanitary fixtures, in all new buildings is required to be delivered at outlets at a temperature not exceeding 50 degrees celsius (°C). This requirement has existed since 1996 and has its basis in research that shows hot water above 50°C significantly increases the risk of scalding from 5 minutes at 50°C, to 5 seconds at 60°C [1]. Its introduction followed advocacy citing the preventable nature of scalding injury through the presence of mixing valves (herein referred to as tempering) in some jurisdictions.

These valves limit the temperature of water supplied to an outlet and have been effective in reducing the risk and severity of scalding at those outlets[2]. Although infrequent, scalding injuries and fatalities still occur in Australia including in those jurisdictions where tempering is mandatory in all cases. This has been the subject of recent research, with one study suggesting occupant behaviour, trade practice, plumbing arrangement, cost and inconsistencies in application of regulations as factors[3].

Notwithstanding these factors, tempering is thought to play a key role in decreasing rates of scalding over-time. However, the rate of scalding and its amenability to further prevention is influenced by the number of water heaters not already subjected to the requirement. This number has decreased since the regulation's introduction due to:

- the number of new buildings subjected to the requirement to temper as a proportion of all building stock increasing; and
- building stock replacement or water heater replacement.

The impact of heated water system replacement is now better understood since the Consultation Regulation Impact Statement (RIS). The rate of tempering is increasing in not only new buildings but also with the replacement of existing water heaters, where at the point of replacement, one, or a combination of the below approaches is adopted:

1. The water heater is moved; and
2. The water heater is replaced with one of the same fuel source (a 'like-for-like' replacement); or
3. The water heater is replaced with one using a different fuel source.

The requirements contained in the Plumbing Code of Australia (PCA) and referenced documents have been subject to differing interpretations by each State and Territory plumbing administration. As such, two approaches have emerged. Since 1997, where a water heater is installed or replaced in existing private dwellings, approaches that have been subject to the tempering requirement at the point of replacement under the abovementioned circumstances are:

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[1] Studies of Thermal Injury (1947) *The relative importance of time and surface temperature in the causation of cutaneous burns.*

[2]Lara A. Harvey, L et al. Burns (2010) *Hospitalised hot tap water scald patients following the introduction of regulations in NSW, Australia: Who have we missed?* p. 912-919.

[3]Harvey. L. et al. Burns (2011) *Safe hot tap water: Knowledge attitude and practice of plumbers, students and regulatory authorities following the introduction of plumbing regulations in NSW, Australia.* p. 234-239.

- 1 to 3 in (New South Wales, Queensland and the Northern Territory).
- 3 in other States and the Australian Capital Territory.

Therefore, due to the scope of its application and the known average lifespan (15 years) of a water heater, the available building stock assumed by this analysis to be amenable for further regulatory influence is significantly less than that assumed by the Consultation RIS. Further, the amenability of scalding to prevention through expanding technical regulation is affected by the factors beyond the scope of regulatory control.

The scope of this RIS is focused on stand-alone water heaters that are replaced with a water heater of the same fuel source in private dwellings. New buildings and all other buildings are excluded from the analysis.

Problem

The problem this RIS considers is scalding injuries and fatalities under the current inconsistent application of the requirements for tempering heated water delivery at the time of replacing water heaters in existing private residences.

Nature of the Problem

The PCA requires heated water supplied by a new heated water service to be delivered to fixtures used primarily for personal hygiene at a temperature that reduces the likelihood of scalding[4]. These fixtures include showers, baths, hand basins and bidets but exclude kitchen and laundry fixtures.

The heating of water in residential buildings contributes to both the health and safety of occupants. The PCA requires water to be stored at 60°C which avoids the growth of Legionella bacteria[5]. The plumbing system must then deliver water to fixtures and appliances at a temperature which reduces the likelihood of scalding.

There is nationally consistent application in tempering heated water delivery in new private dwellings. There is evidence that tempering can have a marked effect on reducing the number of scalding incidents, although this is impacted by other factors[6]. Research shows that heated water above 50°C significantly increases the risk of scalding from 5 minutes at 50°C to 5 seconds at 60°C [7].The PCA Deemed-to-Satisfy Provision (DtS) reference Australian/New Zealand Standard (AS/NZS) 3500.4 and requires all new heated water services to be fitted with a temperature control device that limits the temperature at the outlet to a maximum of 50°C [8].

New water heaters, where installed or replaced in existing private dwellings, are regulated through the PCA under State and Territory legislation. The application of requirements contained in the PCA and its referenced documents varies around Australia.

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[4] NCC 2016 Volume Three – Plumbing Code of Australia *BP2.2 Heated water temperatures*.
[5] NCC 2016 Volume Three – Plumbing Code of Australia *BP2.5 Heated water storage.*
[6] Lara A. Harvey, et al. Burns (2010) *Hospitalised hot tap water scald patients following the introduction of regulations in NSW, Australia: Who have we missed?* p. 912-919.

[8] Australian/New Zealand Standard 3500.4 (2015) *Plumbing and drainage Part 4: Heated water, Clause 5*. Standards Australia.

In existing private dwellings in New South Wales, Queensland and the Northern Territory heated water delivery must be tempered to 50°C when any water heater is replaced. All other jurisdictions do not require tempering where 'like-for-like' replacement water heaters of the same fuel source occurs and where the heated water has not previously been tempered. The nature of the problem is an inconsistent application of the requirement for heated water temperature control in existing buildings, which could be reducing the predictability of an outlet's heated water temperature for some users.

The goal of the National Construction Code (NCC) is to enable the achievement of nationally consistent, minimum necessary standards of relevant safety (including structural safety from fire), health, amenity and sustainability objectives efficiently. Developing nationally consistent building and plumbing requirements is also a primary objective of the ABCB as described in the ABCB's Intergovernmental Agreement[9].

The Consultation RIS asked stakeholders whether they agreed with the description of the problem and whether there were any other factors not considered by the RIS.

The majority of stakeholders believed that the problem had been adequately described.

A State plumbing administration expressed concern that the Consultation RIS did not adequately take into account the size of the existing building stock. The impact analysis in this Final RIS has been updated in response to this concern and now reflects buildings built prior to the introduction of the requirement to temper new buildings in 1997. The estimated stock of existing buildings exposed to the problem is ever changing due to the replacement of water heaters and this is discussed further in the "Extent of the Problem" section of this RIS.

Some stakeholders commented that controlling the growth of Legionella bacteria by storing water at 60°C contributed to the nature of the problem. They suggested that tempering heated water could be leading to an increased incidence of Legionnaire's disease, with one stakeholder citing a report by the UK Chartered Institute of Plumbing and Heating Engineering (CIPHE) connecting the two issues[10].

The ABCB is not aware of any Australian evidence that shows a direct correlation between tempering water to 50°C and an increase in Legionnaire's disease. Nor is this borne out by any obvious discrepancy between the differing applications by the States and Territories. The CIPHE report highlights the need to take both issues into account when designing plumbing systems, which is consistent with the requirements of the PCA.

Further, the issue of Legionella control is much broader than the scope of this analysis and any changes to the requirements would be immaterial given this RIS is only considering tempering of replacement like-for-like water heaters. Assessment of the problem of Legionella bacteria would require separate analysis.

In addition to Legionella, some stakeholders commented that the Consultation RIS did not address the loss of amenity in existing homes, where the existing plumbing system consists of a single supply line

[9] Australian Building Codes Intergovernmental Agreement (2015) Page 8.
[10] CIPHE (2016) Scald Prevention and Legionella.

which, if tempered, would result in some fixtures (kitchen and laundry facilities) being supplied with 50°C water even though this is not required or desirable at those fixtures.

The issue of loss of amenity in existing homes is difficult to measure. Anecdotal advice from plumbing practitioners as part of the consultation process suggested that home owners value their amenity, in terms of having 60°C water at kitchen and laundry facilities[11]. The ABCB recognises the potential for amenity loss in existing homes where a single supply line exists and will consider this impact against any material gain to life safety and/or avoided injury when considering changes to requirements.

Extent of the Problem

The extent of the problem is comprised of:

- the known rate of scalding injury and fatality and the location of incidents, and
- the proportion of still untempered water heaters that are subject to replacement, and therefore, the regulatory influence in 2019 when any regulatory change could occur.

Due to the scope of the regulation's application, it was identified that the dwelling stock in New South Wales, Queensland and the Northern Territory (50% of all dwelling stock) is not able to be influenced through further technical regulation[12].

Stock of influence

The building stock where the problem can occur is fixed and diminishing over time. The size of the building stock where the problem could occur is influenced by two factors; dwelling renewal and replacement of heated water services, both of which are better understood following feedback on the Consultation RIS.

Dwelling renewal rate

Accounting for the proportion of existing buildings that have not been subject to the requirement relies on estimates of the life of a building. Various literature on the lifecycle of a residential building and its components suggest that a reasonable estimate is 40 years[13]. The number of buildings that would contribute to the problem at the time of the introduction of the requirement can therefore be determined using ABS statistics[14] and assumed to have been constructed in the period from 1956 to 1997.

Total activity in the impacted jurisdictions in the forty years prior was 1,910,212 dwellings. When adjusted for those dwellings that would not be influenced by the introduction of the regulation due to the remaining service life, and the existing stock that is replaced by new building stock prior to 2019 under a 40 year life, this figure becomes 927,155.

[11] Safe hot tap water: Knowledge attitude and practice of plumbers, students and regulatory authorities following the introduction of plumbing regulations in NSW, Australia. Harvey. L. et al. Burns 37. 2011. P234-239.
[12] These jurisdictions require tempering in all circumstances.
[13] This acknowledges that Australian houses are rarely demolished due to surpassing their design life or becoming structurally unsafe but rather demolished and re-developed to meet current aesthetic trends and fashions.
[14] Australian Bureau of Statistics Catalogue 8752.0 "Building Activity, Australia June 2016" Table 38.

Table 1: Number of dwellings remaining accounting for those renewed since 1997

Year:	Dwellings constructed	Replacing for
2019	48,819	1979
2020	50,828	1980
2021	50,680	1981
2022	43,910	1982
2023	42,135	1983
2024	53,897	1984
2025	56,441	1985
2026	48,670	1986
2027	44,506	1987
2028	52,781	1988
2029	60,768	1989
2030	52,598	1990
2031	47,969	1991
2032	54,013	1992
2033	60,551	1993
2034	62,232	1994
2035	53,921	1995
2036	42,441	1996
Total	927,155	

Notes:

1. The life of a residential building is taken as forty years.
2. Dwelling replacement rate in any given year is assumed to be the corresponding number of completions 40 years prior. Hence, the number of buildings constructed in 2019 is assumed to be at least the number of buildings constructed in 1979.
3. Excludes NSW, QLD and NT.

Water heater replacement rate

The scope of the current requirement to temper heated water when water heaters are replaced applies in all circumstances in New South Wales, Queensland, and the Northern Territory and when water heaters are replaced with one having a different fuel source in the remaining jurisdictions. Hence the extent of the problem is confined to where there is inconsistency in the application of the regulation – stand-alone water heaters used to replace a water heater of the same fuel source (like-for-like) in existing private dwellings.

The extent to which water heaters have been replaced since 1997 is also an important influence on the extent of the problem. A water heater will be replaced on average every 15 years over the life of the building[15]. These replacements represent an opportunity for it to be replaced with a water heater of a different fuel source, triggering the requirement for tempering. Wilkenfeld (2009) estimates, 78% of water heaters are replaced with one of the same fuel type[16]. The remaining proportion (22%) select a different fuel source, and therefore no longer contribute to the problem. This proportion is considered conservative and could be higher, although reliable estimates are not available for relocations of water heaters.

[15, 15] G Wilkenfeld (2009) "Regulation Impact Statement: for Consultation – Phasing out greenhouse-intensive water heaters in Australian homes". Page 22.

Table 2 shows the number of like-for-like replacement water heaters remaining within the existing dwelling stock from 2019.

Table 2: Number of existing dwellings with like-for-like replacements since 1996

Year replacing for:	Dwelling replacement
1979	38,078
1980	39,645
1981	39,530
1982	26,715
1983	25,635
1984	32,791
1985	34,339
1986	29,611
1987	27,077
1988	32,112
1989	36,971
1990	32,000
1991	29,184
1992	32,861
1993	36,839
1994	37,862
1995	32,805
1996	25,821
Total	**589,877**

The extent of the building stock where the problem occurs under the status quo is estimated as 589,877 dwellings (see Chart 1). This number reduces annually due to the voluntary uptake of tempering at the point of replacement (22% of cases) and renewal of the existing building stock.

Dwellings amenable to regulatory influence

From the perspective of 2019, the extent of the building stock available for influence through further regulation is significantly diminished since 1997 and is diminishing further over time.

A proportion of dwellings will come to the end of their service life prior to a water heater being replaced. Although they constitute part of the problem, these dwellings will not be able to be influenced after 2019 when any regulatory change could come into force under a standard replacement schedule. The extent of building stock amenable to further technical regulation excludes these 'laggards' – buildings that opt not to temper when undertaking their final replacement of their water heater prior to 2019. Table 4 shows the existing dwelling stock taking account of the simplified water heater replacement schedule.

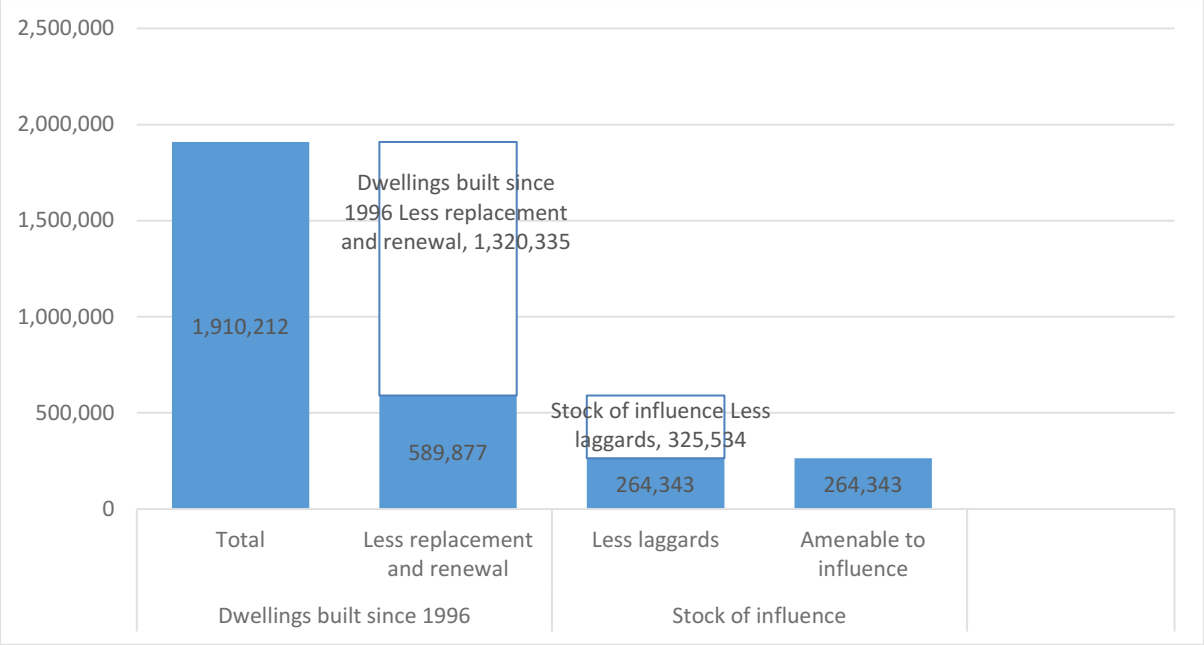
Table 3: Existing dwelling's water heater replacement schedule

Year of construction:	'Like-for-like' water heater replacements	Year of first replacement	'Like-for-like' water heater replacements	Final replacement year:
1989	47,399	2004	36,971	2019
1990	41,026	2005	32,000	2020
1991	37,415	2006	29,184	2021
1992	42,130	2007	32,861	2022
1993	47,229	2008	36,839	2023
1994	48,541	2009	37,862	2024
1995	42,058	2010	32,805	2025
1996	33,104	2011	25,821	2026
Total	338,902		264,343	

Notes:

1. 15 year design life of water heater (e.g. those replaced in 1997 are those installed in 1982).
2. Dwellings are assumed to require their water heater to be replaced twice over their life.
3. 22% are renewed with a water heater of a different fuel source and are excluded as these currently require tempering in all jurisdictions.

Chart 1: Size of the problem



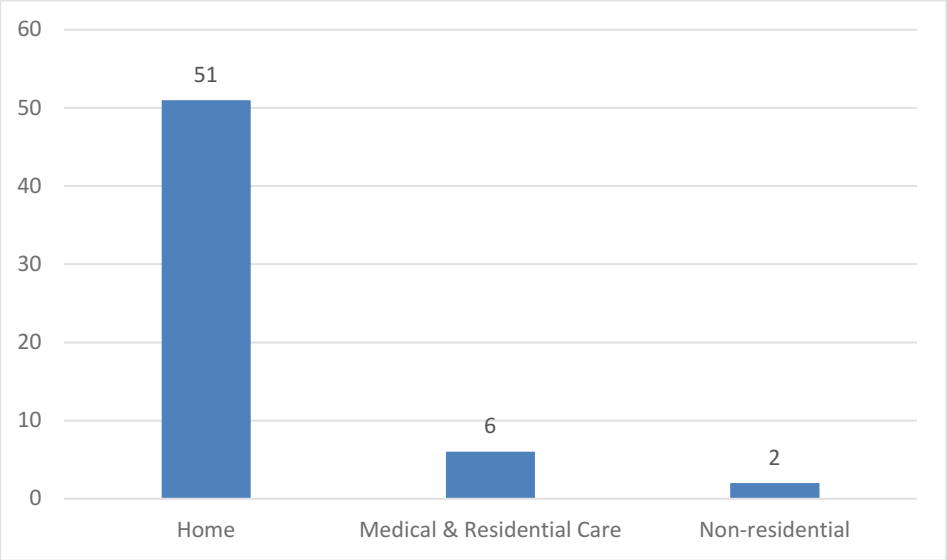
Injuries and fatalities

The extent of the problem is also comprised of the number of injuries and fatalities that are occurring in Australia as a result of being scalded from an untempered outlet at sanitary fixtures. The analysis uses the best available information on incidences of injury and fatality from two sources; information from the National Coronial Information System (NCIS) on fatalities and information from the Australian Institute of Health and Welfare (AIHW) on injury data. Both reports should be read in conjunction with this analysis and can be found on the ABCB website.

Fatalities

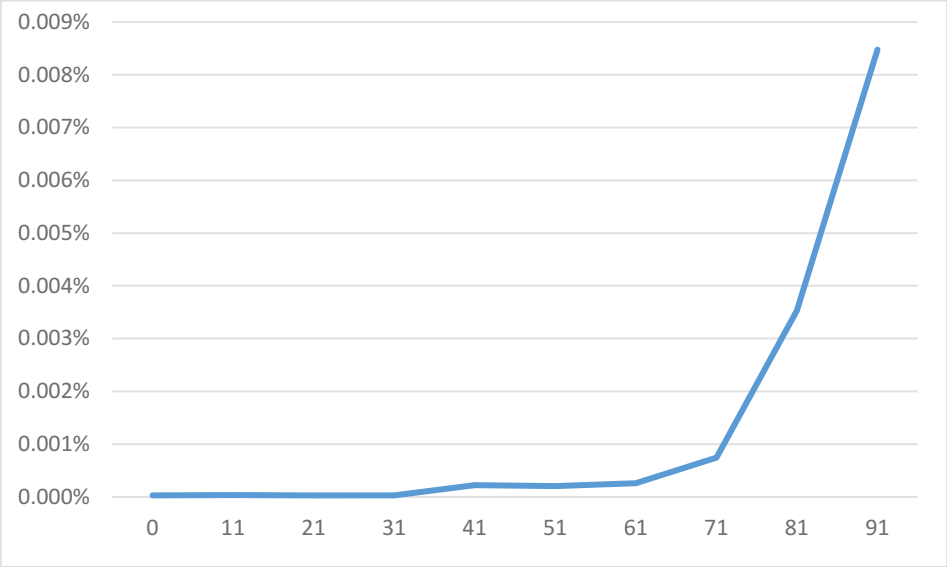
Between 2001 and 2013, 59 fatalities were recorded in all buildings as a result of scalding from mains supply heated water. The data shows that most scalding fatalities occurred in private dwellings and to elderly people as shown in Charts 2 and 3.

Chart 2 – Location of scalding fatalities 2001-2013 (number)



Source: National Coronial Information System Mains Water Scalding Fatalities in Australia 2001 – 2013

Chart 3 – Occurrence of scalding fatality as a portion of age 2001 -2013 (percent)



Source: National Coronial Information System Mains Water Scalding Fatalities in Australia 2001 – 2013

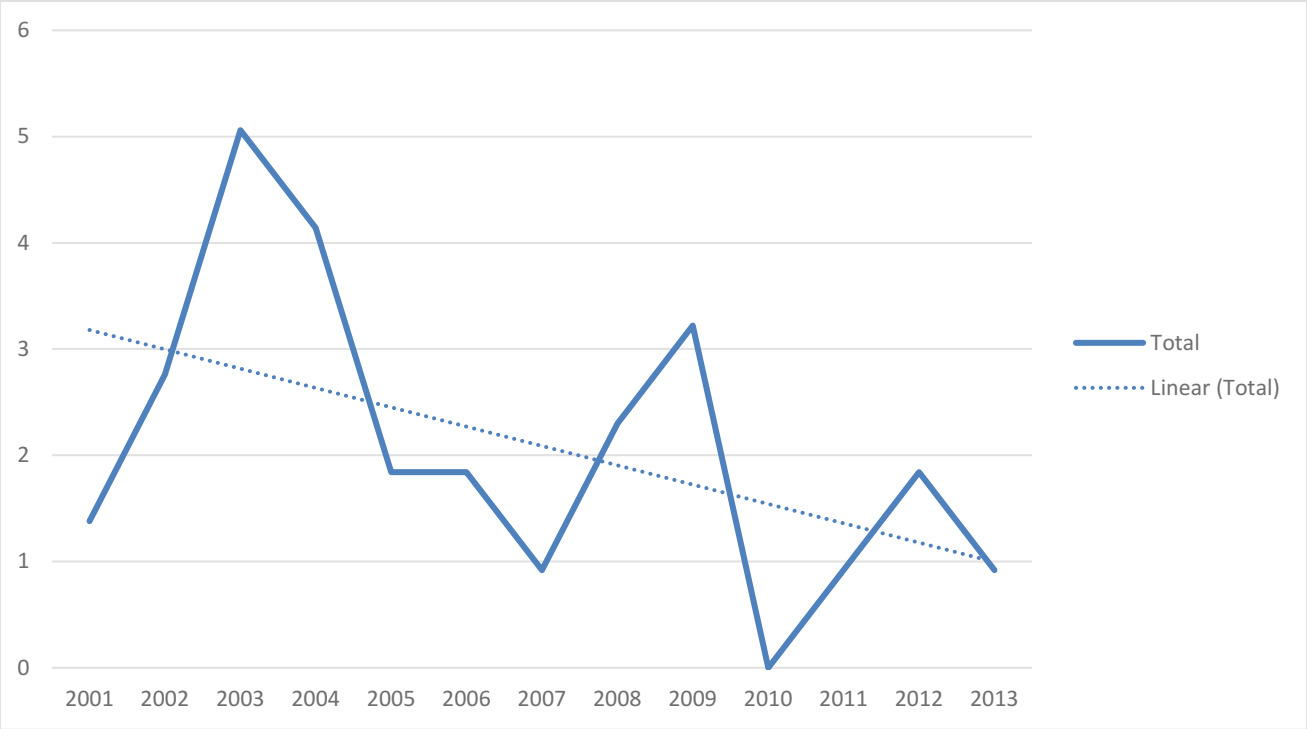
The coronial data describes mains water scalding fatalities by water temperature as chiefly “hot”, “boiling”, “excessively hot”, “scalding” and some fatalities have occurred at temperatures 55°C and greater. This information indicates the temperature of the heated water associated with fatalities is higher than 50°C.

Hence it may be inferred that this water was heated without temperature control, which is possible under the ‘like-for-like’ application of tempering. It is possible that, as people age in their homes and

replace their water heaters from time to time without tempering, they become more prone to accidental scalding. Fatalities may have occurred in these circumstances.

The coronial data shows a trend of decline in the number of scalding fatalities over 2001 to 2013 (Chart 4). This could be largely attributed to the introduction of temperature control in 1996 and suggests that the problem, due to the reasons described above, may be correcting at the current level of intervention. Moreover, given the downward trend, fatalities could be lower in subsequent years than the 1 recorded in 2013.

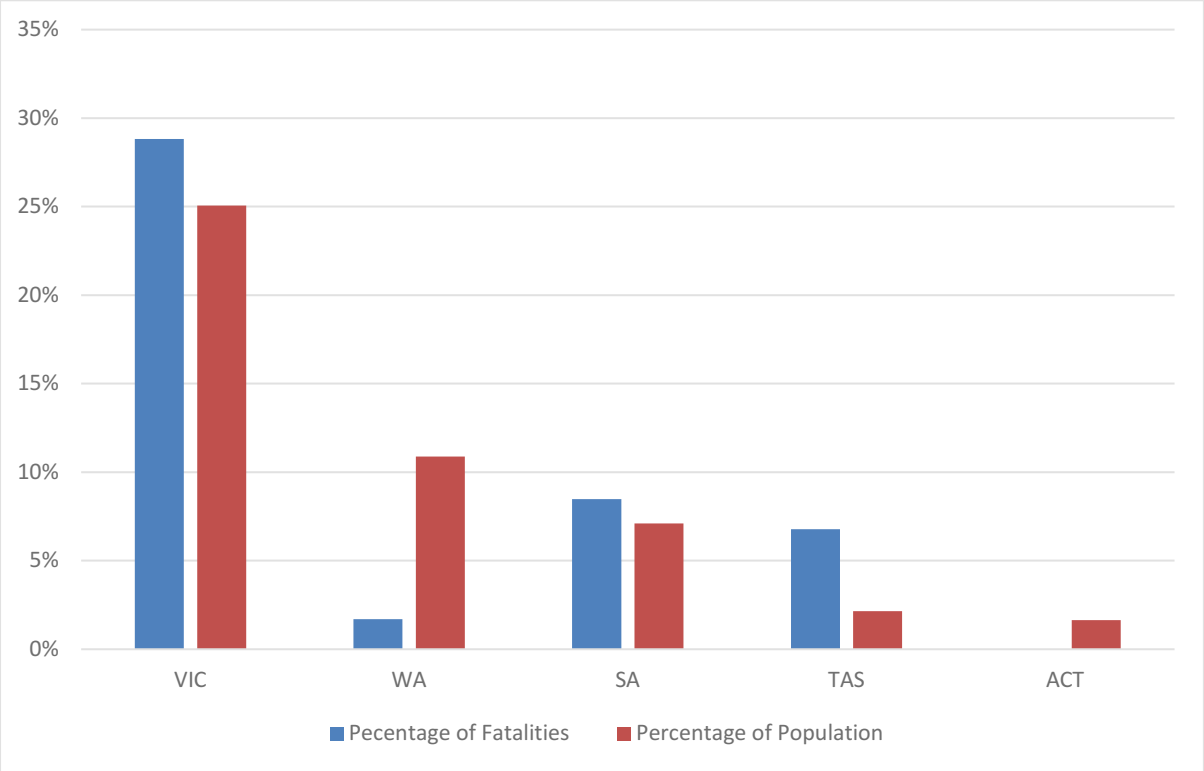
Chart 4 – Scalding fatalities over time (number)



Source: National Coronial Information System Mains Water Scalding Fatalities in Australia 2001 – 2013

Hence, the extent of the problem in terms of fatalities is small and on a clear downward trend.

Chart 5 – Scalding fatalities by jurisdiction (percent)



Source: National Coronial Information System Mains Water Scalding Fatalities in Australia 2001 – 2013 and the Australian Bureau of Statistics

Injuries

The data on scalding injuries reveals various patterns relating to burn and scald injury hospitalisations, which highlight population groups of particular vulnerability. Three groups show high rates of scalding; young children under five, males in their late teens and early twenties and older persons over 70 years of age. Of these groups, young children and the elderly are particularly vulnerable to scalding from hot tap water. There is no available evidence to indicate that people with disability are disproportionately impacted by scalding from hot water based on the available information.

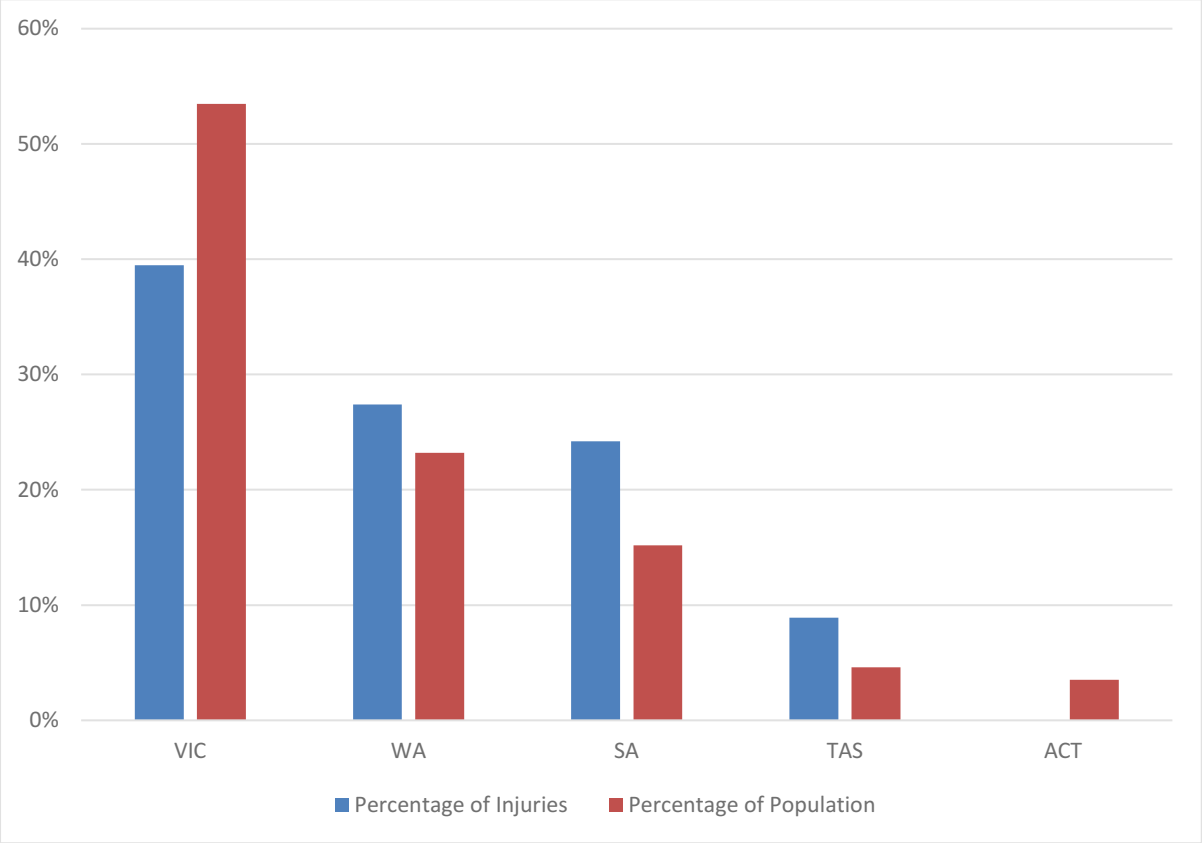
The number of injuries has been revised since the Consultation RIS based on new information from the Australian Institute of Health and Welfare. Between 2011 and 2015, an annual average of 160 hospitalisations were recorded by AIHW as a result of scalding related injuries from heated water in private residences in jurisdictions that do not require heated water tempering when like-for-like water heater replacement occurs. Table 4 shows a breakdown of injury data by jurisdiction.

Table 4: Breakdown of injury databy jurisdiction

	ACT	SA	TAS	VIC	WA	Total
2011	2	41	7	94	37	181
2012	4	36	5	84	31	160
2013	3	35	9	89	41	177
2014	2	37	9	59	44	151
2015	0	38	14	62	43	157
Total	**11**	**187**	**44**	**388**	**196**	**826**

Similar to the data on fatalities, Chart 7 shows that scalding injuries are strongly correlated to population size.

Chart 7 - Scalding injuries by jurisdiction – (average)



Source: Australian Institute of Health and Welfare - Scalding injury hospitalisations (unpublished) 2011 – 2015

Fortunately, most scalds where hospitalisation occurs are not very severe. For the period 1999 - 2007, 47% of scald related injuries resulted in a hospital stay of 1 day with a further 28% requiring hospital stays between 2 and 7 days[17].

The Consultation RIS asked stakeholders whether they were aware of any other research or data that could be used to inform the extent of the problem.

Several stakeholders questioned why the benefits did not include injuries where hospitalisation was not required. They suggested that avoiding referrals to other medical practitioners, such as doctors' surgeries, could significantly contribute to the benefits of the option.

A report by the Public Health Association (2012) found that 90% of all scalding related injuries from heated water required hospitalisation. This is consistent with the time-critical nature of the injury, requiring immediate medical attention. Given that non-hospitalisation scald injuries represent a small proportion of all scalding injuries and are likely to cost much less than hospitalisation, this avoided cost is likely to have an immaterial impact on the overall benefit of any regulatory intervention.

[17]Hospitalised hot tap water scald patients following the introduction of regulations in NSW, Australia: Who have we missed? Lara A. Harvey, et al. Burns 36, 2010. p. 912-919.

Since the Consultation RIS, the extent of the problem has become clearer. Tempering of heated water is known to reduce the severity and therefore the number of scalding injuries. It has a sound basis in science and risk mitigation and is thought to have contributed to a reduction in injuries and fatalities since its introduction in 1996.

The number of scalding fatalities has been shown to be small and diminishing over time. The number of buildings where the problem has the potential to occur is 589,877. However, it is also known that the rate of replacement of water heaters in the existing building stock affects those able to be influenced by technical regulation and this number is smaller when compared to the total pool of 8 million dwellings in Australia.

The extent of the problem in jurisdictions that do not temper in all circumstances is therefore characterised as 160 scalding injuries amenable to prevention and 264,343 dwellings amenable to influence.

Objective

The objective of the PCA is to support the health and safety of occupants, in this case, in relation to potential risks of scalding from heated water used for personal hygiene purposes in private dwellings.

The objective of this RIS is to ensure that the NCC requirements are as far as practicable consistent across the States and Territories as described by the ABCB's Inter-governmental Agreement.

Options

The following options are presented for consideration in this Final RIS.

The status quo

The status quo is the default choice for decision-makers in considering alternatives to achieve the objectives. Where the incremental impacts of other options would result in more costs than benefits, or would be ineffective in addressing the problem or achieving the objectives, the RIS will conclude in favour of the status quo.

Option 1 – to require heated water tempering for all circumstances where water heaters are replaced

Under this Option, the PCA would be amended to apply the current requirement applicable to heated water systems in new dwellings to replacement water systems in existing dwellings.

The focus of this RIS is the inconsistent application of existing regulations by the States and Territories, so a non-regulatory option would not address this issue.

Impact Analysis

The principal stakeholders of this RIS are occupants of existing private dwellings with stand-alone water heaters, particularly the elderly and those who may be vulnerable to scalding from hot water residing in the Australian Capital Territory, South Australia, Tasmania, Victoria and Western Australia.

The Status quo

The status quo will involve continuing inconsistent application of regulation by jurisdictions, where those jurisdictions require heated water from all new water heaters to be tempered to a maximum temperature of 50°C, and other jurisdictions permit like-for-like replacement water heaters in private dwellings without additional tempering. However, under the status quo, the problem continues to diminish under the influence of the renewal of existing stock and the voluntary tempering of heated water when water heaters are replaced. Under these two mechanisms, all dwellings can be assumed to be tempered at a future point (see Table 5).

Table 5: Rate of existing stock diminishing over time

Year	Total stock	Built - replaced - demolished	Replaced	Demolished
2020	551,798	1979	2009	2019
2021	512,153	1980	2010	2020
2022	472,622	1981	2011	2021
2023	445,908	1982	2012	2022
2024	420,273	1983	2013	2023
2025	387,482	1984	2014	2024
2026	353,143	1985	2015	2025
2027	323,533	1986	2016	2026
2028	296,455	1987	2017	2027
2029	264,343	1988	2018	2028
2030	227,372	1989	2019	2029
2031	195,372	1990	2020	2030
2032	166,188	1991	2021	2031
2033	133,327	1992	2022	2032
2034	96,488	1993	2023	2033
2035	58,626	1994	2024	2034
2036	25,821	1995	2025	2035
2037	0	1996	2026	2036

Option 1

Under this Option, the PCA would be amended to apply the current requirement applicable to heated water systems in new dwellings to replacement water systems in existing dwellings.

Cost of Option 1

States and Territories that require tempering of heated water in all circumstances (New South Wales, Northern Territory and Queensland) will not incur additional cost as a result of implementing

this option. Hence, the costs of the option will only impact the remaining jurisdictions. These jurisdictions account for approximately 50% of all dwelling stock in Australia[18].

Plumbing practitioners were encouraged as part of the consultation process to provide information on the extent to which tempering is being undertaken voluntarily in the jurisdictions impacted by the option. There were mixed views on the voluntary uptake. However, many plumbing practitioners felt that tempering was not frequently undertaken, citing cost as the dominant barrier to voluntary adoption.

The cost of the option has been developed using the following information:

- The expected economic lifespan of a residential building is estimated to be 40 years.
  - Based on meta-analysis of lifecycle analyses of residential construction.
- The expected economic life span of a stand-alone water heater is 15 years.
  - Based on average life of water heater.
- 78% of all water heaters are expected to be replaced with a heater of the same fuel type.
  - Based on Wilkenfeld (2009) estimate that 78% of water heaters are replaced with one of the same fuel type[19].
- The average cost of installing a tempering valve is $143.
  - Based on Rawlingsons Construction Handbook (2016) Page 457.
- The stock of private residences built between 1957 and 1997 totalled 3,820,424.
  - ABS 8752.0 "Building Activity, Australia June 2016" Table 38.
- The stock of residences in jurisdictions impacted by Option 1 totalled 1,910,212.
  - Based on the share of dwelling completions in ACT, VIC, SA, TAS and WA: 1984 to 1997.

[18] ABS 8752.0 "Building Activity, Australia June 2016" Table 38.

[19] G Wilkenfeld (2009) *"Regulation Impact Statement: for Consultation – Phasing out greenhouse-intensive water heaters in Australian homes".* Page 22.

The stock of dwellings untempered as of 2019 is estimated to be 589,877. The cost of Option 1 is shown in Table 6.

Table 6: Present Value Cost of Option 1

Year replacement occurs:	Year replacing for:	Number of like-for-like water heater replacements	PV cost per tempering device	Total PV cost
2019	1989	36,971	$143	$5,286,845
2020	1990	32,000	$134	$4,288,043
2021	1991	29,184	$125	$3,648,004
2022	1992	32,861	$117	$3,844,761
2023	1993	36,839	$110	$4,052,282
2024	1994	37,862	$102	$3,861,919
2025	1995	32,805	$95	$3,116,497
2026	1996	25,821	$89	$2,298,051
Total				**$30,396,402**

Notes:

1. A 7% discount rate has been used to calculate the Present Value.
2. All dwelling stock constructed prior to 1989 have either been renewed or have had their water heater replaced for the final time within their 40 year lifecycle.
3. There is a further proportion of this existing stock (laggards) built prior to 1988, that at the point of their second replacement (30 years after installation) will opt not to temper. These are not able to be influenced until becoming part of renewed stock in 2028.

The cost of Option 1 in Present Value terms is $30.3 million. Based on the share of dwelling completions, the cost to each jurisdiction is shown in Table 7.

Table 7: Present Value Cost of Option 1 in each jurisdiction

Jurisdiction	Cost
Australian Capital Territory	$1,215,856
South Australia	$4,255,496
Tasmania	$1,215,856
Victoria	$15,806,129
Western Australia	$7,903,065
Total	**$30,396,402**

Benefits of Option 1

The benefits can be assessed from three perspectives.

Risk

First, the evidence around the nature of the problem shows that people most at risk from scalding fatalities from heated tap water are the elderly in their own homes. Over the years 2001 to 2013, 36 out of 59 scalding fatalities (60%) occurred to people over the age of 70 years. As scalding occurs at temperatures above 50°C it is reasonable to conclude that either the heated water systems have been installed without tempering, or are those replaced on a 'like-for-like' basis. The incidence of scalding fatalities and injuries increases dramatically over the age of 70 years. It is likely that the ageing process occurring concurrently with 'like-for-like' replacement of water heaters has increased the risk to the elderly. Option 1 could therefore reduce this risk to elderly people.

Fatalities

Second, the benefits can be evaluated from the perspective of any reduction in the incidence of scalding fatalities from heated water. However, it is difficult to claim any material benefits in relation to fatalities under Option 1. The extent of the problem, in terms of fatalities, summarised in Chart 3 shows fatalities declining between 2001 to 2013 to one fatality and may well be lower on average in future years.

Injuries

Finally, the extent of the problem from the perspective of injuries has been revised from the Consultation RIS. The cost of scalding injuries impacts on occupants and the wider community in the form of medical expenses, lost productivity and a reduction in overall health and welfare. These costs are reflected in Table 8 and are based on the Australian estimates for Quality Adjusted Life Years[20] and the Value of Statistical Life Years (VSLY)[21]. These indices take into account productivity, welfare and medical costs for a range of effects ranging from short-term scalding injuries to extreme consequences like skin grafting.

Table 8: Annual reduction of health and welfare from scalding related injuries in ACT, SA, TAS, VIC and WA

Severity	Days per injury	Disability weight	Health cost per injury	Medical cost per injury	Total cost per injury	Total incidence	Total cost
Mild	1	0.172	$88	$1,900	$1,988	75	$149,517
Moderate	4	0.172	$353	$7,600	$7,953	45	$356,295
High	8	0.172	$706	$15,200	$15,906	32	$508,993
Severe	7300	0.172	$644,243	$57,000	$701,243	8	$5,609,946
Total	-	-	-	-	-	160	$6,624,750

Notes:

1. Days per injury and total incidence: Lara A. Harvey, et al. (2010) found that 47% of scalding-related injuries required day only admission to hospital, 28% required admission of between 2 and 7 days (4 days has been taken as a midpoint); 20% required admission of 8 days or more and 5% required

[20] Mathers C, Vos T, Stevenson C (1999). The burden of disease and injury in Australia. AIHW cat. No. PHE 17. Canberra. Australian Institute of Health and Welfare.

[21] Abelson, P. (2007) Office of Best Practice Regulation. Establishing a Monetary Value for Lives Saved: Issues and Controversies: WP 2008 – 02:21.

admission of over a month. It has been assumed that for severe scalding injuries, life-long effects are caused impacting in long term consequences to the person's welfare.

2. Disability weight: The index provides weight according to the severity of illness. Mathers C, T, Vos, C. Stevenson "The Burden of Disease and Injury in Australia (1999) AIHW Canberra.
3. Health cost per injury: Measures the amount the community is willing to pay to avoid an adverse health outcome. It is derived from the Quality Adjusted Life Year (QALY) in Australia which is $151,000 (Abelson, 2007). Adjusted for 2016 prices, this amounts to $187, 280. Divided by the number of days in a year, a QALD is $513. Hence the cost of mild scalding injuries in terms of health costs is $513 x 1 day x 0.172 = $88.
4. Medical costs: Medical costs have been estimated using the National Hospital Cost Data Collection Report (2016) prepared by the Independent Hospital Pricing Authority (IHPA[22]). The average cost per hospitalisation was $1900 in the 2014-15 financial year. This cost has then been multiplied by the length of stay based on the severity of scald.

The total cost of scalding-related injuries is therefore estimated to be $6,624,750 annually. As the renewal of the existing building stock occurs, the problem of injuries diminishes over time. The claimable benefits of Option 1 are the difference between the injuries incurred under the status quo when compared with the avoidable injuries under Option 1.

Table 9 – Present Value Benefits of Option 1

Year	Injuries occurring under status quo	Injuries occurring under Option 1	Net annual avoided injuries	Present Value benefits of avoided injuries
2019	160	160	0	$0
2020	149	137	12	$496,783
2021	137	115	23	$889,877
2022	126	94	32	$1,157,093
2023	118	76	43	$1,453,125
2024	111	57	54	$1,705,471
2025	102	35	67	$1,410,012
2026	92	14	77	$2,124,095
2027	83	1	83	$2,139,821
2028	76	0	76	$1,831,172
2029	67	0	67	$1,508,713
2030	56	0	56	$1,178,518
2031	47	0	47	$924,405
2032	38	0	38	$698,496
2033	29	0	29	$498,190
2034	18	0	18	$288,992
2035	6	0	6	$90,029
2036	0	0	0	$0
Total	**1,416**	**688**	**728**	**$18,394,790**

Notes:

1. A 7% discount rate has been used to calculate the Present Value benefits.
2. The severity of injuries is assumed to be consistent over time: 47% of scalding related injuries required day only admission to hospital, 28% required admission of between 2 and 7 days (4 days has been taken as a midpoint); 20% required admission of 8 days or more and 5% required admission of over a month.
3. The number of injuries is a factor of the size of the given cohort of buildings constructed in each year.

[22] National Hospital Data Collection, Public Hospitals Cost Report, Round 19 (Financial year 2014-2015). Independent Hospital Pricing Authority.

4. Benefits were determined using the net annual avoided injuries, multiplied by incidence and severity in each year.

The total number of avoidable injuries under Option 1 is 728 relative to the reduction of injuries incurred under the status quo. This generates a total saving of $18,394,790 in Present Value terms.

The Net Present Value of Option 1 is a cost of $12,001,612. This is considered to be a small cost to achieve a higher level of consumer welfare.

Business compliance costs

Business compliance costs are assessed under the following checklist:

- Notification – businesses will not be required to report certain events.
- Education – businesses will not be required to keep abreast of regulatory requirements.
- Permission – businesses will not need to seek permission to conduct an activity.
- Purchase cost – businesses will not be required to purchase items.
- Record keeping – businesses will not be required to update their records.
- Enforcement – businesses will not incur additional costs when cooperating with audits or inspections.
- Publication and documentation – businesses will not incur costs of producing documents for third parties.
- Procedural – businesses will not incur cost of a non-administrative nature.
- Other – businesses will not incur any other costs other than those identified by the analysis.

Regulatory burden

The Australian Government has introduced the 'Guide to Regulation', which discusses the importance of cutting red tape.

A key principle for Australian Government policy makers in the Guide to Regulation is that:

The cost burden of new regulation must be fully offset by reductions in existing regulatory burden.

All regulatory costs, whether arising from new regulations or changes to existing regulation, must be quantified using the Regulatory Burden Measurement framework. The framework must also be used for quantifying offsetting regulatory savings, where applicable.

As measured in accordance with the framework, the regulatory offset required to implement Option 1 would be a total of $3 million. The Commonwealth's share of this is $333,000.

Governments of the States and Territories are not required under COAG policy to identify regulatory offsets. Some jurisdictions may have their own mechanisms regarding regulatory offsets, which would be a matter for those jurisdictions to consider.

Sensitivity Analysis

A sensitivity analysis has been conducted on the Net Present Values by varying the parameters around the central analysis. Table 10 shows the conclusions of the sensitivity analysis in Net Present Value terms.

These include:

- **Discount rate:** A discount rate of 3% and 11% will be assessed.
- **Installation and maintenance costs:** Installation and maintenance costs of tempering valves may vary particularly between States and Territories, where labour rates vary. Therefore a variation of ± 10% will be assessed.
- **Replacement of like-for-like water heaters:** Water heater replacement rates for like-for-like replacements may vary. Therefore a variation of ± 10% will be assessed.

Table 10 - Net Present Value Sensitivity Analysis

Parameter	Present Value Costs	Present Value Benefits	Net Present Value
Discount rate Low (3%)	$34,246,956	$24,125,834	-$10,121,122
Discount rate High (11%)	$27,206,619	$14,407,194	-$12,799,425
Installation cost Low (-10%)	$27,356,762	$18,394,790	-$8,961,972
Installation cost High (+10%)	$33,436,043	$18,394,790	-$15,041,243
Replacement of like-for-like water heaters Low (68%)	$23,102,065	$18,077,275	-$5,024,790
Replacement of like-for-like water heaters High (88%)	$38,689,964	$18,905,807	-$19,784,157

All parameters tested through sensitivity analysis demonstrate small net costs associated with implementing Option 1.

Consultation

Consultation is the cornerstone of the ABCB's commitment to create a contemporary and relevant National Construction Code that delivers good societal outcomes for health, safety, amenity and sustainability in the built environment. This must be achieved in the context of good regulatory practice that evaluates the costs and benefits to society, as per the objective of the ABCB's Intergovernmental Agreement. The ABCB recognises the value of engaging constructively with the community and industry in order to achieve this.

There were 10 submissions to the Consultation RIS. Submissions were received from the following stakeholders:

1. The Plumbing Products Industry Group
2. Master Plumbers and Gas Fitters Association (WA)
3. Office of the Technical Regulator (SA)
4. Department of Commerce | Building Commission (WA)
5. Victorian Building Authority
6. Master Plumbers Association of Queensland
7. Four plumbing practitioners

There was mixed support between Option 1 and retaining the status quo. Five submitters in favour of Option 1 and five in favour of the status quo. Two of the three State plumbing administrations supported Option 1. Responses to the consultation questions have been incorporated throughout this Final RIS.

Conclusion

While there is nationally consistent application in tempering heated water in new private dwellings, there is inconsistency when applying the same requirements to heated water from replacement 'like-for-like' water heaters.

This RIS considers scalding injuries and fatalities under the current inconsistent application of the requirements for tempering heated water at the time of replacing water heaters in existing private residences.

The objective of this RIS is to ensure that the NCC requirements are as far as practicable consistent across the States and Territories as described by the ABCB's Intergovernmental Agreement.

One option was considered in addition to the option of retaining the status quo – to require heated water from replacement water heaters to be tempered to 50°C, regardless of the circumstances under which they are replaced.

States and Territories that currently require tempering in all circumstances (New South Wales, Queensland and the Northern Territory) would not be impacted by implementing Option 1. The costs of Option 1 therefore impacts the remaining jurisdictions – Australian Capital Territory, Victoria, South Australia, Tasmania and Western Australia.

The total cost of Option 1 is $30,396,402 in Present Value terms. A breakdown of costs in each jurisdiction is shown in Table 11.

Table 11: Present Value Cost of Option 1 in each jurisdiction impacted

Jurisdiction	Cost
Australian Capital Territory	$1,215,856
South Australia	$4,255,496
Tasmania	$1,215,856
Victoria	$15,806,129
Western Australia	$7,903,065
Total	**$30,396,402**

All plausible benefits were investigated as part of informing this analysis. The incidence of scalding fatalities from heated water is currently very low and on a declining trend. Therefore, it is difficult to claim any material benefit from reduced fatalities under Option 1.

Scalding injuries are more frequent due to scalding from heated tap water occurring in the impacted jurisdictions, with an annual average of 160 hospitalisations. Tempering is known to be effective at reducing the risk and severity of scalding injuries. Therefore Option 1 will mitigate injuries from sanitary fixtures following a water heater's replacement at a faster rate than under the status quo. The total benefits attributable to implementing Option 1 are $18,394,790 in Present Value terms. This equates to the avoidance of 728 injuries over 16 years.

The Net Present Value of requiring consistent tempering of heated water from replacement water heaters in the Australian Capital Territory, Victoria, South Australia, Tasmania and Western Australia is shown in Table 12.

Table 12: Net Present Value of Option 1

Present Value Costs	Present Value Benefits	Net Present Value
$30,396,402	$18,394,790	-$12,001,612

As the cost of Option 1 exceeds the benefit, this RIS concludes in favour of the status quo.