



**REGULATION IMPACT STATEMENT  
For Decision**

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**Interconnection of Smoke Alarms**

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**October 2013**

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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 proposals to revise the requirements for smoke alarms in Class 1a buildings.

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## 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 mission is to oversee issues relating to health, safety, amenity and sustainability in building. The ABCB promotes efficiency in the design, construction and performance 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 [www.abcb.gov.au](http://www.abcb.gov.au).

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## Introduction

The Australian Building Codes Board previously considered a Final RIS that provided an analysis of the current smoke alarm provisions contained in the National Construction Code (NCC) against a number of options to improve occupant notification and response times in the event of fire. It considered the impacts in Class 1, 2, 3 and 4 buildings.

The previous Final RIS did not examine one option that was considered in the Consultation RIS – that of interconnecting existing alarms currently required by the Building Code of Australia (BCA).

The analysis in the Final RIS demonstrated that all options involved a significant net cost to the community. This was partly due to the low incidences of fire fatalities and injuries and partly due to the incremental costs involved in requiring additional alarms both with and without interconnection.

The Board considered the Final RIS at its meeting on 27 June 2013. In its deliberation on a decision the Board requested the ABCB Office undertake further research including the cost of the status quo and the cost of interconnecting alarms, and to further explore the quantitative and qualitative benefits.

The cost of the Status Quo is not normally considered in a RIS, because the RIS is forward looking and assessing proposals for regulatory change. The RIS is not an evaluation of past policy. If the smoke alarm provisions in the NCC were reviewed today the analysis would show an overall and significant net cost.

The proposal to interconnect existing alarms will focus this analysis on new houses. The capability of other residential building types to interconnect alarms is very low because the majority have only one alarm.

The purpose of this RIS is to assess the option of interconnecting existing alarms in new houses.

# Nature and Extent of the Problem

## Nature of the Problem

The nature of the problem remains as described in the previous Final RIS.

The nature of the problem is described in the VU report, where it is reported that current smoke alarm requirements contained in the NCC have limited efficacy and have room for improvement. The main improvement detailed in the report is the ability to improve arousal times of occupants.

Categorically the problem arises from activation and notification difficulties, particularly when occupants are asleep. Experimental evidence suggests that current requirements do not provide complete coverage and may not successfully detect or notify occupants of fire.

The argument raised in the VU report discusses how under the current minimum requirements in the NCC, closed doors and the proximity of alarms is reducing the alarm signal strength at areas where it is most desired; such as in bedrooms when occupants are asleep or in areas remote from the fire ignition point. Occupants are not being notified as quickly, or at all, of the presence of fire.

75dBA with a frequency of 3100Hz is typically considered to be the required sound pressure level to awaken sleeping occupants. The current smoke alarm technology required by the Building Code of Australia (BCA) for residential houses is an AS3786 system which produces 85dBA at a frequency of 3100Hz.

Five sample dwellings were used as part of the VU study which investigated the use of multiple smoke alarm types to determine the likely resultant dBA level at the predicted bedhead location from the room of sound origin (RSO). The following results were observed.

Table 1: Sound Pressure Levels at the Bedhead

Emitted sound level in RSO (dBA)	Frequency (Hz)	Status of all doors	Average sound level in other rooms (dBA)
85	3100	Open	52
105	3100	Open	67
85	3100	Closed	36
105	3100	Closed	51

The study concluded that the dBA level is being significantly reduced by the time it reaches the predicted bedhead location. With doors closed it was determined that the signal strength of an alarm was greatly reduced. However, the level of this reduction greatly depended on the design and layout of the building.

The VU report suggests that increasing the stringency of smoke alarm provisions so that every room in a every residential dwelling had a working smoke alarm would result in 17-30% fewer fatalities, and potentially up to 50% in some circumstances.

## Other Factors affecting the Problem

It is noted that a range of 'other factors' influence the efficacy of smoke alarms including behavioural and social issues. This highlights that design and engineering solutions are only part of the answer.

A key element that needs to be considered is whether new regulatory intervention would affect any injuries or fatalities occurring in new construction.

The problem of failing to be notified and evacuated from the dwelling due to a fire may be linked to a range of factors, including but not limited to, social economic status, higher risks associated with vulnerable individuals (young, elderly, impaired), disconnection of alarms, impairment by drugs or alcohol, maintenance of property, non-compliance or simply not being effectively notified.

It is also noted that individuals considered vulnerable will not necessarily benefit from an increase in placement of alarms. Those with high frequency hearing loss will find it difficult to hear any alarm, and it has been demonstrated that children fail to arouse to the pitch of a traditional smoke alarm.

There is a strong issue of the use of smoke alarms within the building stock. AFAC reported that out of all residential dwelling fires attended by the fire brigade only 33% were found to have a working smoke alarm.

These factors call into question the significance of the problem in new construction. Particularly if there is such a level of non-compliance and attitude towards nuisance alarms, it may be suggested that the removal of alarms will continue to occur.

These factors may impact differently in the existing building stock and new construction. However there is an issue with lack of data disaggregating new and older construction. This data would enable further quantitative discussion on these other factors.

These other factors, behavioural and social, would be expected to reduce the efficacy of smoke alarms per se, and may be directly responsible for a proportion of fatalities and injuries in residential construction. Hence these aspects of the problem cannot be addressed in the NCC.

Overall, the account of the problem provided in the VU report was comprehensive and warrants review, however issues relating to behavioural and social factors should also be considered.

## Objective

The objective is to enhance the safety of residents in new houses by alerting them of a fire in the building so they may safely evacuate.

## Option

This RIS presents two choices for the Board:

- The Status Quo
- The Option - to interconnect alarms currently required by the BCA in new houses

### Status Quo

The Status Quo is the default option for decision makers in considering options to address the problem. 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 would conclude in favour of the Status Quo.

### The Option

**The Option would amend the smoke alarm provisions in the NCC to require smoke alarms to be interconnected in new houses.**

The Option could not apply to new sole occupancy units with only one alarm which would consist of:

- most apartments, and sole occupancy units in Class 3 and 4 residential buildings
- most three bedroom houses and some four bedroom houses

The percentage of new dwellings where multiple alarms are currently installed is estimated to be 60%, of new houses, or 62,000 houses<sup>1</sup>.

In addition, the Option would address the problem only when residents are awake.

When residents are sleeping, interconnection will not change the signal strength of the alarms and so it will not be sufficient at the bed-head to arouse the sleeping resident. Hence the Option will not provide incremental benefits over and above the Status Quo.

The VU report did not specifically investigate this Option. However the report did evaluate the efficacy of current alarm systems - how distance from alarms and the effect of closed doors has in reducing signal strength in areas where it is most desired, such as bedrooms where the occupants are asleep or in areas remote from a smoke alarm. The report showed that the current provisions in the NCC are not delivering the required signal strength to awaken a sleeping occupant in most instances. Inter-connecting alarms will not improve signal strength in these instances and hence is no different from the Status Quo.

When residents are awake, interconnection of alarms may facilitate alerting residents of a fire where the distance between fire and occupant is large. From the national coroners' report on fire fatalities in houses, of fatalities not involving self-harm, 38% were asleep and 62% were awake. Hence the Option potentially could avoid the 62% of non-self-harm fatalities in houses.

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<sup>1</sup> Of new houses constructed each year, 20% known to be two or more stories, 40% assumed to be three-bedrooms, and 40% four or more bedrooms.

# Impact Analysis

## Costs

The costs of the Option are the addition costs for labour and materials to inter-connect existing alarms.

Table 2: Costs of Interconnection of alarms, for each new house

Interconnection labour	Interconnection wire cost	Total
\$13	\$8	\$21

- Cost based on interconnection of two smoke alarms.
- Interconnection cable costs have been estimated at \$52.00 per 100m being a single core double insulated mains cable
- Each smoke alarm has an allowance of 15m of cabling for interconnection.
- Labour rate indications vary from \$55.00/Hr to \$90/Hr. \$80/Hr has been used. It is considered any profit margin on labour is contained within this rate
- For interconnection an additional labour allowance of 10 minutes is made for the clipping of both interconnect and mains supply cable as well as the termination of 2 additional wires. Where interconnection is required the mains supply cable and interconnect cable are run simultaneously at the rough in stage.

Table 3: Number of housing completions in Australia annually

Number of houses being completed per year
103,000

- ABS Table 37 Number of Dwelling Unit Completions per Sector, Australia.

Table 4: Expected number of houses with multiple alarms constructed annually

Number of houses with multiple alarms
62,000

- Of new houses constructed each year, 20% known to be two or more stories, 40% assumed to be three-bedrooms, and 40% four or more bedrooms.

Table 5: Annual Costs

Annual cost of installation	Present Value Costs*
\$1,302,000	\$9,784,832

- \*A 7% discount rate has been used over a 10 year period to calculate the costs of the Option.

## Benefits

The benefits of the Option are realised when fire-related injuries and fatalities in new houses are avoided. These benefits occur when residents are awake in their homes and at distance to a sounding alarm where signal strength would normally be too weak to alert residents of a fire. Benefits will not occur when residents, who are awake, are close to the fire or alarm, or when they are asleep. Overall the incidence of fatalities when residents are awake and at a distance to the sounding alarm, which can be potentially avoided by the Option, is very low.

### Fatalities

New information from the National Coroners Information System<sup>2</sup> provides insight into the circumstances of fire fatalities from 2001 to 2006.

Key information to calculate the benefits are:

- 374 fatalities occurred that were not a result of intentional self-harm, at an average rate of 62 fatalities per year.
  - 24 fatalities (38%) per year occurred when the occupant was resting or asleep.
  - 38 fatalities (62%) per year occurred when the occupants were awake.

The fatality rate is consistent with the fatality rate used in the previous Final RIS, with an adjustment made for self-harm.

New houses constructed each year comprise 1.9% of the existing stock of houses. So fatalities avoided when residents are awake, in new houses, are estimated to be 0.7 fatalities per year.

The effectiveness of the Option will only benefit residents in two storey houses and other houses that have bedrooms at opposing sides. It is estimated that this is 20% of all new houses installed with multiple alarms. Therefore the estimated fatality rate avoided is 0.14.

The increase in effectiveness from the status quo in these circumstances is likely to be marginal; however for consistency with the findings of the VU report a 17% effectiveness rate has been applied.

**Overall, the fatality rate avoided by the Option is 0.024 per year.**

Fatality rate occurring in new houses	
Fatalities per year	62
Fatalities where occupants have been awake, per year (62%)	38
Fatalities occurring in new buildings, per year (1.9%)	0.7
Fatalities occurring in new double storey houses or other houses where occupants could be at a distance from sounding alarm, per year (20%)	0.14
Applying the effectiveness in these Situations (17%)	<b>0.024</b>

<sup>2</sup> House Fires, National Coroners' Information System Bulletin, May 2007.

## Injuries

The reduction in injuries is estimated to be proportional to the fatalities avoided.

Injury rate occurring in new houses	
Injuries per year	433
Injuries where occupants have been awake, per year (62%)	268
Injuries occurring in new buildings, per year (1.9%)	5
Injuries occurring in new double storey houses or other houses where occupants could be at a distance from sounding alarm, per year (20%)	1
Applying the effectiveness in these situations (17%)	<b>0.17</b>

In summary, the Option could avoid 0.024 fatalities and 0.17 injuries per year. The low incidence of avoided fatalities and injuries per year means that the calculated benefits will be similarly small.

Cost avoided	Annual	Present Value
Fatalities	\$90,440	\$1,290,120
Injuries	\$2,333	\$33,286
Total	\$92,773.42	\$1,323,406

Present Value Costs	Present Value Benefits	Net Present Value
\$9,784,832	\$1,323,406	-\$8,461,426

The Option would result in a net cost to society of \$8.5 million. The benefit cost ratio is significantly less than unity at 0.13 which indicates that the Option would be very inefficient in addressing the problem.

## Conclusion

The Option to interconnect alarms would apply to new houses, however, only to those constructed with multiple alarms. This is estimated to be 60% of new housing construction. It would not apply to sole occupancy units in other residential buildings which typically have only one alarm. Hence the costs of the Option relate to 60% of new housing.

The benefits of the Option relate to residents in 20% of new housing, where currently there is a significant distance between a sounding alarm and the occupant. In addition the Option will only benefit residents who are awake, but not those who are asleep. These factors diminish the possible benefits of the Option relative to the costs.

Overall, the Option has been evaluated as being a net cost to society, of \$8.5 million, with a very low benefit cost ratio of 0.13. In these circumstances, the Status Quo would provide a superior outcome for the community.