Australian Government
Department of Employment

Deputy Secretary
Sandra Parker

Senator Bridget McKenzie
Chair
Senate Education and Employment Legislation Committee
PO Box 6100
Parliament House
CANBERRA ACT 2600

Dear Senator

On 21 November 2013 the Department appeared before the Education and Employment Legislation Committee for the 2013-2014 Supplementary Budget Estimates.

I advised the Committee that the Department had commissioned a cost benefit analysis to help inform the development of the National Strategic Plan for Asbestos Awareness and Management 2013-2018 which has yet to be to be finalised.

I enclose a copy of the draft report *Analysis of asbestos removal approaches for ACM in workplaces* for tabling as requested by you (Hansard pages 103-4).

I note that while the report says that is a final; it is still a draft. A further matter for noting is that the report is based on a proposed removal of asbestos containing materials from all work places by 2030. The current version of the *National Strategic Plan for Asbestos Awareness and Management 2013-2018* seeks removal of asbestos containing material from all government owned and controlled workplaces and high risk asbestos containing material from all commercial buildings by 2030.

Yours sincerely

Sandra Parker

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11 December 2013

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The Allen Consulting Group

Analysis of asbestos removal approaches for ACM in workplaces

Final report

April 2013

Report to the Office of Asbestos Safety

The Allen Consulting Group

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Contents

Abbreviations

ABS	Australian Bureau of Statistics
ACD	Asbestos contaminated dust or debris
ACM	Asbestos containing material
ACT	Australian Capital Territory
AIHW	Australian Institute of Health and Welfare
APSC	Australian Public Service Commission
ASCC	Australian Safety and Compensation Council
ATSDR	Agency for Toxic Substances and Disease Registry, United States
COAG	Council of Australian Governments
DALY	Disability adjusted life years
DDB	Dust Diseases Board
DDT	Dust Diseases Tribunal
DEEWR	Department of Education, Employment and Workplace Relations
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
EPA	Environmental Protection Agency
n.d.	No date
NHMRC	National Health and Medical Research Council
NOHSC	National Occupational Health and Safety Commission
NPV	Net present value
NSW	New South Wales
NT	Northern Territory
OBPR	Office of Best Practice Regulation
PI	Prohibited imports
PRA	Prioritised removal of asbestos
RMA	Risk management approach
SA	South Australia
WA	Western Australia
WHS	Work, Health and Safety
YLD	Years of life lost due to disability

Executive Summary

Asbestos is a collective term for a group of fibrous mineral silicates of the serpentine and amphibole mineral groups, which were formerly used in commerce. Asbestos containing materials can generate elongated particles with a length-to-breadth ratio of three to one or more (Parkes 1993). Asbestos was widely used in Australia during the 1950s to 1970s, with some uses continuing until the 2000s (DEEWR 2012). Certain qualities of asbestos, such as its strength, flexibility and resistance to fire and chemical attack, made it useful for many industrial applications.

Inhalation of asbestos fibres is known to cause a number of diseases such as asbestosis, lung cancer and mesothelioma (NHMRC 2012). Asbestos can become a fine airborne dust made up of tiny fibres when it is mined or processed or when Asbestos Containing Materials (ACM) are sanded, sawn or drilled. These fibres are easily inhaled and, due to the small size and elongated shape of the particles, are able to resist the lung's natural cleaning process (Safe Work Australia 2010).

In December 2003 Australia banned the manufacture, supply, storage, transport, sale, use and re-use, installation and replacement of products and materials containing asbestos (DEEWR 2012). Asbestos fibres are still present in the built environment and there can be a long time lag between exposure to asbestos and the subsequent adverse health impacts (DEEWR 2012).

The Australian Government established the Asbestos Management Review in 2010. The *Asbestos Management Review Report* (DEEWR 2012) examined the current arrangements for the management of asbestos, and activities required to implement a new approach that would build on the current Risk Management Approach (RMA) by requiring all in situ ACM to be progressively removed.

As part of this process, the Allen Consulting Group has been commissioned by the Office of Asbestos Safety within the Department of Education, Employment and Workplace Relations (DEEWR) to undertake this study. The study estimates the costs and benefits of extending the current RMA to asbestos-containing materials (ACM) to incorporate the staged, systematic and safe removal of all ACM from workplaces in Australia by the year 2030 (also known as the Prioritised Removal Approach (PRA)).

This study will form part of the work that is being undertaken to better understand the benefits and costs generated by the prioritised removal of asbestos in workplaces. It involves investigating, assessing and evaluating the costs and benefits of extending the current RMA to require the staged, systematic, safe removal of all ACM from the built environment.

The analysis has explored a variety of costs and benefits of moving from the RMA to the PRA. Due to a lack of data and information a number of these costs and benefits have been assessed qualitatively. This study has focused on assessing the two primary costs and benefits of moving from the RMA to the PRA, being health benefits and the cost of removing asbestos from workplaces, quantitatively. This has entailed the used of a number of assumptions. The key assumptions used are set out in Table ES1.1.

Table ES 1.1

KEY BASE CASE ASSUMPTIONS

Health benefits	Cost of removing ACM from workplaces
Australia-wide incidence of mesothelioma is 3.7 times greater than the predicted incidences of mesothelioma cases in NSW males.	The proportion of non-residential building activity undertaken in each state and territory relative to total work done varied between 31-50 per cent.
Asbestos-related diseases are 3.14 times greater than the number of mesothelioma incidences in Australia.	On average, ACM is made up of 20 per cent asbestos content.
Occupational exposure accounts for 70 per cent of asbestos-related disease.	All ACM used prior to 1973 has already been removed from buildings. 25 per cent of ACM used in 1973 in non-residential buildings is still in use. From 1973, each year four per cent more ACM remains in use.
Prioritised removal will reduce the number of asbestos-related diseases by 80 per cent.	The average cost of removing ACM is $3,800 per tonne.

Source: Allen Consulting group analysis

The study also assessed machinery of government costs quantitatively, while all other costs and benefits have been assessed qualitatively.

Table ES 1.2 summarises the costs and benefits of moving to the PRA. Health benefits of approximately $2.7 billion are anticipated to arise from the PRA, while the cost of removing asbestos from workplaces under the PRA is estimated to be $114 billion greater than under the RMA. In addition, machinery of government costs are estimated to cost just over $0.5 million.

The overall finding of the cost benefit analysis is that the costs of moving to PRA significantly outweigh the benefits. A number of the impacts identified in this analysis have not been assessed quantitatively. This is primarily due to a lack of information and data. Nonetheless, the costs and benefits associated with these impacts are expected to be low and not material to the overall analysis. They have been assessed qualitatively as to their likely nature and scale.

Given the magnitude of the costs associated with removing ACM from workplaces, this analysis has attempted to provide a "best-case" scenario for the policy. Despite this, the analysis shows little economic support for the move to the PRA. The sensitivity and break-even analysis undertaken further demonstrate this point.

Table ES 1.2

BENEFITS AND COSTS OF THE PRA

Impact	Description	Assessment
Benefits		
Health benefits	The reduction in asbestos-related disease as a result of the PRA	In total, it is expected that PRA will result in $2.68 billion in health benefits.
Cost savings from the reduction in ongoing risk management of asbestos	A range of potential costs savings may result including savings in the costs of complying with ongoing management of asbestos requirements	Cost savings are likely to be small in magnitude. For example each annual inspection required to update asbestos registers costs between $250-$1000, while ACM identified as a concern is generally likely to be removed rather than enclosed, encapsulated or sealed. There may also be cost savings resulting from a reduced need to ensure employees are not exposed to asbestos.
Costs		
Cost of removing asbestos from workplaces	The additional cost of removing ACM from workplaces under the PRA	The additional cost of removal is estimated to be $114.09 billion.
Cost of replacement material	The cost of replacing ACM removed from buildings before the end of their useful life	Stakeholders suggested that the cost of replacing ACM with other material is similar to the cost of removal. That is, the cost of replacing ACM would be estimated to be $40 per square metre. However it is noted that the costs associated with the removal of ACM are likely to impact on the economic viability of buildings and hence PRA is likely to alter the lifespan of buildings.
Machinery of Government costs	Costs incurred by the government through organisational or functional changes affecting government, due to the introduction of new legislation or regulation	It is estimated that machinery of government costs in relation to a move to the PRA would cost $60,000 for each jurisdiction, with a total estimated cost of $540,000.
Disturbance to business operations	The cost of disruption to business activities as a result of the removal of ACM	Mandating the removal of certain types of ACM within certain timeframes may cause a disruption to business operations, where they are affected by such activities. However, it was noted by stakeholders that disturbance to business operations can be minimal if removal is undertaken in an appropriate manner, such as the used of negative air pressure, as the risk of exposure associated with such removal is low. The costs associated with such disturbance will be highly variable according to the nature of the business, the type and location of ACM and the risk for employees.
Training additional accredited removal staff	The cost associated with training additional removalists in order to remove a greater amount of ACM form workplaces in a shorter time period	In order to remove this greater amount of ACM, additional trained and accredited removalists would be required. The costs related to this include the cost to removal businesses of training new staff and the cost of gaining appropriate licenses. It is anticipated that the costs associated with the training of additional staff would be low
Environment costs	The costs associated with an increase in illegal dumping associated with the PRA	Assuming a high level of compliance with existing regulation it is anticipated that the environmental costs associated with a move to the PRA would be low.

Source: Allen Consulting Group analysis

Chapter 1

This study

Asbestos is a collective term for a group of fibrous mineral silicates of the serpentine and amphibole mineral groups which were formerly used in commerce. Asbestos containing materials can generate elongated particles with a length-to-breadth ratio of three to one or more (Parkes 1993). Asbestos was widely used in Australia during the 1950s to 1970s, with some uses continuing until the 2000s (DEEWR 2012). Certain qualities of asbestos, such as its strength, flexibility and resistance to fire and chemical attack, made it useful for many industrial applications.

Inhalation of asbestos fibres is known to cause a number of diseases such as asbestosis, lung cancer and mesothelioma (NHMRC 2012). Asbestos can become a fine airborne dust made up of tiny fibres when it is mined or processed or when Asbestos Containing Materials (ACM) are sanded, sawn or drilled. These fibres are easily inhaled and, due to the small size and elongated shape of the particles, are able to resist the lung's natural cleaning process (Safe Work Australia 2010).

In December 2003 Australia banned the manufacture, supply, storage, transport, sale, use and re-use, installation and replacement of products and materials containing asbestos (DEEWR 2012). Asbestos fibres are still present in the built environment and there can be a long time lag between exposure to asbestos and the subsequent adverse health impacts (DEEWR 2012).

The Australian Government established the Asbestos Management Review in 2010. The *Asbestos Management Review Report* (DEEWR 2012) examined the current arrangements for the management of asbestos, and activities required to implement a new approach that would build on the current Risk Management Approach (RMA) by requiring all in situ ACM to be progressively removed. The RMA involves registering the location of ACM in Workplaces, assessing the risk to health and safety, and selecting an appropriate action (or control) based on the severity of the risk and the practicability of the actions.

The Review contained 12 recommendations for a national strategic plan to improve asbestos awareness and management arrangements across all sectors of the Australian community.

The RMA is provided for under work health and safety legislation and applies to Workplaces. Recommendation 4 of the Review report called for:

> The development of systems and processes, which would result in the staged removal of all ACMs from government and commercial buildings and structures by a target date of 2030, with:
>
> Limited ability for a renewable certificate of exemption where the ACM is not deemed to be a health hazard and where its removal by 2030 is regarded to be impractical.

There was significant variation in the submissions received from stakeholder groups on the issue of the staged removal of ACM from the built environment. Due to these differing opinions the Review recommended that further work be undertaken.

As part of this process, the Allen Consulting Group has been commissioned by the Office of Asbestos Safety within the Department of Education, Employment and Workplace Relations (DEEWR) to undertake this study. The study estimates the costs and benefits of extending the current RMA to asbestos-containing materials (ACM) to incorporate the staged, systematic and safe removal of all ACM from workplaces in Australia by the year 2030 (also known as the Prioritised Removal Approach (PRA)).

This study will form part of the work that is being undertaken to better understand the benefits and costs generated by the prioritised removal of asbestos in workplaces. It involves investigating, assessing and evaluating the costs and benefits of extending the current RMA to require the staged, systematic, safe removal of all ACM from the built environment.

1.1 Key definitions

Table 1.1 provides a summary of the key definitions of terms that are used throughout the report. These terms pertain to the approaches in managing the risks of asbestos exposure, the meaning of 'workplace' and the types of asbestos — 'friable' and 'non-friable'. Defining these terms is important as they influence the scope of the cost-benefit analysis of prioritised removal. These terms will be referred to throughout the report.

In particular, the distinction between RMA and PRA is important in setting the context of the cost-benefit analysis. Additionally, the definition of 'workplace' is an important consideration in calculating the health benefits of prioritised removal.

Table 1.1

KEY TERMS

Term	Definition
ACM	Any material or thing that contains asbestos.
Workplace	Workplace as defined in Section 8 of the Model Work Health and Safety Act. This Act has, as at 1 January 2013, been implemented in seven of nine Australian jurisdictions. For the purpose of this study, however, 'workplace' does not include the terms set out in Section 8(2). Workplace is defined in Section 8(1) as follows: • A workplace is a place where work is carried out for a business or undertaking and includes any place where a worker goes, or is likely to be, while at work. Section 8(2) defines 'place' to include the following: • a vehicle, vessel, aircraft or other mobile structure; and • any waters and any installation on land, on the bed of any waters or floating on any waters.
Risk Management Approach	Risk Management Approach involves registering the location of ACM in Workplaces, assessing the risk to health and safety, and selecting an appropriate action (or control) based on the severity of the risk and the practicability of the actions. While the ideal action is to eliminate risk, in the case of ACM this approach may also encompass options such as encapsulation to maintain its condition. Opportunistic removal is also encouraged (e.g. removal of ACM during renovation or other building works). Under this approach it is envisaged that ACM will remain in the built environment for the short to medium term, however all would ultimately be removed as it becomes unsafe – or through opportunistic removal.
Prioritised Removal Approach	Prioritised Removal is based on the principle that all ACM poses a health risk and, as such, should be removed in an orderly prioritised manner according to the severity of the risk posed within defined timeframes (for the purpose of this research by the year 2030). This approach holds that all ACM eventually degrade, so even material that is ostensibly safe (i.e. bonded and stable) may become unsafe over time. Degradation can be the result of weathering over the course of years, or an unexpected event or impact that results in the sudden release of airborne asbestos fibres, such as that which occurs in natural disasters.
Exemptions	Exemptions are proposed in instances where the ACM is not deemed to be an immediate or high priority health risk and Prioritised Removal would result in premature demolition in order to remove otherwise encapsulated or bonded ACM behind or beneath structures. To cater for these circumstances it is anticipated that limited ability to obtain a nationally consistent certificate of exemption, renewable every five years and administered by the relevant agency within each jurisdiction, will be available.
Friable asbestos	Friable asbestos means material that: • is in a powder form or that can be crumbled, pulverised or reduced to a powder by hand pressure when dry; and • contains asbestos (Model Work Health and Safety Regulations 2011).
Non-friable asbestos	Non-friable asbestos means material containing asbestos that is not friable asbestos, including material containing asbestos fibres reinforced with a bonding compound (Model Work Health and Safety Regulations 2011).

Source: Request for Quotation, DEEWR (2013) and Safe Work Australia (2011).

1.2 Methodology

The methodology for this study was based on an integrated set of activities including:

- a desktop review of contemporary domestic and international literature;
- stakeholder consultations; and
- input and advice from two expert advisers, Mike Van Alpen and Professor Bill Musk.

A preliminary desktop search was conducted in order to obtain statistics in relation to asbestos-related disease, the production and trade of asbestos, and the costs and benefits of the prioritised removal of asbestos. Primary sources of information and data include:

- Australian Institute of Health and Welfare (AIHW);
- the Australian Bureau of Statistics (ABS);
- the World Mineral Statistics Dataset (2011);
- Clements *et al.* (2007); and
- Safe Work Australia (2010, 2012b).

State and territory governments also provided relevant data and information, with a range of representatives from state and territory governments consulted, in order to gain insights into the regulation and management of asbestos. The team also consulted asbestos removalists and other stakeholders. A list of stakeholders consulted is at Appendix A.

The cost-benefit analysis of this study utilises the data and information from the desktop review. The analysis aims to quantify the costs and benefits as far as practicable. It includes an analysis of health benefits, as well as the cost savings that may result from the PRA. The costs examined in the analysis include the cost of removing asbestos from workplaces, the cost of replacement materials, machinery government costs, as well as a number of other costs.

This study also received assistance (advice and peer review) and information from two experts in the fields of asbestos management and asbestos-related disease, Mike Van Alphen and Professor Bill Musk. Mike Van Alphen was previously a researcher in the Cooperative Research Centre for contamination assessment and remediation of the environment and is currently working with the Mawson Institute of the University of South Australia. Dr Bill Musk is a respiratory physician at Sir Charles Gairdner Hospital in Western Australia, and is also Clinical Professor of the School of Population Health at the University of Western Australia. The Allen Consulting Group team thanks Mike Van Alphen and Professor Bill Musk for their assistance in undertaking this study.

1.3 Approach to measuring the costs and benefits

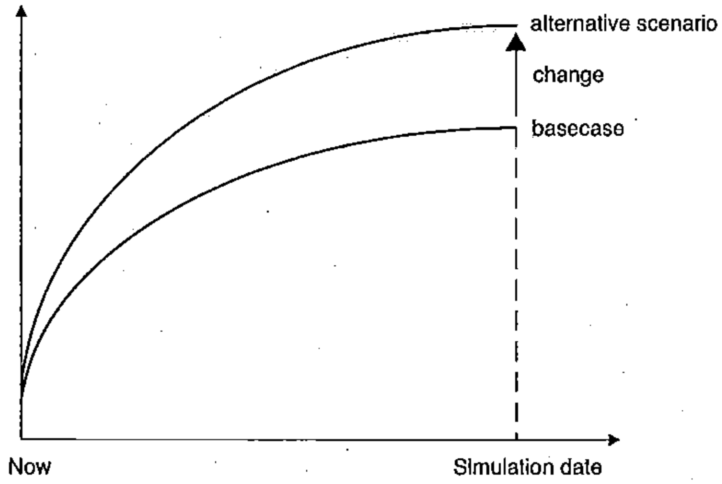
The broad approach of this analysis is to apply a with/without comparative metric. In essence, this evaluation asks: *if prioritised removal were to be implemented, what would be the difference in costs and benefits compared to the current risk management approach?* This is a common technique used for evaluation of this nature, and is consistent with other policy analyses. The Commonwealth Treasury for example, makes this point explicitly (Treasury 2011, pg. 24).

> Scenario modeling does not predict what *will* happen in the future. Rather it is an assessment of what *could* happen, given the structure of the models and input assumptions.
>
> Scenarios are an analytical lens through which to view a problem; they do not factor in all elements of the 'real world'... Scenarios guide understanding of policy impacts, relativities of different policy options and the extent that parts of the economy (technology, preferences and so on) need to shift from current trends to achieve particular outcomes, given the model's assumptions.

This approach allows the analysis to specifically isolate the impacts that result from prioritised removal and abstract away from other developments, holding all else constant. The with/without principle is depicted in Figure 1.1.

Figure 1.1

COMPARATIVE STATIC INTERPRETATION OF RESULTS



Source: The Allen Consulting Group.

It is important to note that not all costs and benefits are quantifiable due to reasons such as lack of actual or appropriate data. Table 1.2 provides a summary of the benefits and costs of implementing prioritised removal of asbestos and ACM in Australia, as well as the method of assessment for the cost-benefit analysis.

Table 1.2

ASSESSING THE BENEFITS AND COSTS OF PRIORITISED REMOVAL

Benefit/ Cost	Assessment method
Benefits	
Health benefits	Quantitative
Cost savings	Qualitative
Costs	
Cost of removing asbestos from workplaces	Quantitative
Cost of replacement material	Qualitative
Machinery of Government costs	Quantitative
Disturbance to business operations	Qualitative
Training additional accredited removal staff	Qualitative
Environment costs	Qualitative

Source: The Allen Consulting Group.

The cost-benefit analysis is accompanied by a break-even analysis to account for variability in the outcomes predicted by the cost-benefit analysis. A break-even analysis identifies the minimum benefits required for an intervention to provide a net positive outcome. It is typically adopted in instances where the benefits of a regulatory program are difficult to quantify.

1.4 This report

The remainder of this report is structured as follows:

- Chapter 2 examines the harm caused by asbestos;
- Chapter 3 details the use and regulation of asbestos in Australia;
- Chapter 4 describes the benefits of prioritised removal;
- Chapter 5 explores the costs of prioritised removal;
- Chapter 6 discusses the limitations and key issues of this study; and
- Chapter 7 outlines the impact analysis.

Chapter 2

The harm caused by asbestos exposure

Asbestos is a term that refers to six types of naturally occurring mineral fibres that belong to two groups, namely the:

- serpentine Group — which consists of chrysotile asbestos; and
- amphibole Group — which comprises of anthophyllite, amosite, crocidolite, tremolite and actinolite asbestos (DEEWR 2012).

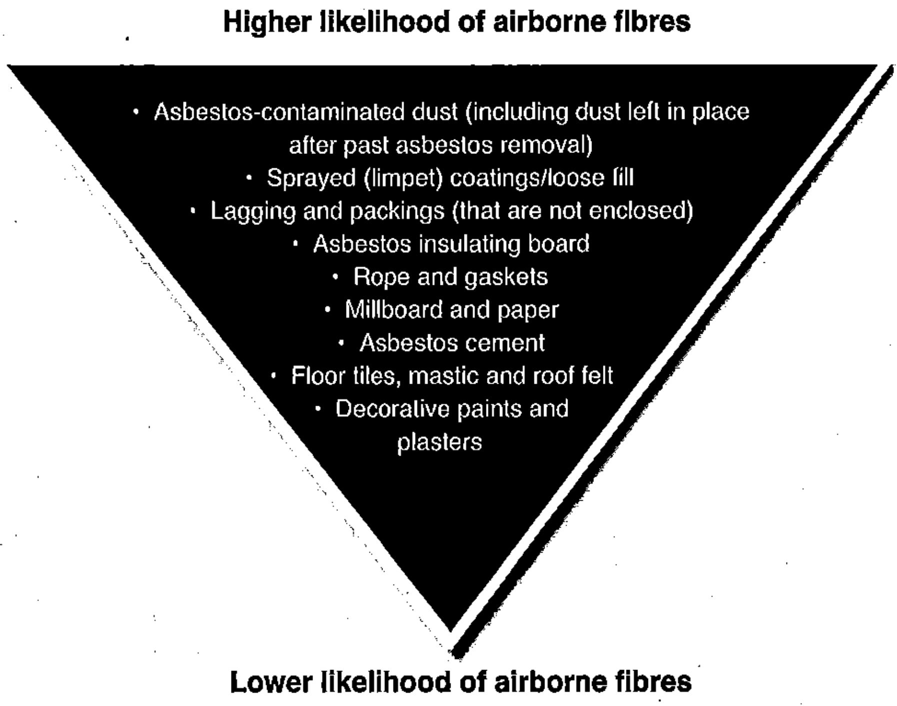
The inhalation of asbestos fibres can cause a number of diseases, as the microscopic airborne fibres are easily inhaled, and lodged in human lungs (NHMRC 2012). Although some of the fibres are expelled, the fibres have been known to be highly resistant to removal by the lungs' natural cleaning processes. The accumulation of asbestos fibres in the lungs can lead to inflammation and scarring of the lung, which affects breathing and can lead to disease (Agency for Toxic Substances and Disease Registry, US, 2008). Chapter 3 provides further discussion on asbestos-related illness and the types of asbestos associated with each illness.

Asbestos poses a significant health risk, when the material is in the form of dust or fibres which become airborne and available for inhalation (Australian Health Protection Principal Committee 2012). Asbestos encapsulated in materials normally does not pose a health risk unless the ACM has been disturbed or deteriorated due to weathering or ageing, causing it to release asbestos fibres into the air (Australian Health Protection Principal Committee 2012). While asbestos workers and miners have historically been the main group with the highest risk of exposure, their family members have also been diagnosed with asbestos-related diseases from contaminated clothing (ATSDR US 2001). Residents who lived near asbestos mines or processing plants have also been at risk due to general environmental contamination (ATSDR US 2008).

Figure 2.1 lists some of the materials and objects in which asbestos fibres can currently be found, and the likelihood of airborne fibres being released into the air if these objects are deteriorated or disturbed. Lower risk objects are those that have the asbestos encapsulated within them (i.e. preserved within a resilient material such as reinforced plastics or vinyls), making it difficult for the asbestos fibres to escape. Asbestos or ACM that are stored in objects that deteriorate or can be disturbed easily, therefore, entail a higher risk of asbestos becoming airborne and hence leading to disease.

Figure 2.1

LIKELIHOOD OF AIRBORNE FIBRES TO BE RELEASED INTO THE AIR IF IT HAS BEEN DETERIORATED OR DISTURBED



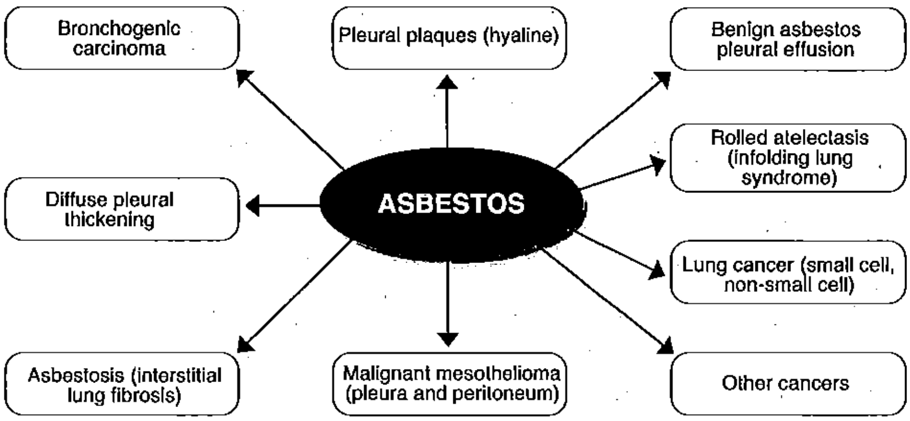
Source: Safe Work Australia (2011), How to manage and control asbestos in the workplace: Code of practice, accessed at <http://www.safeworkaustralia.gov.au/sites/SWA/about/Publications/Documents/625/How_to_Manage_and_Control_Asbestos_in_the_Workplace.pdf>

The key implication of the effective ban on the importation and production of asbestos in Australia in 2003 is that the burden of asbestos-related disease should diminish over the longer term (Safe Work Australia 2012b). However, ACM and asbestos was extensively used in construction and manufacturing in products that can have long service lives, hence the material can still be found in many products and articles. Furthermore, workers who were exposed to asbestos in the 1970s and 1980s may have contracted an asbestos-related disease that is yet to be diagnosed, or remain with an elevated probability of developing an asbestos-related disease in the future due to persistence of fibres in the body, especially the lungs. The cessation of asbestos usage in Australia, and the long latency of asbestos-related disease, poses a challenge in the estimation of future asbestos-related disease.

Asbestos exposure is associated with a number of diseases, including mesothelioma as shown in Figure 2.2.

Figure 2.2

ASBESTOS-RELATED DISEASE



Source: Musk undated.

Table 2.1 provides further information on the types of asbestos-related diseases. As can be seen, exposure to asbestos can cause an array of diseases although other factors — such as smoking and inhalation of other types of dust — may also increase risk of developing an asbestos-related disease.

The most widely used indicators associated with asbestos exposure are pleural plaques, mesothelioma and asbestosis, due to the established causal relationships between asbestos exposure and these diseases. As noted by Safe Work Australia (2012b):

> Asbestosis is caused exclusively by asbestos and asbestos is the only known cause of mesothelioma.
>
> Safe Work Australia (2012b), *Asbestos-related disease indicators*, October 2012, Canberra.

It is important to note that mesothelioma is a disease that is potentially acquired at low to high levels of exposure to airborne asbestos, whereas asbestosis is a disease that typically impacts on persons with high levels of exposure as in the former asbestos mining, milling and asbestos product manufacturing industries. The risk of mesothelioma however is considered by USEPA (2013) in their risk assessment, to be proportional to the magnitude and duration of inhalation exposure to asbestos.

These asbestos-related diseases are discussed in further detail in the subsequent sections.

Table 2.1
ASBESTOS RELATED DISEASES

Disease	Description
Malignant mesothelioma (pleura and peritoneum)	Mesothelioma has the longest latency of any asbestos-related disease, usually taking between 15 and 40 years or more to develop. Symptoms of the disease usually only become evident when the disease is extensive. Because it arises on the mesothelial surfaces of a cavity (the pleural cavity or the peritoneal cavity) it is virtually extensive from the outset. Treatment to date has been ineffective and necessarily focussed on maintaining good quality of life for as long as possible. Exposure to crocidolite and also other amphiboles (eg: amosite) asbestos, as opposed to chrysotile, is mostly associated with this disease.
Asbestosis (interstitial lung fibrosis)	Asbestosis usually takes around 10 years or more to develop following relatively heavy and prolonged exposure to asbestos (CCV 2010) before the disease advances to a stage where symptoms become apparent. Although it is usually a chronic rather than a fatal disease, it is a serious condition that can lead to death from respiratory failure. Ongoing medical treatment is necessary to maintain reasonable quality of life. People with asbestosis may have a greater risk of developing lung cancer or mesothelioma than other people who have been exposed to similar amounts of asbestos fibres.
Lung cancer (Bronchogenic carcinoma) (small cell, non-small cell)	All types of asbestos are deemed capable of causing lung cancer. For individuals who smoke and are exposed to asbestos, the risk of lung cancer is a product of exposure and smoking
Pleural plaques (hyaline)	The incidence of plaques is related to time since first exposure to asbestos but poorly related to degree of exposure. All varieties of asbestos can cause pleural plaques. Plaques have only a small effect on lung function. The may cause chest pain.
Diffuse pleural thickening	This disease usually appears 20 to 25 years after first exposure to asbestos. Pleural thickening increases with time, and is unrelated to degree of exposure. In this condition, changes in lung function may result and may cause significant disability especially when progressive.
Benign asbestos pleural effusion	Fluid in the pleural cavity is sometimes found in individuals previously exposed to asbestos. The onset of this disease may be acute or insidious and the effusion small or large. The latency for benign asbestos pleural effusion is shorter than for malignant mesothelioma, although malignant mesothelioma often initially presents with effusion in which evidence of malignancy is difficult to find on repeated aspirations.
Rolled atelectasis (infolding lung syndrome)	This disease involves the collapse of the lung due to in-drawing and infolding of the sub-pleural lung tissue. It is associated with asbestos exposure, especially with previous benign asbestos effusion.
Other cancers	Studies have shown a relationship between carcinoma of the larynx and exposure to asbestos, as well as to smoking. However, this was not seen in Western Australian crocidolite workers. Other studies have shown associations between cancer of the colon, breast, leukaemia, multiple myeloma and Waldenstrom's macroglobulinaemia and asbestos exposure. However it is unlikely that these are causal relationships.

Source: National Health and Medical Research Council (2012), Safe Work Australia (2012b), Musk (undated) and American Family Physician (2007).

2.1 Malignant Mesothelioma

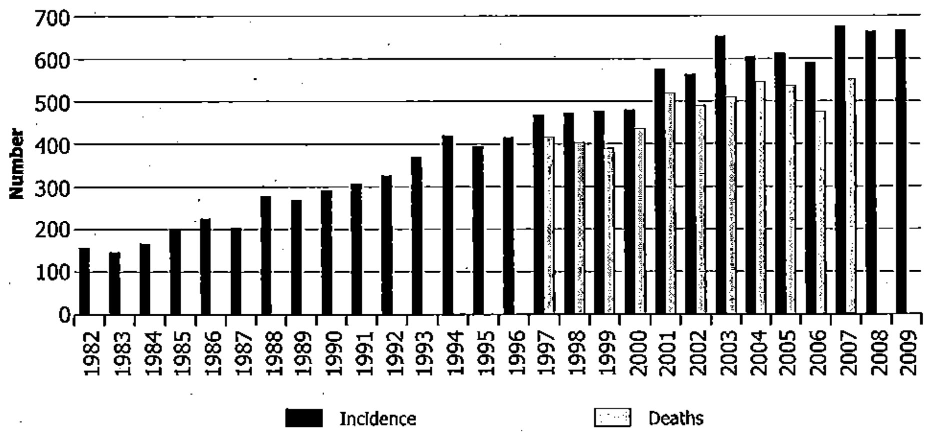
Malignant mesothelioma is a type of cancer that affects the "mesothelial" membranes surrounding the lungs and lining the chest cavity (pleural mesothelioma), covering the bowel and lining the peritoneal cavity in the abdomen (peritoneal mesothelioma), covering the heart and lining the pericardial cavity and covering the testicles and lining the scrotal sac in men Although the disease can be usually traced back to past asbestos exposure, not every individual who is exposed to asbestos will contract mesothelioma (Safe Work Australia 2010). Pleural mesothelioma is the most commonly diagnosed form of malignant mesothelioma , representing 94 per cent of cases of mesothelioma in Australia since 1982 (Safe Work Australia 2012b).

The disease is more prevalent in males than females, and amongst the older generation (AIHW 2012b). This is due to exposure of asbestos in male dominated occupations such as mining and construction and the long latency periods between exposure and onset of the disease. Approximately 15 to 40 years usually elapses after asbestos exposure before the symptoms begin to show (AIHW 2012b). The risk of developing mesothelioma increases exponentially with time since exposure for 40-50 years.

Figure 2.3 shows the number of incident cases and deaths for all types of mesothelioma in Australia. In 1982, approximately 134 individuals were diagnosed with mesothelioma, and in 2009 about 540 were diagnosed (AIHW 2012b). This represents an annualised increase in incidence of five per cent. The number of deaths due to mesothelioma is only available from 1997 to 2007. In 1997 there were 416 deaths from mesothelioma and in 2007 this increased to 551 (AIHW 2012b).

Figure 2.3

MESOTHELIOMA INCIDENCES AND DEATHS



Source: The Australian Institute of Health and Welfare (AIHW) (2012c), *Mesothelioma for Australia*, ICD10 C45, Australian Cancer Incidence and Mortality Workbooks, Canberra.

The age-standardised incidence rate of mesothelioma in Australia is 2.7 cases per 100,000 of the population, as shown in Table 2.2. The state that has the highest incidence rate is Western Australia, with 4.8 deaths per 100,000, which can largely be attributed to the former mining of blue asbestos at Wittenoom in the Pilbara and the widespread use of this form of asbestos in building products in WA until the late 1960s (Australian Mesothelioma Registry 2011). The other states that had a death rate above the national average were South Australia and Queensland.

Table 2.2

NEW CASES OF MESOTHELIOMA AND AGE-STANDARDISED RATES, 2011

State	Persons	Rate per 100,000 population
NSW	171	2.3
Vic	130	2.3
Qld	126	2.9
WA	103	4.8
SA	54	2.8
Tas	14	2.4
ACT	9	NA
NT	5	NA
Total	**612**	**2.7**

Source: Australian Mesothelioma Registry (2011), *1st Annual Report: Mesothelioma in Australia 2011*, Alexandria.

2.2 Asbestosis

Pneumoconiosis is a lung disease resulting from inhaling certain dusts, mostly in the workplace, such as silica, asbestos and coal dust (AIHW 2010). Asbestosis is a type of pneumoconiosis specifically caused by inhalation of asbestos fibres. Symptoms of asbestosis usually appear approximately 10 years after initial exposure to asbestos fibres, a relatively shorter latency period than mesothelioma (Safe Work Australia 2012b).

Asbestosis is characterised by asbestos fibres lodged deep within the lung causing inflammation and the formation of scar tissue in the walls of the airspaces. Over time, the scarred and stiff lung tissue makes breathing difficult resulting in shortness of breath with the need to provide oxygen and sometimes chest pain (Safe Work Australia 2012b). Currently there is no cure for asbestosis, only treatment to relieve its symptoms. Asbestosis does not always/often cause death, however it may trigger it due to reduced lung function, which places stress on the body's organs especially the heart. For those diagnosed with asbestosis, death is usually caused by respiratory failure with subsequent cardiac failure as a result of the added work imposed on the heart (Safe Work Australia 2012b). Furthermore, individuals with asbestosis also have a heightened risk of developing lung cancer or mesothelioma because of their asbestos exposure.

Asbestosis, unlike mesothelioma, is not required to be reported to health authorities, hence the incidence rate of the disease is unknown (Safe Work Australia 2012b). Compensation statistics are available and provide some indication of the scale of the pneumoconiosis problem. There were 245 successful compensation claims for asbestosis in 2004-05 (AIHW 2010). In 1997-98 there were a total of 95 cases (AIHW 2010).

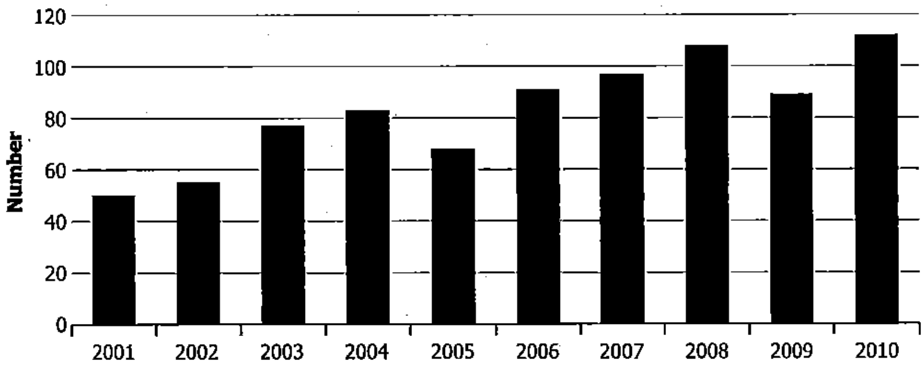
The Australian Institute of Health and Welfare (AIHW) (2010) also noted that there has been an increase in the death rate for pneumoconiosis since 1998 and that deaths due to asbestosis have increased especially. This rising trend has two explanations (AIHW 2010):

- firstly, workers exposed to low levels of asbestos decades ago are now beginning to show symptoms of the disease; and
- secondly, there is increased recognition of the condition by physicians although there has not been a simultaneous increase in hospitalisations due to pneumoconiosis.

Figure 2.4 shows the number of deaths that are attributable to pneumoconiosis due to asbestos and other mineral fibres. In 2001, there were 50 deaths and this increased to 112 in 2010, indicating an annualised nine per cent increase within the specified timeframe (however it is noted that this includes pneumoconiosis deaths due to other mineral fibres as well).

Figure 2.4

DEATHS ATTRIBUTED TO PNEUMOCONIOSIS DUE TO ASBESTOS AND OTHER MINERAL FIBRES



Source: Australian Bureau of Statistics (2012), Causes of Death, Australia, 2010.

2.3 Other asbestos-related disease

Asbestos exposure also promotes or triggers the onset of other diseases, as described below (Musk undated):

- *Lung cancer (bronchogenic carcinoma)* — Lung cancer can take 20 years or more before the cancer develops and asbestos is only one of many agents linked to its development. It is reported to occur only following levels of exposure similar to those for asbestosis and is strongly associated with workplace exposure to asbestos fibres. It is much more likely to occur in people who smoke and/or who have asbestosis.

  Asbestos appears to promote, rather than initiate, bronchogenic malignancies. In an individual exposed to asbestos, who also smokes, the risk of lung cancer approaches a product of the separate exposure and smoking risks. Studies indicate that lung cancer risk measurably increases after moderate degrees of industrial asbestos exposure although there is no level of carcinogen below which there is no risk.

- *Pleural plaques* — Pleural plaques can be observed radiographically or at autopsy or chest operation in asbestos exposed individuals. Relative to diffuse pleural thickening, pleural plaques are seen less often in individuals exposed to crocidolite, and more often observed in individuals exposed to anthophyllite. Pleural plaques have only a minor effect on lung function although they may cause chest pain.
- *Diffuse pleural thickening* — this disease may appear 30 years after first exposure to crocidolite but is more common in the 20 to 25 year time period. Progression of the disease is more common in individuals who develop thickening earlier after first exposure. Changes in lung volume may result and cause significant disability especially when progressive diffuse pleural fibrosis occurs.
- *Benign asbestos pleural effusion* — This disease is associated with fluid in the pleural cavity. It is attributed to asbestos exposure when no other/alternative cause is found in someone who has been exposed to asbestos. The effusion may resolve, or recur occasionally, and may develop to diffuse pleural fibrosis or rolled atelectasis.
- *Rolled atelectasis* — This disease involves the collapse and contraction of lung tissue, and is associated with asbestos exposure, especially with previous benign asbestos effusion. This disease can be observed on CT scanning but needs to be distinguished from peripheral lung cancer that may need treatment.
- *Other cancers* — Asbestos exposure has been associated with a range of cancers such as colon, breast, leukaemia, multiple myeloma and ovarian cancer. However, a causal relationship between these cancers and asbestos exposure has not been fully established.

Chapter 3

Asbestos in Australia

The use, importation and production of asbestos in Australia has been banned since December 2003. However, the risk of asbestos exposure still exists because asbestos was widely used in building and construction work, as well as in a diversity of products such as cement, sheet and roofing materials and the brake pads of cars for most of the twentieth century. Inhalation of asbestos fibres can cause many types of disease and has been subject to regulation, including in workplaces for a number of years.

Regulation of asbestos-related activity commenced in the 1970s when states began implementing exposure limits to asbestos fibres. In the 1980s, the production of asbestos ceased in Australia and in the 1990s all uses of asbestos in Australia had ended. Importantly, in January 2012 the Model Work Health and Safety (WHS) Act, WHS regulations and Model Codes of Practice commenced. The objective of the WHS Act is to provide a consistent framework for risk management of asbestos in workplaces. Prior to this, each jurisdiction had its own legislation in relation to the management of in-situ asbestos.

This chapter outlines the uses and regulation of asbestos and ACM in Australia, providing context for the subsequent cost-benefit analysis.

3.1 Use of asbestos in Australia

Examples of products where asbestos can be found include insulation, fireproofing materials, cement sheeting, electrical insulation boards, fire-proof textiles, additives in paints and sealants, vinyl sheeting and floor tiles, vehicle brake pads and clutches and water pipe. This widespread use was due to a number of useful properties of asbestos fibres — they are strong, flexible, resistant to fire and chemical attack, and have good insulating properties (National Health and Medical Research Council 2012).

Table 3.1 shows the industries and the corresponding products or uses that may involve asbestos. In Australia, over 60 per cent of all production and 90 per cent of all consumption of asbestos fibre was by the asbestos cement manufacturing industry (ASCC 2008a). Much of this industry's output remains in service today in the form of 'fibro' houses and water and sewerage piping (ASCC 2008a).

Table 3.1

INDUSTRIES AND PRODUCTS/ USES

Industry	Products/ use
Construction	• Fire resistant board • Floor finishes and ceiling tiles • Shingles or tiles (external or ceiling) • Corrugated asbestos cement roofing sheets • Ceiling and wall insulation • Pipes, tubes or fittings (e.g. flue pipes) • Lagging or jointing materials (including on pipes) • Floor coverings (e.g. vinyl asbestos tiles) and the backings of linoleum floor coverings • Compressed asbestos cement sheeting
Car manufacturing	• Brake and clutch linings • Under sealant • Gaskets • Body fillers • Brake pads and clutch facings
Textile	• Fire blankets and curtains • Fireproof garments (including gloves) • Gasket materials • Waterproof membranes • Felts and theatre curtains
Aerospace, marine and rail transport	• Thermal insulation around plant and equipment • Strengthening of metals and ceramics which are exposed to heat • Heat proof lagging on pipes in ships
Other	• Decorative paints and plasters • Hessian sacks that have contained asbestos • Millboard and paper • Lagging and packings (that are not enclosed) • Sprayed coatings/loose fill

Source: Asbestos Diseases Society of Australia (2012) and DEEWR (2012).

With the commencement of the regulation of asbestos, its use in building and construction materials began to decline in the 1980s and by the 1990s the practice of using asbestos in construction had effectively ended (DEEWR 2012). Despite this, a specific type of asbestos — chrysotile — continued to be imported and used in the manufacture of friction products (such as brake pads and linings) and gaskets (DEEWR 2012).

The regulation of asbestos and ACM was due to increasing awareness about the health hazards posed by the inhalation of asbestos fibres. Although the link between asbestos exposure and disease (asbestosis) was observed in the early 1920s (DEEWR 2012), it took decades (particularly for lung cancer and malignant mesothelioma) before a clear causal link was established. This was partly due to the long latency times between asbestos exposure and the onset of disease but also because of slowness of the industry and regulatory authorities to respond to the available information. Since the 1970s, jurisdictions in Australia began initiating a series of phased bans on the use, manufacture and importation of asbestos and ACM, as discussed further in Section 3.3.

3.2 The changing nature of risk in asbestos exposure

It is important to be mindful of the changing nature of risk to asbestos exposure, since asbestos mining ceased in the 1980s and its production and trade was prohibited in 2003. Historically, exposure to asbestos typically came from the following sources:

- mining, milling and transporting asbestos;
- manufacturing asbestos-containing products; and
- using those products, primarily while constructing buildings (Safe Work Australia 2012b).

Box 3.1 provides further information about past occupational exposure to asbestos.

Box 3.1

HISTORICAL OCCUPATIONAL EXPOSURE TO ASBESTOS

The Australian Mesothelioma Register (AMR) operated from 1986 to 2007. It began operating again in 2011. The AMR collected and monitored data on the number of new cases of mesothelioma and past exposure to asbestos. The AMR's data shows that in the past workers with the highest rates of mesothelioma were those who had worked in occupations associated with asbestos mining or dust forming operations such as handling, sawing, sanding, grinding, drilling, turning or general maintenance and renovation. Specific occupations recording high numbers of workers exposed included:

- carpenters & joiners;
- Wittenoom workers;
- asbestos miners
- builders and builders' labourers;
- navy & merchant navy workers;
- railway workers;
- boiler makers (cleaners, attendants, installers & welders); and
- power station workers.

Source: Safe Work Australia 2012b.

As asbestos is no longer produced or used in Australia, the sources of exposure have altered. Previously, the occupational groups at highest risk of exposure were workers who mined, milled and transported asbestos, manufactured ACM or were engaged in the use of ACM in building or construction work (Safe Work Australia 2010). When asbestos mining ended in the 1980s and its use, importation and production banned in 2003, the nature of asbestos exposure changed.

Furthermore, the long lag rates between exposure and onset of disease means that the current observed rates of disease can be attributed to exposure some decades ago. For instance, mesothelioma cases in Wittenoom workers in Western Australia began increasing after the mines closed in 1966. In the 1960s there were two cases of malignant mesothelioma in Wittenoom workers, and in the period from 2000 to 2008 this number rose to 82 cases (Musk, Olsen, Shilkin, Threfall, Reid, Lee, Franklin, Alfonso and deKlerk 2012). The future incidence of asbestos-related disease due to current exposures, therefore, could be due to exposure that is largely non-occupational in nature, relates to uncontrolled access by tradespersons or exposures of those involved with the management, removal and disposal of asbestos (see Olsen MJA 2012).

Presently the main source of asbestos exposure is from old buildings undergoing renovation or demolition (Safe Work Australia 2012b). Workers involved in the refurbishment, renovation or demolition of old buildings may have the highest risk of exposure, particularly if they work in areas where asbestos is present but has not been identified, or the risks have been poorly assessed or managed. Workers can be unwittingly exposed to asbestos. Additionally, asbestos products put in place during the 1950s, 1960s and 1970s also pose a health risk to homeowners who renovate their own properties (Safe Work Australia 2012b). Those involved in testing asbestos and inspecting ACM will also face low risks, and asbestos removalists will face low to modest risks of exposure as well.

3.3 Regulation of asbestos in Australia

From the late 1970s, jurisdictions began implementing a series of regulations on exposure limits of asbestos fibres. The limitations for both crocidolite and amosite were 0.1 fibres/ml, and for chrysolite, 1.0 fibres/ml. The exposure limit for chrysolite was reduced to 0.1fibres/ml in 2003 by the National Occupational and Safety Commission (NOHSC) (DEEWR 2012).

The ban on mining asbestos was implemented in 1983, and by December 1984 most jurisdictions had banned the mining of raw asbestos and the manufacture, import and installation of products containing crocidolite and amosite (DEEWR 2012). In 2001 the NOHSC declared that all uses of chrysotile should be prohibited from 31 December 2003, subject to a few exemptions. There were, however, some specialised provisions that allowed the importation of asbestos. Box 3.2 provides further information on cases where the importation of asbestos is not prohibited.

Box 3.2

CUSTOMS (PROHIBITED IMPORTS) REGULATIONS 1956 — BAN ON ASBESTOS IMPORTS

The importation into Australia of amphibole asbestos, or goods containing amphibole asbestos, is prohibited unless:

- the importation is of raw materials that contain naturally occurring traces of amphibole asbestos; or

- the Minister administering the Occupational Health and Safety Act 1991 or a person authorised by that Minister confirms that he or she has granted permission to import the amphibole asbestos or goods, and the confirmation is produced to a Collector; or
- the importation is of hazardous waste as defined in section 4 of the Hazardous Waste (Regulation of Exports and Imports) Act 1989; or
- all of the following apply:
  - the importation is of a ship or resources installation of at least 150 gross tonnage, as shown by the International Tonnage Certificate (1969) for the ship or resources installation;
  - the amphibole asbestos in the ship or resources installation was fixed or installed before 1 January 2005;
  - the amphibole asbestos in the ship or resources installation will not be a risk to any person unless the amphibole asbestos is disturbed.

The importation into Australia of chrysotile, or goods that contain chrysotile, is prohibited unless:

- the chrysotile is, or the goods are, hazardous waste as defined in section 4 of the Hazardous Waste (Regulation of Exports and Imports) Act 1989; or
- an authority of a State or Territory confirms that the proposed use of the chrysotile or goods is in accordance with the State or Territory law relating to occupational health and safety; or
- the Safety, Rehabilitation and Compensation Commission confirms that it has granted an exemption under the Occupational Health and Safety (Safety Standards) Regulations 1994 for the use of the chrysotile or goods; or
- the Seafarers Safety, Rehabilitation and Compensation Authority confirms that it has granted an exemption under the Occupational Health and Safety (Maritime Industry) (National Standards) Regulations 2003 for the use of the chrysotile or goods; or
- the Minister administering the Occupational Health and Safety Act 1991 or a person authorised by that Minister confirms that he or she has granted permission to import the chrysotile or goods; or
- the chrysotile is, or the goods are, being imported from the Australian Antarctic Territory; or
- the goods are raw materials that contain naturally occurring traces of chrysotile; or
- all of the following apply:
  - the importation is of a ship or resources installation of at least 150 gross tonnage, as shown by the International Tonnage Certificate (1969) for the ship or resources installation;
  - the chrysotile in the ship or resources installation was fixed or installed before 1 January 2005;
  - the chrysotile in the ship or resources installation will not be a risk to any person unless the chrysotile is disturbed.

Source: Custome (Prohibited Imports) Regulation 1956, Statutory Rules 1956 No. 90 as amended, made under the Customs Act 1901.

While asbestos is banned from being imported into Australia, asbestos materials may be unintentionally brought into the country. If retailers or importers suspect that their products contain asbestos, they are required to inform their state or territory WHS regulator (Safe Work Australia 2012b).

Although the 2003 prohibition placed a ban on all uses of asbestos, it did not entail the removal of asbestos or ACM that were in place (i.e. in-situ) on 31 December 2003. Hence ACM and asbestos can still be present in the built environment, including workplaces (Safe Work Australia 2012b).). For instance, asbestos cement or sheeting used in the construction of warehouse has a high probability of remaining, unless the building is significantly modified or renovated in the meantime.

In order to minimise exposure risk, jurisdictions in Australia have implemented regulations that require any asbestos to be identified and removed from the built environment — or if removal is not practicable, (in some jurisdictions) for the ACM or asbestos to be encapsulated, enclosed or sealed[1]. In South Australia (SA), there was a preference for asbestos items in workplaces to be labelled, as well as identified in a register, to ensure that people did not inadvertently access asbestos items and managed asbestos appropriately. In SA, the concept of 'encapsulation' has been less favoured as this tended to offer people the opportunity to 'hide' asbestos containing items and not deal adequately with the risk. State and territory legislation also prohibit activities that involve the potential disturbance of in-situ asbestos such as drilling, boring and grinding, as such actions may disturb ACM and release airborne asbestos fibres (Safe Work Australia 2012b).

ACM in workplaces

A key feature of the regulatory environment is the harmonisation of WHS laws. On 1 January 2012, the WHS Act, WHS regulations and Model Codes of Practice commenced. The objective of harmonised regulations is to provide a consistent framework for the risk management of asbestos exposure in workplaces (Safe Work Australia 2012b). Box 3.3 provides further detail into the harmonisation of WHS Laws. As of January 2013, all jurisdictions have passed WHS Laws with the exception of Western Australia and Victoria (National Safety Council of Australia undated).

Box 3.3

HARMONISATION OF WORK, HEALTH AND SAFETY LAWS

In July 2008, the Council of Australia Governments (COAG) formally committed to the harmonisation of work health and safety laws by signing an Intergovernmental Agreement for Regulatory and Operational Reform in Occupational Health and Safety (IGA).

The model work health and safety legislation consists of an integrated package of a

- model Work Health and Safety (WHS) Act, supported by:
  - model Work Health and Safety (WHS) Regulations;
  - model Codes of Practice; and a
  - National Compliance and Enforcement Policy.

Safe Work Australia is the national policy body responsible for the development and evaluation of the model Work Health and Safety laws. The Commonwealth, states and territories are responsible for regulating and enforcing work health and safety laws in their jurisdictions.

Source: Work Safe Tasmania (2012).

[1] Enclosing asbestos requires building a structure around the ACM so that it is completely covered and prevents access to it by individuals. Encapsulation is preserving the asbestos in a resilient material such as cements and reinforced plastics. Sealing is the least effective method for controlling airborne asbestos — it involves covering the surface of the ACM with a protective coating (Safe Work Australia 2011b).

According to the Model Work Health and Safety Act (2011), a workplace is any place that an individual goes for work. For the purposes of this study, 'workplace' is defined as any place that an individual goes to for work, however there are certain exclusions in 'workplace' definition for the purposes of this study. Box 3.4 provides further information on how workplace is defined in the Model Work Health and Safety Act.

Box 3.4

MEANING OF WORKPLACE IN THE MODEL WORK HEALTH AND SAFETY BILL

The Model Work Health and Safety Act aims to provide a balanced and nationally consistent framework to secure the health and safety of workers and workplaces.

'Workplace' is defined in Section 8(1) as follows:

- A workplace is a place where work is carried out for a business or undertaking and includes any place where a worker goes, or is likely to be, while at work.

Section 8(2) defines 'place' to include the following:

- a vehicle, vessel, aircraft or other mobile structure; and
- any waters and any installation on land, on the bed of any waters or floating on any waters.

Source: Model Work Health and Safety Act (2011).

For the purpose of this study, the definition of 'workplace' does not include the terms stated in Section 8(2) of the Model Work Health and Safety Act. Specifically, it excludes vehicles, vessel aircraft and other mobile structures. However, it includes asbestos and ACM buried in soil such as buried asbestos cement pipes.

Currently, jurisdictions in Australia have implemented legislation in relation to managing the risk of asbestos exposure in workplaces. The current approach to managing risk (the RMA) involves registering the location of ACM in workplaces, assessing the risk to health and safety, and selecting an appropriate action (or control) based on the severity of the risk and the practicability of the actions (DEEWR 2012). While the ideal action is to eliminate risk, by removal, in the case of ACM risk management may also encompass options such as encapsulation to contain it.

Compliance with the codes of practice that support the WHS Act is not mandatory, as long as there is a better method than that provided in the code. Box 3.5 provides further information on compliance with the codes of practice. Currently, two codes of practice provide guidance on the risk management of asbestos. *How to manage and control asbestos in the workplace: code of practice* (2011) provides practical guidance on WHS Regulations that relate to the identification and management of asbestos. *How to safely remove asbestos: code of practice* (2011b) provides guidance on duties for asbestos removal.

Box 3.5

CODES OF PRACTICE

Codes of Practice provide practical guidance on how to meet the standards set out in the WHS Act (Work Health and Safety Act) and the WHS Regulations. Codes of Practice are admissible in proceedings as evidence of whether or not a duty under the WHS laws has been met. They can also be referred to by an inspector when issuing an improvement or prohibition notice.

It is recognised that equivalent or better ways of achieving the required work health and safety outcomes may be possible. For that reason compliance with Codes of Practice is not mandatory providing that any other method used provides an equivalent or higher standard of work health and safety than suggested by the Code of Practice.

Source: Safe Work Australia (2012), Guide to the Model Work Health and Safety Act, accessed at <http://www.safeworkaustralia.gov.au/sites/SWA/about/Publications/Documents/717/Guide-to-the-WHS-Act.pdf>

The key regulation that covers the risk management of asbestos is the Code of Practice on how to manage and control asbestos in the workplace (Safe Work Australia 2011). This Code of Practice provides guidance on achieving the health, safety and welfare standards required under the WHS Act and WHS Regulations. The key regulation in the risk management of asbestos is described thus:

Regulation 419

A person conducting a business or undertaking must not carry out or direct or allow a worker to carry out work involving asbestos if that work involves manufacturing, supplying, transporting, storing, removing, using, installing, handling, treating, disposing of or disturbing asbestos or ACM, except in prescribed circumstances.

Note: The prohibition on the supply of asbestos also prohibits the sale of asbestos or ACM.

Hence the regulation encourages the elimination of risk of asbestos exposure, however if this is not 'reasonably practicable' then the minimisation of risk is allowed. For instance, if removal of the ACM is not practicable, then enclosing or encapsulating it is viable.

The first step in the risk management process is the identification of asbestos, and recording this in the asbestos register (defined in Box 3.6). Asbestos registers often are integrated with asbestos management plans and recommendations to manage risk, and can be supported by maps, analysis reports and asbestos in air monitoring data. The risk of exposure to airborne asbestos must then be assessed, and control measures must be implemented to eliminate or reduce those risks. The final step is to review the control measures to ensure that they are effective in eliminating or controlling the risks (Safe Work Australia 2011).

In identifying any asbestos or ACM, *Regulation 422* of the WHS Regulations stipulate that a 'competent person' is required to undertake the identification. This can be anyone who is trained to handle and take asbestos samples and knowledgeable about building and construction practices to determine where asbestos is present.

Regulation 424 of the WHS Regulations stipulate that the location and presence of asbestos or ACM in the workplace is clearly indicated by labels is reasonably practicable. Importantly, an asbestos register has to be maintained and kept in the workplace.

Box 3.6

WHAT IS AN ASBESTOS REGISTER?

The asbestos register is a document that lists all identified (or assumed) asbestos in a workplace. The asbestos register must:

- record any asbestos or ACM that has been identified or is likely to be present at the workplace from time to time. This would include:
- the date on which the asbestos or ACM was identified
- the location, type and condition of the asbestos; or
- state that no asbestos or ACM is identified at the workplace if the person knows that no asbestos or ACM is identified or is likely to be present from time to time at the workplace.

Source: Safe Work Australia 2011.

Regulation 425 stipulates that 'a person with management or control of a workplace must ensure an asbestos register is prepared and kept at the workplace'. Additionally, the register must be 'maintained, to ensure the information in the register is up-to-date'. Importantly, *Regulation 425* notes that asbestos register is not required to be prepared when:

- the workplace is a building that was constructed after 31 December 2003; and
- no asbestos has been identified at the workplace; and
- no asbestos is likely to e present at the workplace from time to time.

If asbestos is identified or assumed to be present, the person responsible with management or control of a workplace is required to produce an asbestos management plan. *Regulation 429* requires that the plan must be maintained to ensure that information is up-to-date. If naturally occurring asbestos is found in the workplace, the asbestos management plan must incorporate this information and the risks it entails (*Regulation 431-434*).

Furthermore, before any demolition and refurbishment work is undertaken the person responsible is required to:

- review the asbestos register;
- provide a copy of the asbestos register to the person carrying out the demolition or refurbishment work; and
- ensure asbestos that is likely to be disturbed is identified and, so far as is reasonably practicable, removed.

Removal and handling asbestos

A range of control measures can be implemented in order to minimise and control the risk of asbestos exposure. The code of practice on how to manage and control asbestos in the workplace (Safe Work Australia 2011) considers that the ultimate goal is to have a workplace free from asbestos. The removal of asbestos depends on whether the asbestos is friable or non-friable. Box 3.7 further describes the actions that must be undertaken if the asbestos is friable and non-friable.

Box 3.7

LICENSED ASBESTOS REMOVAL

The ultimate goal is to have a workplace free from asbestos. Removal may be the most appropriate way to achieve this. For example:

- **Friable asbestos** — If asbestos is friable and it has been determined that it should be removed, it must be removed by a Class A licensed removalist as soon as reasonably practicable. Instances where removal should be of the highest priority would include friable asbestos that is in poor condition and is located in an area where it poses a significant risk of exposure.
- **Non-friable asbestos** — If asbestos is non-friable, is more than 10 m² and has been determined that it should be removed, it must be removed by a licensed asbestos removalist as soon as reasonably practicable. Where it is not reasonably practicable to remove it, control measures must be put in place to eliminate any exposure, so far as is reasonably practicable, or to minimise exposure so far as is reasonably practicable, but always ensuring the exposure standard is not exceeded.

Source: Safe Work Australia 2011.

If removing asbestos is not reasonably practicable, then enclosure may be implemented instead. Enclosing the asbestos requires building a structure around the ACM so that it prevents any fibres from escaping into the air. It also prevents access to the ACM. It is recommended that enclosure only be used for non-friable asbestos where removal is not practical and where the asbestos is at risk of damage from work activities (Safe Work Australia 2011).

Encapsulating asbestos requires capturing the asbestos in a resilient matrix, for instance reinforced plastics, vinyls, resins, mastics and flexible plasters. This reduces the opportunity for asbestos to be released into the air. It is recommended only when the original asbestos bond is still intact.

Storage, transport and disposal of asbestos

Before commencing the asbestos removal, removalists are required to design the route for removal of the asbestos waste bags or containers through the area in the workplace where asbestos is being removed. The codes on how to manage and control asbestos in the workplace (Safe Work Australia 2011a) and safely removing asbestos (Safe Work Australia 2011b) require that only unused bags and heavy-duty 200 μm (minimum thickness) polythene sheeting can be used. The bags must not be more than 1200 mm long and 900 mm wide to prevent manual task injuries.

A competent person — usually the asbestos removal supervisor — should develop a waste disposal program and methods used to transport waste through a building. In workplaces that are occupied, the codes of practice require waste containers should only be moved through buildings outside of working hours.

Asbestos waste that has been removed from the asbestos removal area, should either be:

- placed in a solid waste drum, bin or skip for secure storage and eventual disposal; or
- removed immediately from the site by an environmental protection agency (EPA) approved/licensed carrier for disposal.

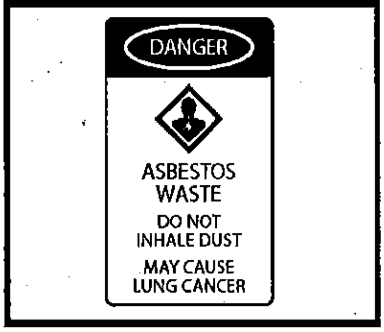
Asbestos waste drums or bins should be handled carefully. They should be placed as close to the asbestos removal area as possible, be lined with plastic and warning labels, and have their rims sealed and outer surfaced wet-wiped and inspected before they are removed from the asbestos removal work area (Safe Work Australia 2012b). Box 3.8 shows examples of labels for waste containers and drums that contain asbestos.

Box 3.8

LABELS FOR WASTE CONTAINERS AND DRUMS

All containers containing a hazardous chemical such as asbestos must comply with to the labelling elements of the GHS. The waste drums or bins should be lined with plastic (minimum 200 μm thickness), and labels warning of the asbestos waste should be placed on the top and side of each drum or bin with the words, 'Danger: Asbestos Do not break seal' or a similar warning. Examples of labels are included below.

LABEL 1: Sample asbestos waste bag.



SIGN 1: Sample asbestos removal area.

Source: Safe Work Australia (2011b) How to Safely Remove Asbestos: Code of Practice.

The transport of commercial asbestos waste is covered under each state and territory's environmental protection agency (EPA) legislation. In general, a removalist with a Class A licence is required to remove friable asbestos. The removalist must ensure, so far as is reasonably practicable, the asbestos removal work area is enclosed to minimise the release of asbestos fibres. If the asbestos removal involves large scale friable asbestos, the work area should be enclosed and under 'negative pressure' with the use of negative air pressure units. If large-scale non-friable asbestos is to be removed, a Class B licence removalist is usually required, however a risk assessment should be undertaken and consider factors such as proximity of the asbestos to work areas, weather conditions and the amount of asbestos to be removed (Safe Work Australia 2011b). Table 3.2 provides further information on the types of asbestos removal licences.

Each jurisdiction's EPA requires that asbestos waste be disposed in a landfill that is approved, or is able to lawfully receive the waste. Certain states and territories also require that the asbestos waste be disposed in a certain manner. For instance, the Northern Territory requires that asbestos waste must be covered in orange marker mesh identifying that asbestos is buried in the area (Department of Natural Resources, Environment, the Arts and Sport, Northern Territory 2012) and New South Wales requires that the waste must be covered with 'natural material' such as clay, gravel, sand, soil or rock (New South Wales EPA 2012). Jurisdictions also specify how deep asbestos should be buried. The Australian Capital Territory requires that stabilised asbestos waste in bonded matrix should be at least one metre deep and asbestos fibres have to be at least three metres below the planned final land surface of the landfill site (ACT Government 2011). Victoria requires that asbestos waste must not be deposited within two metres of the final tipping surface of the landfill (Victoria EPA 2009). Further information is provided in Appendix B.

Table 3.2

TYPES OF ASBESTOS REMOVAL LICENCES

Type of licence	What asbestos can be removed?
Class A	Can remove any amount or quantity of asbestos or ACM, including: • any amount of friable asbestos or ACM; • any amount of asbestos contaminated dust or debris (ACD); and • any amount of non-friable asbestos or ACM.
Class B	Can remove: • any amount of non-friable asbestos or ACM Note: A Class B licence is required for removal of more than 10 m^2 (square metres) of non-friable asbestos or ACM but the licence holder can also remove up to 10 m^2 of non-friable asbestos or ACM. • ACD associated with the removal of non-friable asbestos or ACM. Note: A Class B licence is required for removal of ACD associated with the removal of more than 10 m^2 of non-friable asbestos or ACM but the licence holder can also remove ACD associated with removal of up to 10m^2 of non-friable asbestos or ACM.
No licence required	Can remove: • up to 10 m^2 of non-friable asbestos or ACM • ACD that is: – associated with the removal of less than 10 m^2 of non-friable asbestos or ACM – not associated with the removal of friable or non-friable asbestos and is only a minor contamination.

Source: Safe Work Australia 2011b.

Prioritised removal of asbestos and ACM

Current legislation does not require that in-situ asbestos be removed. An alternative approach to managing the risk of asbestos is hence to implement a method of gradually removing asbestos and ACM in the built environment — this involves completely eliminating exposure risk, not just managing or maintaining it. This approach can be called the prioritised removal of asbestos (PRA). Prioritised removal is currently not implemented in Australia.

PRA is based on the principle that all ACM poses a health risk and, as such, should be removed in an orderly prioritised manner according to the severity of the risk posed within defined timeframes (for the purpose of this research by the year 2030). This approach holds that all ACM eventually degrade, so even material that is ostensibly safe (i.e. bonded and stable) may become unsafe over time. Degradation can be the result of weathering over the course of years, or an unexpected event or impact that results in the sudden release of airborne asbestos fibres, such as that which occurs in natural disasters.

The purpose of this study is to estimate the costs and benefits of PRA. It involves investigating, assessing and evaluating the costs and benefits of extending the current RMA to require the staged, systematic, safe removal of all ACM from the built environment. Importantly, the study will also assess the risk that PRA entails, such as the unintentional release of fibres into the air while removing the ACM. A key component of the cost-benefit analysis is to compare the PRA to the RMA (i.e. the current approach).

Chapter 4

The benefits of Prioritised Removal of ACM

The key benefits of the prioritised removal of asbestos are human health benefits and the potential cost savings that result from the reduced need to manage asbestos exposure risks in workplaces. The potential benefits of the PRA in Australia can be categorised accordingly:

- *Health benefits* — the reduction in asbestos-related diseases and deaths as a result of reduced exposure to ACM in workplaces.
- *Cost savings* — the reduced need for monitoring and managing ACM in workplaces.

This chapter outlines these benefits.

4.1 Health benefits

Exposure to asbestos can cause a number of diseases, and removing asbestos from the built environment will reduce exposure to ACM and in the longer term, can be expected to decrease the number of associated diseases.

In order to quantify the health benefits of the prioritised removal of asbestos, it is necessary to first calculate the reduction in the number of asbestos-related disease as a result of PRA and then attribute values to these. This is determined by a series of calculations, such as the forecasted number of asbestos-related disease in the future (starting from 2013), the proportion of diseases attributable to workplace exposure and the rate at which prioritised removal will reduce such disease.

This section outlines the data and information used and the steps followed to calculate the health benefits of the PRA.

Forecast incidences of mesothelioma in Australia

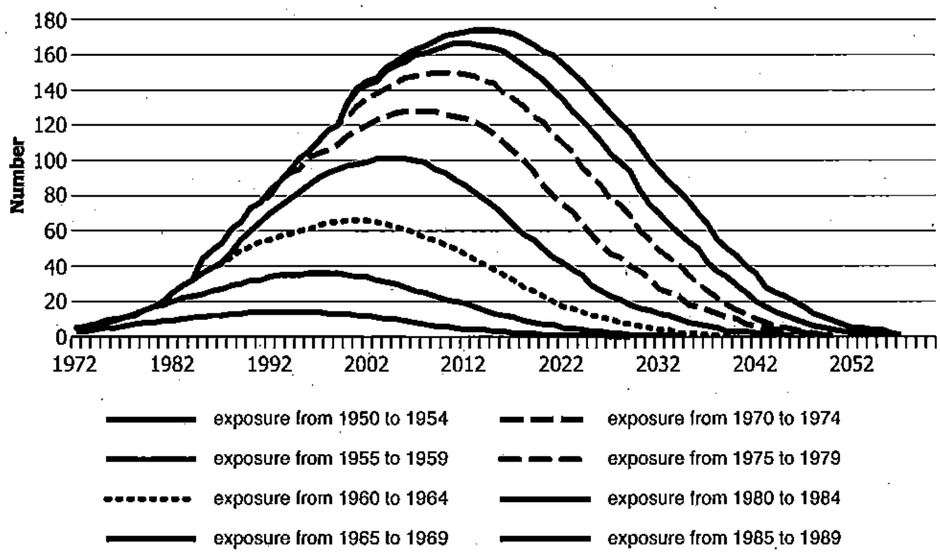
The first step in estimating the health benefits from the PRA is to forecast the number of individuals diagnosed with asbestos-related disease, which are estimated to result from the current approach to managing ACM.

Each year, a number of individuals are diagnosed with mesothelioma. The number of new mesothelioma cases each year is referred to as mesothelioma incidences (AIHW 2012b). The forecast number of asbestos-related disease in Australia has been based on incidences of mesothelioma. The incidence of mesothelioma has been based on the profile of mesothelioma in NSW males estimated by Clements *et al.* In addition, past data on mesothelioma incidences from 1982 to 2009 from the Australian Cancer Incidence and Mortality Workbooks (2012) for Mesothelioma (ICD10 C45) informed the calculations.

The Clements *et al.* (2007b) model is established on age cohort and calendar year of exposure. By accounting for age at exposure, the Clements *et al.* (2007b) model was able to stratify the number of cases in any given year by period of exposure. It estimates the incidence of mesthelioma in NSW males from 1972-2060 based on exposure between 1950-1989. It predicts a peak number of cases in 2014, with 6,430 cases between 2006 to 2060. This is illustrated in Figure 4.1, where the number of mesothelioma cases in a given year from 1972 is the cumulative sum of cases due to exposure since that year.

Figure 4.1

PREDICTED NUMBER OF CASES, BY PERIOD OF EXPOSURE, NSW MALES



Source: Clements *et al.*(2007b).

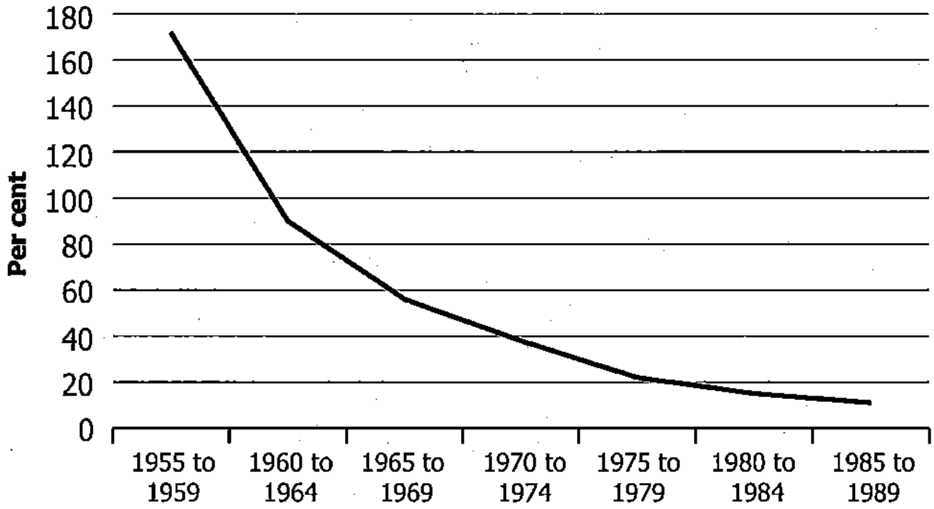
The Clements *et al.* (2007b) model assumes that there is no exposure risk for 'birth cohorts born from 1970 after the 2003 calendar year' (Clements 2007a).

In order to forecast the incidence of mesothelioma in NSW estimated to result from current practice, the profile of incidence as a result of exposure between 1985-1989 formed the baseline for the incidence of mesothelioma in NSW males from 2013 onwards.

An important feature of the Clements. *et al.* (2007b) model is that the cumulative number of cases by exposure period increases with time, however the rate of increase slows exponentially with time, as shown in Figure 4.2.

Figure 4.2

PERCENTAGE INCREASE IN CUMULATIVE MESOTHELIOMA CASES

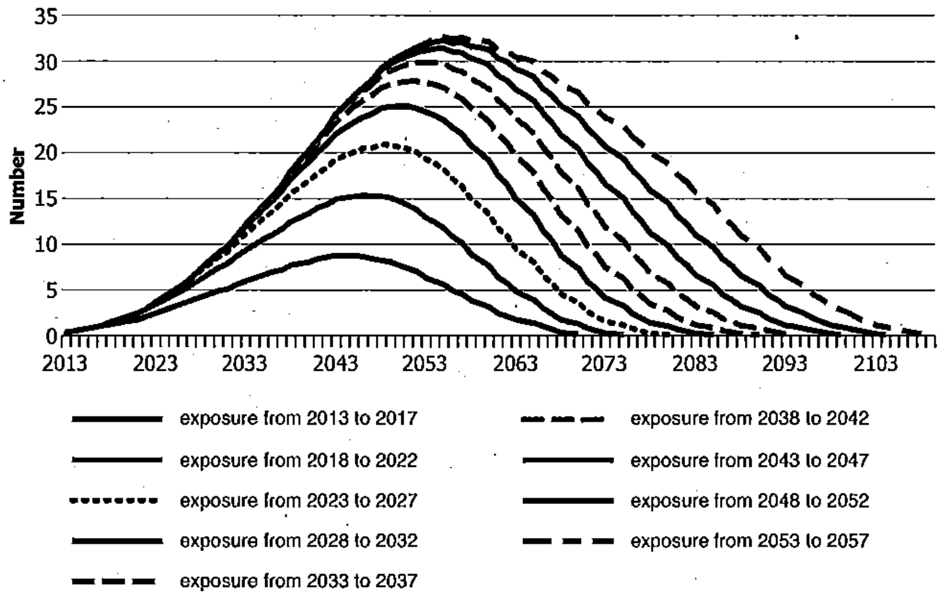


Source: Allen Consulting Group analysis of Clements *et al.* (2007b) data.

By using the profile of mesothelioma incidence as a result of exposure between 1985-1989 and adjusting it to take into account the decreasing incidence of mesothelioma incidence outlined above, mesothelioma incidence in NSW males from 2013 was estimated, as outlined in Figure 4.3.

Figure 4.3

PROFILE OF MESOTHELIOMA CASES FROM 2013 ONWARDS



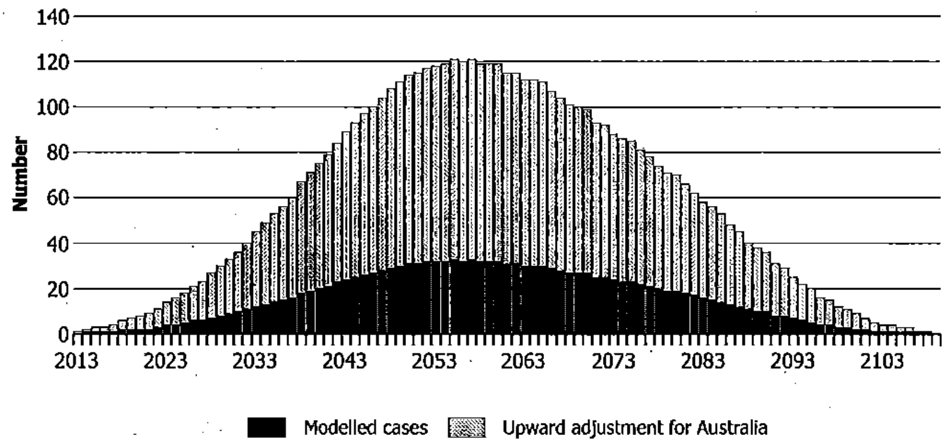
Source: Allen Consulting Group analysis of Clements *et al.* (2007b) data.

As the Clements *et al.* (2007b) model was based on NSW males, the projections were scaled up to estimate Australia-wide predictions for both males and females. A multiple of 3.7 was applied to the predicted incidences of mesothelioma in NSW males. This was based on the average multiple between mesothelioma cases in NSW males and Australia-wide incidences between 1989 and 2009, obtained from the Australian Cancer Incidence and Mortality Workbooks (2012) for Mesothelioma.

Figure 4.4 illustrates the number of actual and forecast male and female, Australia wide, mesothelioma cases based on this approach. It shows the accumulation of cases due to exposure from 2013 onwards. For example, the mesothelioma cases in 2053 shown here are collectively derived for exposure between 2013 and 2053.

Figure 4.4

PROJECTED CASES OF MESOTHELIOMA — AUSTRALIA-WIDE



Source: Allen Consulting Group analysis of data from Clements et al.(2007b).

Adjust forecast mesothelioma incidences for other asbestos-related diseases

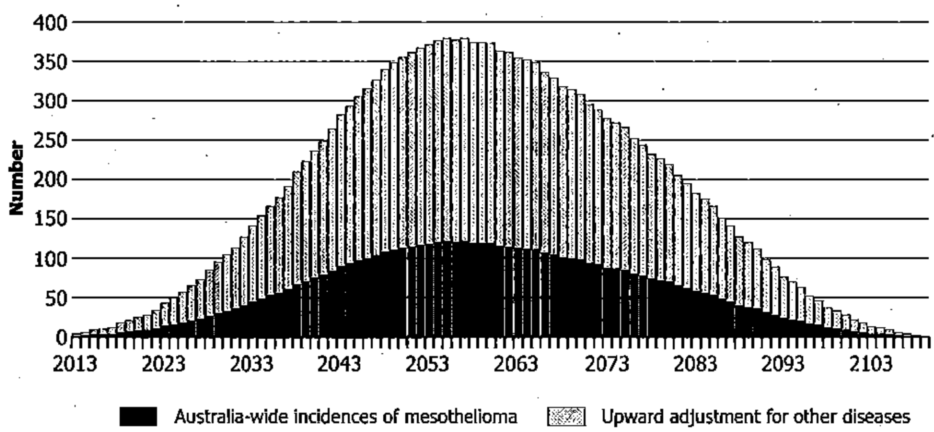
The data on mesothelioma incidences was then upwardly adjusted to account for the fact that asbestos exposure causes other diseases in addition to mesothelioma, such as asbestosis and lung cancer. The data on mesothelioma incidences was upwardly adjusted using a multiple derived in the following way:

- According to Leigh, Davidson, Hendrie and Berry (2002), the ratio of asbestos-related lung cancer to mesothelioma is estimated at a ratio of 2:1. Hence the number of mesothelioma cases should be upwardly adjusted by 200 per cent. Other studies have reported lower ratios of lung cancer to mesothelioma. For instance the Finity Consulting (2010) study for WorkCover Tasmania has reported that lung cancer was 20 per cent of mesothelioma cases. Another study by McCormack and Schuz (2012) reported lung cancer to be 80 per cent of mesothelioma cases. This study has utilised the ratio in the Leigh *et al.* (2002) study in order to avoid underestimation of health costs imposed by asbestos exposure.

- Additionally, the ratio of deaths due to asbestosis and mesothelioma between 2001 and 2007 has averaged 14 per cent, based on calculations that used data from the Australian Bureau of Statistics (2012) on causes of death and AIHW (2012c) Australian Cancer Incidence and Mortality Workbooks. This suggests an upward adjustment of mesothelioma incidences of 14 per cent.

The upward adjustment of mesothelioma incidences to account for all asbestos-related diseases therefore used a multiple of 3.14, which is equivalent to a 314 per cent increase in mesothelioma incidences. Figure 4.5 illustrates the number of mesothelioma cases, as well as the number of incidences of asbestos-related diseases (i.e. upwardly adjusted numbers).

Figure 4.5
PROJECTED ASBESTOS-RELATED DISEASE — AUSTRALIA-WIDE



Source: Allen Consulting Group analysis of data from Clements *et al.*(2007b), ABS (2012), Causes of death and AIHW (2012c), Australian Cancer Incidence and Mortality Workbooks.

Adjust for occupational exposure

The estimated incidence of asbestos-related disease then needs adjusted to determine the incidence attributable to occupational exposure, as this study is focused on workplace exposure.

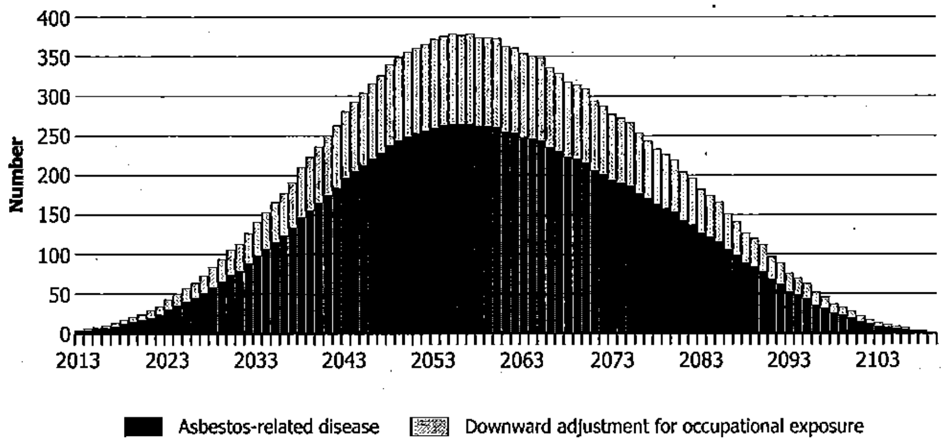
A study commissioned by Work Cover Tasmania, found that occupational exposure has averaged 70 per cent since the early 2000s (Finity Consulting 2010). This figure was based on mesothelioma claims to the NSW DDB compared to total incidence reported to the NSW Cancer Registry. Another study by Olsen *et al.* (2011), published in the British Journal of Cancer, found that occupational exposures to asbestos for men accounted for approximately 83 per cent of all exposure. In addition, some stakeholders suggested that non-occupational exposure for women could be used as a proxy for future risk of asbestos exposure. According to Olsen *et al.* (2011), non-occupational exposure in women has been estimated to be 44 per cent between 1960 and 2008. Based on these studies the proportion of forecast asbestos-related disease due to workplace exposure has been assumed to be 70 per cent.

As noted in Chapter 3, the nature of risk in relation to asbestos exposure has changed. Since the use, importation and production of asbestos was banned in 2003, and due to workplace regulation of the management of ACMs, it is anticipated that the proportion of asbestos-related diseases due to occupational exposure will reduce in the future. As such, this estimate is conservative and may overestimate the share of asbestos-related disease due to occupational exposure in the future.

Figure 4.6 shows the proportion of asbestos-related disease attributable to occupational exposure.

Figure 4.6

PROPORTION OF ASBESTOS-RELATED DISEASE ATTRIBUTABLE TO OCCUPATIONAL EXPSOURE

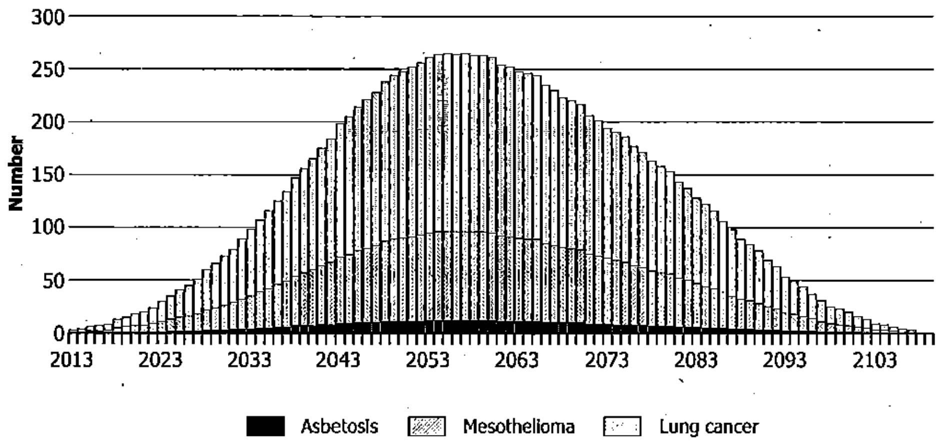


Source: Allen Consulting Group analysis of data from Clements et al.(2007a), ABS (2012), Causes of death, AIHW (2012c), Australian Cancer Incidence and Mortality Workbooks, Berry et al (2012) and Work Cover Tasmania (2010).

Figure 4.7 illustrates the number of asbestos-related diseases attributable to occupational exposure according to disease type. As can be seen, lung cancer has the highest burden of disease, followed by mesothelioma and asbestosis. The relative shares of health burden for each type of asbestos-related disease will have implications for the estimation of health savings from prioritised removal of ACMs in workplaces.

Figure 4.7

ASBESTOS-RELATED DISEASES ATTRIBUTABLE TO WORKPLACE EXPOSURE, BY DISEASE TYPE



Source: Allen Consulting Group analysis of data from Clements *et al.*(2007a), ABS (2012), Causes of death, AIHW (2012), Australian Cancer Incidence and Mortality Workbooks, Berry et al (2012) and Work Cover Tasmania (2010).

Asbestos-related diseases in each state and territory

The estimated incidences of asbestos-related disease were then apportioned according to state and territory. This was based on data on the rolling five-year average of mesothelioma incidences for each state and territory provided by Safe Work Australia (2012c). The rolling five-year average of incidences for each state and territory were divided by the total five-year average of Australia-wide incidences. This gave the relative shares of mesothelioma cases for each state and territory for the years 1985 to 2008. Table 4.1 provides the average relative shares of incidences for each state and territory.

Table 4.1

SHARES OF MESOTHELIOMA INCIDENCES, 1982 TO 2008

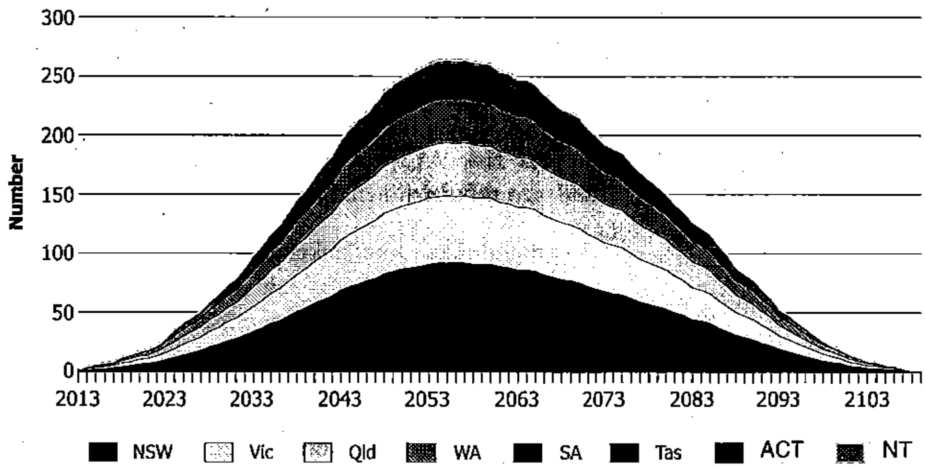
State	Relative share of mesothelioma incidences (per cent)
NSW	34.86
Vic	21.38
Qld	16.97
WA	14.05
SA	10.11
Tas	1.57
ACT	0.75
NT	0.31
Total	*100.00*

Source: Allen Consulting Group analysis of data from Safe Work Australia (2012c).

As can be seen, NSW has the highest share of incidences, followed by Victoria, Queensland and Western Australia. The average relative shares of mesothelioma incidences were then applied to the estimated incidences of asbestos-related disease in Australia to give incidences by state and territory, as shown in Figure 4.8.

Figure 4.8

INCIDENCE OF OCCUPATIONAL ASBESTOS-RELATED DISEASE BY STATE AND TERRITORY



Source: Allen Consulting Group analysis of data from AIHW (2012c), Australian Cancer Incidence and Mortality Workbooks and Safe Work Australia (2012c).

The benefits of prioritised removal of asbestos

The prioritised removal of asbestos by 2030 is anticipated to reduce asbestos-related disease relative to the current RMA. Hence, the next step involves calculating the reduction in asbestos-related disease as a result of a move to prioritised removal.

This study has assumed that PRA will begin in 2014, and that the overall profile of asbestos-related diseases is similar to that of mesothelioma incidences estimated by Clements *et al.*. It is expected that the move to PRA will reduce the number of asbestos-related diseases relative to the forecast baseline incidences of occupational asbestos-related disease outlined above.

This reduction is anticipated to occur as a result of ACM being removed from workplaces, and hence exposure (and/or potential exposure) to asbestos would be reduced. Under the PRA the highest risk materials would be removed from workplaces first and hence many of the health benefits result soon after the implementation of the PRA.

It was noted by stakeholders that a move to prioritised removal would decrease the risk associated with exposure to asbestos as a result of natural disasters such as flooding. This is such that under the PRA, the highest risk materials would be removed from workplaces first. Therefore in the event of future natural disasters the greatest risk materials would already have been removed and exposure during such events should be reduced[2].

This study assumes that the number of diseases will be reduced by 80 per cent in the longer term. In the first five years of PRA it is expected that all the highest risk ACM will be removed. Once all the high risk (for example friable) ACM have been removed, it is assumed that asbestos-related diseases will be reduced by 80 per cent. Under the RMA, ACM are removed from workplaces when it is practicable (for instance when buildings undergo refurbishment). However under the PRA, the highest risk ACM will be removed regardless of whether the workplace will undergo refurbishment or whether the ACM is in good condition.

It is noted that some stakeholders expressed a concern that in the short-term there may be an increase in exposure to asbestos and hence asbestos-related disease as a result of the PRA. It was suggested that removing asbestos from the built environment may entail certain exposure risks that could result due to accidents or non-compliance of persons involved in the removal of asbestos.

A greater number of workers being employed in the industry would increase the number of individuals potentially exposed to asbestos fibres. In addition, the disturbance of asbestos may also expose other individuals. If this was found to be the case, and a greater number of individuals became exposed to asbestos, then there could be a short-term increase in the number of asbestos-related diseases.

However, asbestos removalists and workplaces are governed by legislation in relation to the management, removal and transport of asbestos which requires the removal of ACM in a manner that minimises potential exposure. Under the PRA the same regulations would apply, hence the risk of unintentional or accidental exposure is anticipated to be low provided those involved in the removal of asbestos followed appropriate procedures and comply with legislation.

It is therefore not anticipated that there will be a high level of additional short-term exposure under the PRA. Further a lack of data on the size of the potential risk has resulted in the modelling undertaken for this report to not consider any short-term increase in asbestos-related disease as a result of the PRA.

Asbestos-related diseases are often fatal and also require ongoing hospital treatment. For instance, individuals diagnosed with mesothelioma are likely to undergo surgery, radiotherapy or chemotherapy, as well as suffer pain and breathing difficulties (Musk n.d). Therefore, a reduction in the future number of asbestos-related diseases is anticipated to reduce the number of hospitalisations and deaths and improve the quality of life of those who would have suffered from an asbestos-related disease. These are discussed in turn in the subsequent sections.

2 For example, a recent storm in Kiama on the NSW South Coast resulted in emergency services assisting in the clean up of asbestos debris. Further information can be found at: http://www.theaustralian.com.au/news/breaking-news/kiama-asbestos-removal-continues/story-fn3dxiwe-1226585557777

Reduced hospitalisations due to PRA

The number of hospitalisations due to asbestos exposure in the workplace is expected to reduce as a result of the PRA. In order to calculate the number of hospitalisations per year required by those diagnosed with asbestos-related disease, the differing effects of mesothelioma, lung cancer and asbestosis were considered, as outlined below.

- *Mesothelioma* — After the first year of diagnosis, 50 per cent of mesothelioma patients will survive. The survival rate was estimated from the Australian mesothelioma registry (2011), which noted that in 2011, there were 310 deaths amongst patients diagnosed with mesothelioma. Of those diagnosed in 2011, the death rate was around 51 per cent.

  After five years of being diagnosed of mesothelioma, the survival rate is patients is estimated to be 6 per cent. This estimation was derived from the Australian Institute of Health and Welfare report (2012b), which found that from 2006 to 2010, the five-year survival for individuals diagnosed with mesothelioma was 6 per cent. After 5 years, survivors are assumed to incur no health costs as the profile of survival after 5 years is uncertain. This may underestimate the health benefits, however, due to the small number of survivors it is likely that these will not be material.

  This study has assumed that individuals who are diagnosed with mesothelioma in any given year will require one hospitalisation episode. Those who survive for the subsequent years will continue to receive an episode of hospitalisation. Combining this information with the survival rates, the number of hospitalisation in a given year was calculated.

- *Lung cancer* — According to Cancer Australia (2013), the five-year survival for 2006-2010 for lung cancer in Australia was 14.1 per cent. After 5 years, survivors are assumed to incur no health costs as the profile of survival after 5 years is uncertain. This may underestimate the health benefits, however, due to the small number of survivors it is likely that these will not be material.

  The resulting hospitalisations in any year is based on newly diagnosed lung cancer patients, as well as survivors from previous years, according to this survival rate.

- *Asbestosis* — According to the ATSDR (2012), 'severe asbestosis may lead to respiratory failure over 12 to 24 years', and that asbestosis patients usually die of 'other causes such as lung cancer, mesothelioma and other causes'.

  This study hence assumes that asbestosis patients will continue to survive for the next 10 years after being diagnosed, and that each year of survival requires a hospitalisation episode.

  Hence the resulting hospitalisations from asbestosis in any given year depends on newly diagnosed asbestosis patients, as well as patients diagnosed in previous years.

In order to estimate the number of reduced hospitalisations from the PRA, the difference in hospitalisations between the RMA and PRA has to be calculated. Using the assumptions and methodology described above, it was estimated that there would be a reduction of 26,109 hospitalisations under the PRA between 2014 and 2116.

This assumes that the PRA commences in 2014 and the majority of disease incidences would occur 40 years later on average, however there will be a few cases that occur earlier and some much later than 40 years.

Table 4.2 shows the number of hospitalisations reduced as a result of PRA for each state and territory from 2014 to 2116.

Table 4.2

REDUCTION IN HOSPITALISATIONS FROM PRA, 2014 TO 2116

State	Mesothelioma	Lung cancer	Asbestosis	Total
NSW	2,338	6,004	760	9,102
Vic	1,434	3,683	466	5,583
Qld	1,138	2,922	370	4,430
WA	942	2,419	306	3,668
SA	678	1,741	221	2,639
Tas	105	271	34	410
ACT	50	129	16	196
NT	21	53	7	80
Total	**6,705**	**17,222**	**2,181**	**26,109**

Source: Allen Consulting Group analysis.

Improved quality of life

In addition to being hospitalised, those who are diagnosed with asbestos-related diseases experience a reduction in their quality of life. The total improvement in quality of life years is the sum of the quality of life improved for newly diagnosed patients, as well as survivors diagnosed in previous years. The estimated quality of life years improved as a result of the PRA is the same as the number of hospitalisations, shown in Table 4.2. In total it would be expected that 26,109 quality of life years would be improved under the PRA.

Reduced deaths

A reduction in the number of asbestos-related diseases due to the PRA is anticipated to reduce the number of deaths in the future. Importantly, this study has assumed that the highest risk ACM will be removed from workplaces in the first five years of PRA. Hence in the first five years of PRA there will be a gradual increase in health benefits, which will reach 80 per cent by the fifth year of PRA. Thereafter, reduction in asbestos-related diseases will be 80 per cent.

Under the assumptions noted above it was estimated that a total of 8,581 lives will be saved, as illustrated in Table 4.3.

Table 4.3

LIVES SAVED UNDER PRA, 2014 TO 2113

State	Mesothelioma	Lung cancer	Asbestosis	Total
NSW	1,039	1,953	-	2,992
Vic	637	1,198	-	1,835
Qld	506	950	-	1,456
WA	419	787	-	1,205
SA	301	566	-	868
Tas	47	88	-	135
ACT	22	42	-	64
NT	9	17	-	26
Total	**2,980**	**5,601**	**-**	**8,581**

Source: Allen Consulting Group analysis.

Reduced carer costs

Each individual diagnosed with an asbestos-related disease is expected to incur a cost related to caring. This study has accounted for this cost by assuming that each diagnosed individual will require someone to care for him or her as long as they survive. The number of years that carers are required is hence the number of newly diagnosed individuals, as well as survivors from previous years. Using this logic, the resulting number of 'carer years' is equivalent to that found in Table 4.2.

4.2 *Quantifying the benefits of PRA*

The health benefits of the PRA are calculated by summing the value of the reductions in hospitalisations, increase quality of life and the reduction in deaths as a result of the PRA. The following sections describe the costs in relation to:

- hospitalisation and treatment incurred by an individual diagnosed with mesothelioma, asbestosis, lung cancer, or any other type of cancer caused by asbestos exposure;
- quality of life costs incurred by contracting an asbestos-related disease;
- the value of life lost due to premature death caused by asbestos exposure; and
- the cost of care given to individuals with an asbestos-related disease.

Hospitalisation and treatment costs

Statistics on the hospitalisation and treatment costs incurred were obtained from the following sources:

- NOHSC (2001); and
- AIHW (2012a).

The hospitalisation and treatment costs obtained from these sources for an individual diagnosed with mesothelioma, asbestosis and lung cancer are summarised in Table 4.4 (note that all costs have been converted to 2012 dollars).

Table 4.4

HOSPITALISATION AND TREATMENT COSTS PER PERSON, $2012

Disease	NOHSC	AIHW
Mesothelioma	77,109	NA
Asbestosis	2,976	NA
Lung Cancer	77,109	NA
Average hospitalisation and treatment costs	*52,398*	*5,057*

All values have been converted into $2012 dollars using Australian Bureau of Statistics (2013) *Consumer Price Index* data, cat. no. 6401.
Sources:
NOHSC (2001), NOHSC *Regulatory Impact Statement on the Proposed Phase Out of Chrysotile Asbestos*
The Workers Compensation Dust Diseases Board, *Annual Report 2002-03*
AIHW (2012a), *Australian Hospital statistics, 2010-11.*

As can be seen, the estimate provided by AIHW (2012a) is significantly lower than the NOHSC. This is because the AIHW statistic was based on 'average recurrent expenditure' for each hospitalisation. The NOHSC statistics, conversely, are based on specific asbestos-related diseases. This illustrates that the expected hospitalisation and treatment costs for asbestos-related diseases are much higher than the typical (i.e. average) hospitalisation cost per person. This is especially true for the case of mesothelioma, which is estimated to incur hospitalisation and treatment costs of approximately $77,000 per person. Asbestosis, on the contrary, incurs a much lower hospitalisation and treatment cost. As a result, the NOHSC statistics have been used to calculate the health benefits.

Value of a statistical life and quality of life costs

Asbestos-related diseases can reduce the quality of life of affected individuals, as well as lead to premature death. Estimates for the value of a statistical life and quality of life costs have been used in order to quantify the benefit of the PRA in improving quality of life and reducing the number of deaths associated with exposure to asbestos.

Quality of life costs entail a reduced value in an individual's life due to the suffering caused by disease. This cost is estimated using the value of a statistical life year adjusted for disability. The resulting estimate provides a disability adjusted life year (DALY).

The value of a statistical life indicates the value of reducing the risk of premature death. The value of statistical life can be expected to be higher if it is based on younger individuals with longer to live (OBPR 2008).

According to the Office of Best Practice Regulation (2008):

- the value of a statistical life year is $168,000; and
- the value of a statistical life is $3.9 million (both in 2012 dollars).

Table 4.5 provides the high and low range of burden of disease weights for lung cancer and asbestosis, which are used to discount the value of a life year (i.e. reflect a reduced quality of life). As there was no actual weight for mesothelioma, the disease weight for lung cancer was used as a proxy. For asbestosis, the disease weight for chronic obstructive pulmonary disease was used. Burden of disease weights were obtained from the AIHW workbooks for 'years of life lost due to disability' (YLD) (AIHW 1999).

Table 4.5

WEIGHTS FOR BURDEN OF DISEASE

Range	Lung cancer and mesothelioma	Asbestosis
Low	0.44	0.17
High	0.93	0.53
Average	0.7	0.4

Source: AIHW '(1999), Years of life lost due to disability' (YLD) workbooks.

It is important to note that, the average age of death for an asbestos-related disease ranges from 61 to 75 years of age. This means that the calculated benefits of lives saved may be overestimated, since the VSL is based on a 'healthy person living for another 40 years' (OBPR 2008).

Carer cost savings

To account for the yearly cost that is incurred by a carer for an individual diagnosed with an asbestos-related disease, it was assumed that government payments represent the value of carers time as follows:

- *A payment from the government's Carer Allowance to individuals who provide daily care to patients with an asbestos related disease* — This amounts to a payment of $115.40 per fortnight (Department of Human Services 2013).
- *A payment from the government's Carer Payment to individuals who are unable to work in paid employment because they provide full-time care to someone with a severe disability* — This amounts to $722.70 per fortnight (Department of Human Services 2013).

The health benefits

The health benefits related to the PRA were calculated in the following way:

- The benefits in reduced hospitalisations were calculated by multiplying the difference in number of hospitalisations (under PRA and RMA) by the cost of each hospitalisation. The study used the cost of hospitalisation and treatment for mesothelioma, lung cancer and asbestosis from NOHSC (see Table 4.4).
- The benefits of improved quality of life were calculated by first estimating the difference in the number of newly diagnosed diseases — and survivors of previous diagnoses — under PRA and RMA. This difference was then multiplied by the value of a statistical life year (i.e. $168,000) and the average disability weight of lung cancer and asbestosis (see Table 4.5).

- The benefits of reduced deaths were calculated by estimating the number of lives saved under PRA, then multiplying it by the value of a statistical life (i.e. $3.9 million).
- The benefits from reduced carer costs were calculated by estimating new incidences of asbestos-related disease, as well as the survivors of disease from previous years. This was then multiplied by the current rate for the Carer Payment and Carer Allowance.

The net present value of the benefits for each state and territory, by benefit type, is shown in Table 4.6. Net present value compares the value of costs and benefits over time (calculated in today's dollars). A discount rate of seven per cent was used, as is required by the OBPR (2011).

In total, it is expected that PRA will result in $2.7 billion in health benefits. As can be seen, most of the health benefits accrue to NSW, followed by Victoria and Queensland. It is anticipated that NSW will receive approximately $933 million in health benefits. For Victoria and Queensland this is $572 million and $454 million respectively. The NT will receive the lowest level of health benefits, valued at $8 million.

Table 4.6

HEALTH BENEFITS IN EACH STATE AND TERRITORY, BY BENEFIT TYPE, $ MILLION (NPV)

State	Hospitalisation and treatment	Quality of life	Value of life	Carer costs	Total
NSW	47	46	827	14.01	**933**
Vic	29	28	507	8.59	**572**
Qld	23	22	402	6.82	**454**
WA	19	18	333	5.65	**376**
SA	14	13	240	4.06	**270**
Tas	2	2	37	0.63	**42**
ACT	1	1	18	0.30	**20**
NT	0	0	7	0.12	**8**
TOTAL	**134**	**131**	**2,371**	**40**	**2,675**

Source: Allen Consulting Group analysis.

The highest benefits come in the form of lives saved, which was estimated to be approximately $2.4 billion. Hospitalisation and quality of life benefits each contribute about $130 million to overall health benefits from PRA. Finally, carer cost savings amount to $40 million.

Table 4.7 illustrates the health benefits according to mesothelioma, asbestosis and lung cancer. The largest health burden is imposed by lung cancer — a total of $1.7 billion in health benefits will result from the PRA. Mesothelioma is the second largest health burden, with an estimated $948 million in health benefits. A further $21 million will result by reducing asbestosis incidences.

Table 4.7

HEALTH BENEFITS BY DISEASE AND BENEFIT TYPE, $ MILLION (NPV)

Disease	Hospitalisation and treatment	Quality of life	Value of life	Carer costs	Total
Mesothelioma	40	31	872	6	948
Lung cancer	93	86	1,499	29	1,704
Asbestosis	1	14	-	6	21
Total	134	131	2,371	40	2,675

Source: Allen Consulting Group analysis.

4.3 Cost savings from the reduction of ongoing risk management of asbestos

Under the RMA businesses incur compliance costs relating to the ongoing risk management of ACM. A range of businesses incur ongoing costs including for building owners, occupants of buildings containing ACM and by businesses ensuring their employees do not become exposed to asbestos through their day to day work.

Under the RMA building managers/owners (duty holders) of a workplace building are required to remove asbestos from a building site where reasonably practicable. If this is not possible, they are required to manage the risks of asbestos, and this entails costs. A number of ways exist to manage the risk of asbestos exposure such as enclosing, encapsulating and sealing the ACM or asbestos article. If enclosing, encapsulating or sealing the asbestos is not possible, then safe work practices have to be implemented. It should be noted that these measures are interim measures. When such buildings are eventually demolished, asbestos removal costs will still be incurred. Table 4.8 provides examples of costs incurred under the RMA.

Table 4.8

RISK MANAGEMENT MEASURE AND POTENTIAL COSTS INCURRED

Ongoing risk management measure	Examples of costs incurred
Enclosing asbestos — an interim control measure that is undertaken when immediate removal of asbestos is not possible	• May involve regular inspections by a competent person to identify whether the enclosed asbestos requires removal due to damage or deterioration
Encapsulation — preserving the asbestos in a resilient material such as cements and reinforced plastics	• Need to hire a trained person to encapsulate the ACM • Compliance with several procedures such as use of appropriate Respiratory Protective Devices and decontamination
Sealing — an interim measure that is used when removing or enclosing the asbestos cannot be implemented	• Requires equipment and tools, such as airless sprayer at low pressure, appropriate coating that has the required fire resistance, thermal insulation and UV properties necessary for it to be effective. • Coating may wear off over time and need a replacement

Source: Safe Work Australia (2011).

Additionally, implementing these measures require investment in appropriate tools and equipment. Personal protection equipment such as coveralls, footwear and gloves and respiratory and protective equipment have to be used correctly.

Under the PRA, these ongoing costs would not be incurred. However, stakeholders suggested that for building owners, the ongoing costs of compliance are generally low. For example it was suggested that annual inspections necessary in order to update asbestos registerers cost approximately $250-1,000 per year, while testing to check whether samples contain asbestos cost around $25-40 per sample. It was suggested that buildings owners updating their asbestos register would only require two tests per annum, while a building that has not previously been tested may require up to eight.

In relation to the ongoing management of ACM, stakeholders suggested that generally, it was more likely that ACM identified as a concern would be removed rather than enclosed, encapsulated or sealed. As such, the savings that may result from a move to the PRA in relation the ongoing management of ACM in buildings are anticipated to be low.

Other stakeholders noted that the potential presence of asbestos within materials, which certain workplaces are handling, means that they incur costs to ensure their employees are not exposed to asbestos. For example it was suggested that car repairers may need to take precautionary steps to ensure their employees are not exposed to asbestos, such as in brakes. If the PRA was implemented, in time these steps may not be necessary and lead to cost savings.

While there are a range of potential cost savings from the movement to prioritised removal, stakeholders have suggested that these are small in magnitude and a lack of sufficient data and information on these costs savings mean they have not been assessed quantitatively in this report.

Chapter 5

The costs of Prioritised Removal of ACM

A range of costs will result from the extension of the current RMA to PRA. As noted in Chapter 4, these include:

- the cost of removing asbestos from workplaces;
- the cost of replacement materials;
- machinery of government costs;
- disturbance to business operations;
- training additional accredited removal staff; and
- environmental costs.

This chapter explores, both quantitatively (where possible) and qualitatively, these costs.

5.1 Cost of removing asbestos from workplaces

The major cost associated with the PRA relates to the removal and disposal of ACM. However, not all the actions associated with prioritised removal will generate *additional* costs — some costs, which would be incurred under the current RMA are bought forward to an earlier date. For example, the cost of removing ACM from buildings as a hazardous waste would be incurred under both the PRA and the RMA. However, under the PRA, in many instances ACM would be removed earlier than under the RMA and hence these costs would be incurred at an earlier date.

In addition to moving costs forward, the nature of these costs may vary. For example, the cost associated with removing ACMs from a building that is to be demolished, would be expected to be lower than for a building, which is to stay in use. Further, removing ACMs from buildings that are to continue in use would generally entail replacing the ACM with other materials. This would involve further costs.

In order to calculate the cost of removing asbestos from workplaces as a result of the prioritised removal of asbestos, it is necessary to first estimate the volume of ACM in workplaces. This is determined by a number of calculations, such as the volume of asbestos consumed in Australia, the proportion of asbestos used in residential or commercial buildings and the rate at which ACMs have been removed from commercial buildings. This then allows the cost of removing and disposing of ACMs to be estimated, as well as the cost of replacement materials. Following this calculation, the timing of such costs is considered allowing a comparison of the costs of removing ACM under the RMA and PRA.

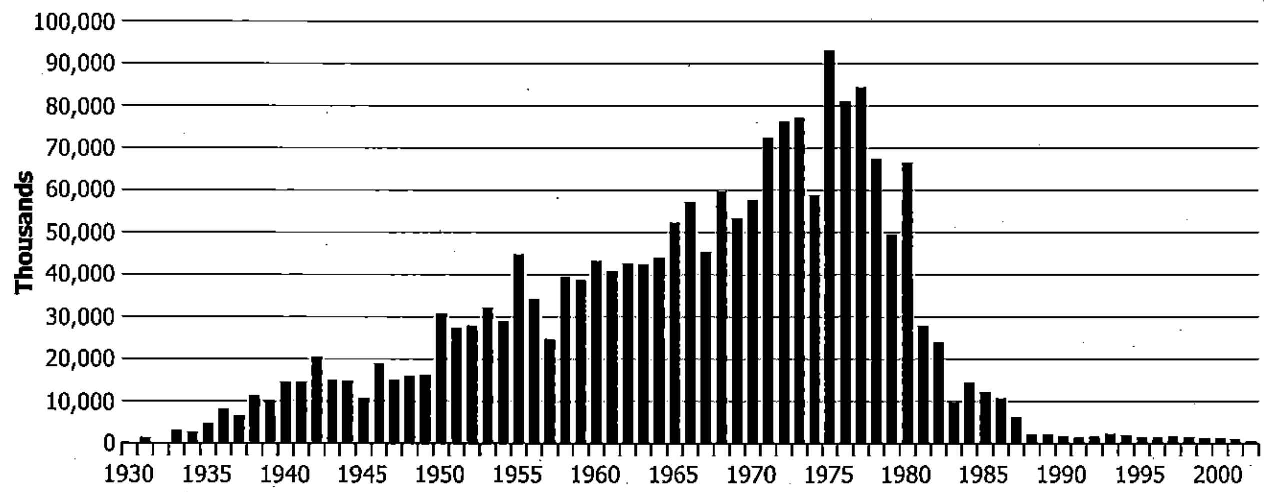
This section outlines the data and information used and the steps followed to calculate the cost of removing asbestos from workplaces.

Amount of raw asbestos consumed in Australia

The first step in estimating the cost of removing asbestos from workplaces involves determining the amount of asbestos consumed in Australia. As shown in Figure 5.1, consumption of asbestos began in the 1930s gradually increasing, until it peaked in 1975, with the consumption of just over 93 million tonnes of raw asbestos. With the ban of asbestos mining in 1983, consumption dropped sharply. From 1987, asbestos consumption in Australia had almost ceased except for a small number of specialist uses.

Figure 5.1

AMOUNT OF RAW ASBESTOS CONSUMED IN AUSTRALIA



Source: Minerals UK Centre for sustainable mineral development, various years.

Data on the consumption of raw asbestos was obtained from the Minerals UK Centre for sustainable mineral development. Other data sources also estimate the amount of asbestos consumed in Australia. This includes the US Geological Survey (USGS) dataset (2006). However, this study utilised the datasets from the Minerals UK Centre because they provided asbestos consumption on a yearly basis, which enabled ease of analysis. The USGS (2006) dataset provided data on a less frequent basis, and yearly data was only available from 1995 onwards (only production data was available for every year). There are some discrepancies between both datasets, for instance in 1975 the USGS dataset indicated consumption to be at 73,000 metric tonnes, while the Minerals UK dataset estimated it to be at 93,000 metric tonnes. In 1980, however, both datasets indicated the same consumption value, at 66,000 metric tonnes. Consumption values from 1990, 1995 to 1997 are identical in both datasets, however the values begin to diverge again from 1998 onwards.

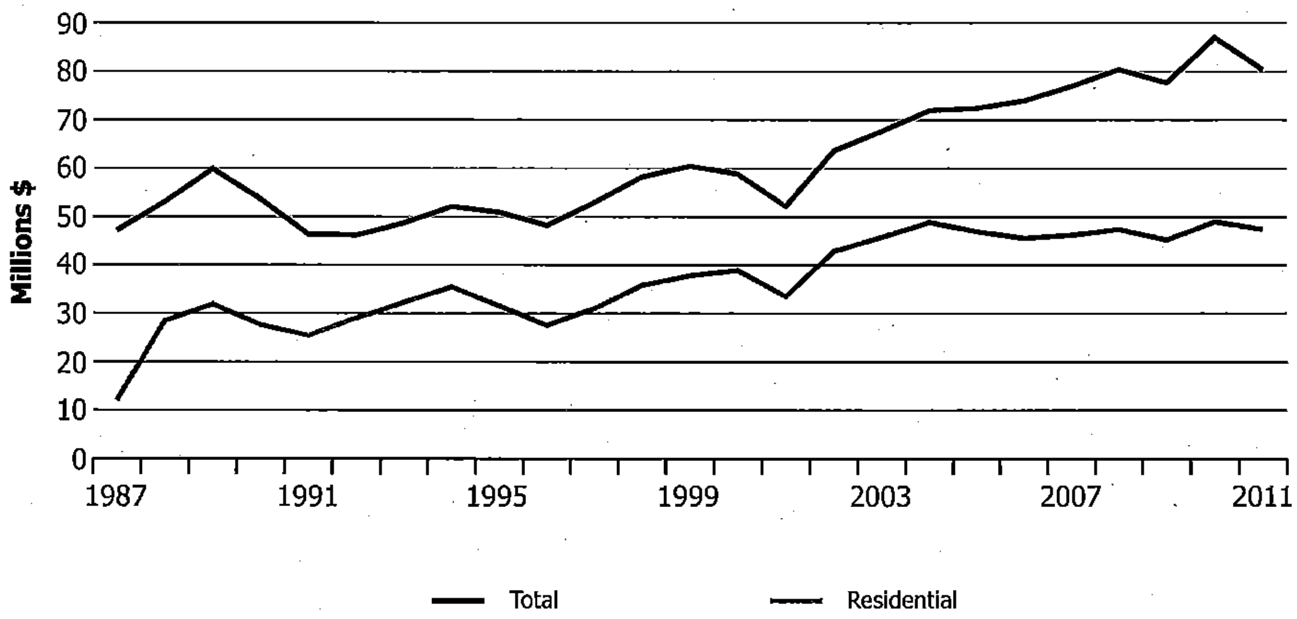
Non-residential use of raw asbestos

Raw asbestos consumed has either been used for residential construction or non-residential construction. Since this study is focused on the prioritised removal of ACM in workplaces, the next step involves estimating the amount of raw asbestos that was consumed that relates to workplaces. In the absence of information and data on the actual amount of asbestos consumed that relates to workplaces, the relative value of non-residential work done to total work done has been used as a proxy.

Figure 5.2 shows the value of total building work undertaken in Australia, as well as the value of residential building work. The difference between total and residential building work provides an indication of non-residential building work being undertaken. The figure demonstrates that generally, 30 to 50 per cent of all building work undertaken in Australia is non-residential.

Figure 5.2

VALUE OF BUILDING WORK DONE, 1987-2011

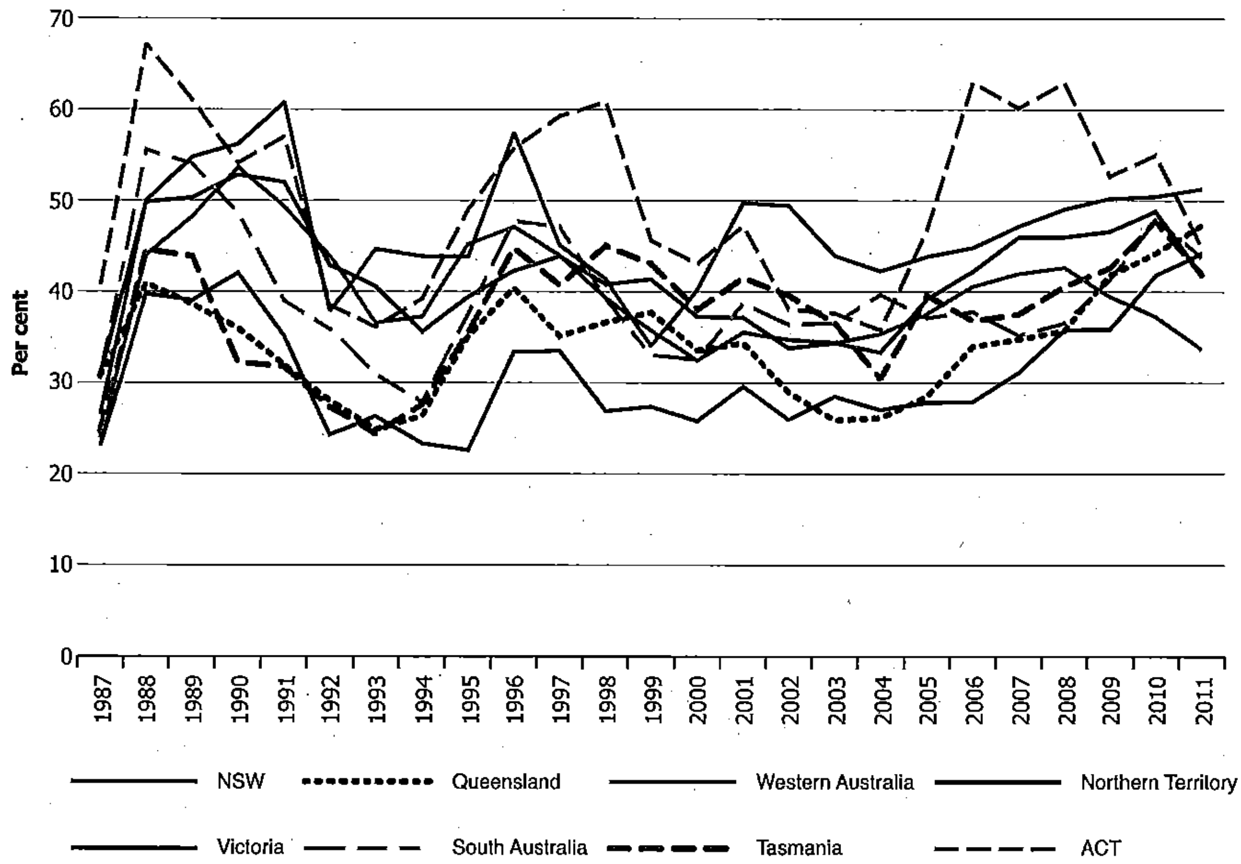


Source: Australian Bureau of Statistics 2012 *Value of Building Work Done by Sector, States and Territories - Chain Volume Measures*, Cat No. 8752.0 and Australian Bureau of Statistics 2012 *Value of Residential Building Work Done, States and Territories - Chain Volume Measures*, Cat No. 8752.0

However, the proportion of non-residential building work for each state and territory differs. Figure 5.3 shows the proportion of non-residential building work undertaken by value from 1987-2011. The figure shows that the ACT generally undertakes the highest proportion of non-residential building work and WA the lowest proportion of non-residential construction.

Figure 5.3

PROPORTION OF NON-RESIDENTIAL BUILDING WORK, STATE AND TERRITORY, 1987-2011



Source: Allen Consulting Group analysis Australian Bureau of Statistics 2012 *Value of Building Work Done by Sector, States and Territories - Chain Volume Measures*, Cat No. 8752.0 and Australian Bureau of Statistics 2012 *Value of Residential Building Work Done, States and Territories - Chain Volume Measures*, Cat No. 8752.0

Data for the years prior to 1987 is not available. In order to estimate the proportion of non-residential building activity undertaken in each state and territory prior to 1987, the average proportion of the value of non-residential building work to total work done from 1987-2011 has been used, as shown in Table 5.1.

Table 5.1

AVERAGE NON-RESIDENTIAL WORK UNDERTAKEN WITHIN EACH STATE AND TERRITORY AS A PROPORTION OF TOTAL CONSTRUCTION IN THAT JURISDICTION (1987-2011)

State	Per cent
NSW	42
Vic	40
Qld	34
SA	40
WA	31
Tas	38
NT	46
ACT	50

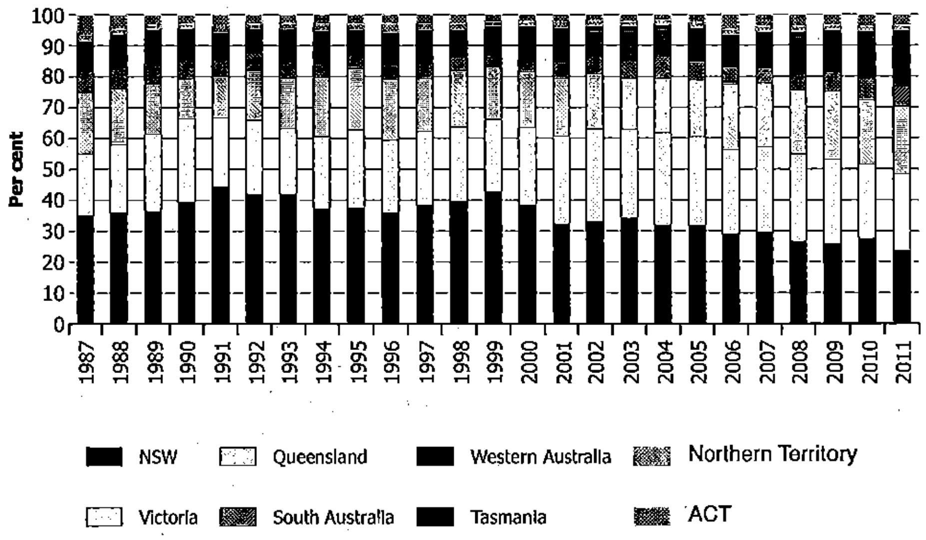
Source: Allen Consulting Group analysis, Australian Bureau of Statistics 2012 *Value of Building Work Done by Sector, States and Territories - Chain Volume Measures*, Cat No. 8752.0 and Australian Bureau of Statistics 2012 *Value of Residential Building Work Done, States and Territories - Chain Volume Measures*, Cat No. 8752.0

Proportion of raw asbestos used in each state and territory

The amount of raw asbestos used in each state and territory has been estimated by apportioning the *total* raw asbestos consumed in each year to the various states and territories based on the value of non-residential construction work undertaken. This has been done by calculating the relative shares of non-residential building work undertaken by each state and territory. Figure 5.4 illustrates the shares of non-residential work undertaken. As can be seen NSW, Victoria and Queensland are states with the highest shares of non-residential construction.

Figure 5.4

PROPORTION OF NON-RESIDENTIAL BUILDING IN EACH STATE AND TERRITORY, 1987-2011



Source: Allen Consulting Group, Australian Bureau of Statistics 2012 *Value of Building Work Done by Sector, States and Territories - Chain Volume Measures*, Cat No. 8752.0 and Australian Bureau of Statistics 2012 *Value of Residential Building Work Done, States and Territories - Chain Volume Measures*, Cat No. 8752.0

Again, due to the lack of data available prior to 1987, the average proportion of non-residential work undertaken over the years by each state and territory from 1987-2011 has been used as a proxy for the previous years. NSW has the highest share, on average, on non-residential construction, as shown in Table 5.2.

Table 5.2

NON-RESIDENTIAL CONSTRUCTION IN EACH STATE AND TERRITORY AS A PROPORTION OF TOTAL AUSTRALIAN NON-RESIDENTIAL CONSTRUCTION

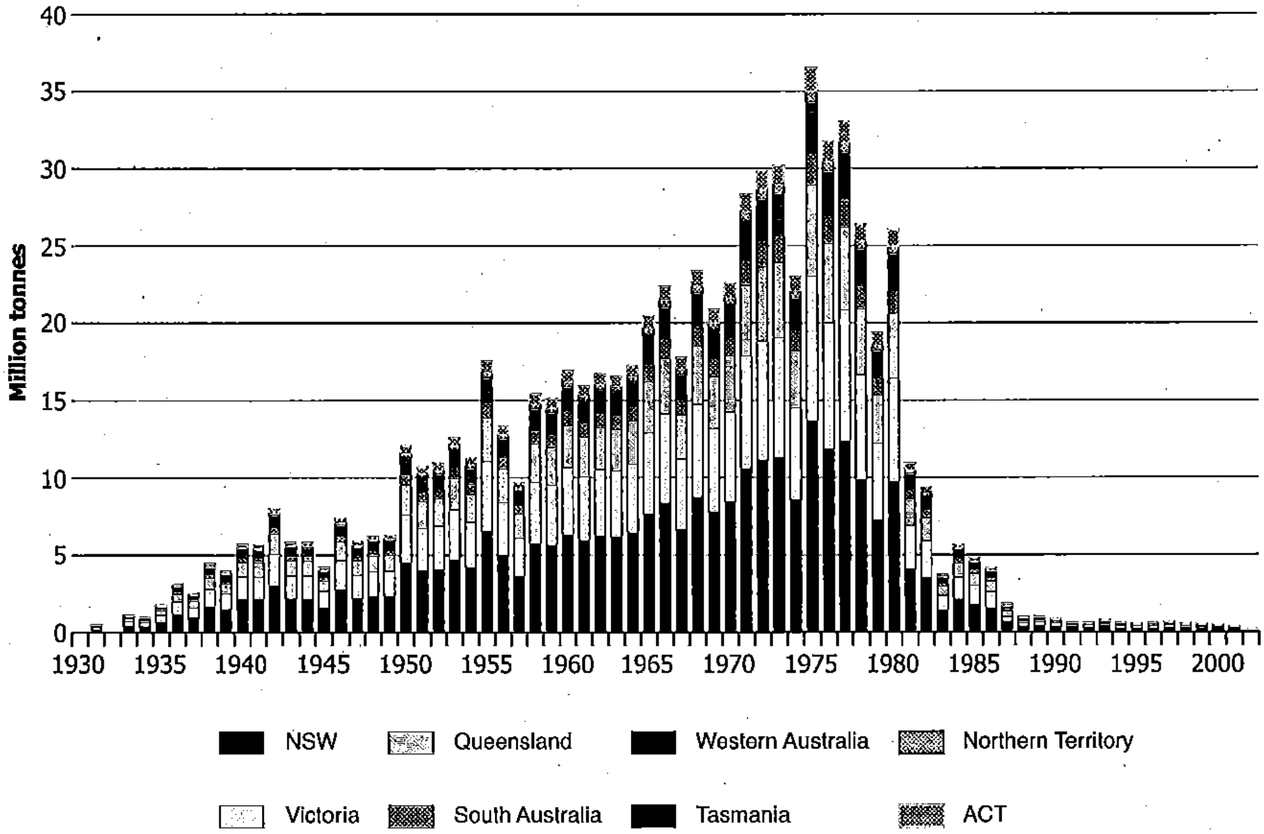
State	Per cent
NSW	35
Vic	25
Qld	18
SA	6
WA	10
Tas	2
NT	2
ACT	3
Total	**100**

Source: Allen Consulting Group analysis, Australian Bureau of Statistics 2012 *Value of Building Work Done by Sector, States and Territories - Chain Volume Measures*, Cat No. 8752.0 and Australian Bureau of Statistics 2012 *Value of Residential Building Work Done, States and Territories - Chain Volume Measures*, Cat No. 8752.0

Based on the above proxies, the amount of raw asbestos consumed in the construction of non-residential buildings, in each year, by each state and territory, can be estimated. The estimated amount of raw asbestos used in each state and territory is shown in Figure 5.5. NSW and Victoria are estimated to have consumed the largest quantities of raw asbestos over the years. Notably, this relates directly to the higher value of construction activity occurring in these states and may over estimate the amount of asbestos consumed, as no adjustment has been made for different patterns of use within each state and territory.

Figure 5.5

RAW ASBESTOS CONSUMED BY EACH STATE AND TERRITORY



Source: Allen Consulting Group analysis, Australian Bureau of Statistics 2012 *Value of Building Work Done by Sector, States and Territories - Chain Volume Measures*, Cat No. 8752.0 and Australian Bureau of Statistics 2012 *Value of Residential Building Work Done, States and Territories - Chain Volume Measures*, Cat No. 8752.0 and Minerals UK Centre for sustainable mineral development, various years.

The amount of ACM

The above analysis is based on the amount of raw asbestos consumed. However, asbestos is rarely used in its raw form and generally makes up only a proportion of a given material. The proportion of asbestos varies within products as demonstrated in Table 5.3.

Table 5.3

ABESTOS CONTENT OF ACM

Material	Asbestos content (per cent)
Asbestos insulating board	16-40
Asbestos cement	10-15
Textured coatings	1-4.2
Sprayed coatings	85
Lagging	50-100
Ropes/yarns	100
Floor material	1-2.5
Mastics	0.5-2

Source: Health and Safety Executive, undated, accessed at http://www.fia-online.co.uk/pdf/Presentation/asbestos.pdf

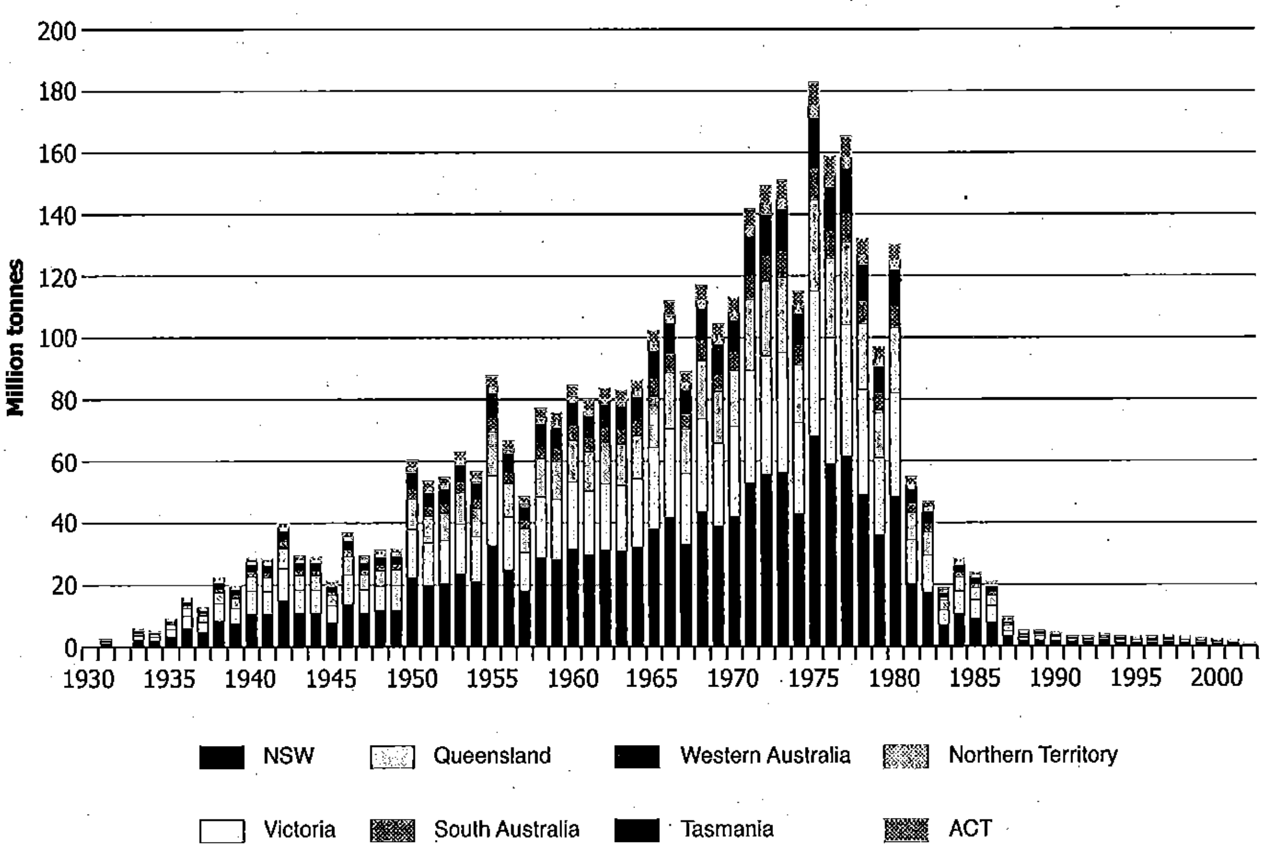
Stakeholders suggested that the majority of ACM in non-residential buildings is in the form of asbestos sheeting. This is supported by risk assessment survey undertaken by URS Australia Pty Ltd for the ACT Asbestos (assessment) Taskforce. The risk assessment found that for commercial and institution buildings in the order of 65 per cent of ACM was described as sheeting, with the remainder spread across a wide variety of materials (URS 2005).

This study has assumed that, on average, ACM is made of 20 per cent of asbestos content. As a result, the amount of raw asbestos needs to be leveraged up in order to estimate the amount of ACM in each state and territory.

This has been calculated by applying a multiplier of five to the amount of raw asbestos consumed in each state and territory. Figure 5.6 shows the total amount of ACM in each state and territory. In 1975, the peak year of asbestos consumption, it has been estimated that approximately 182 million tonnes of ACM was used in non-residential buildings in Australia.

Figure 5.6

AMOUNT OF ACM CONSUMED IN EACH STATE AND TERRITORY



Source: Allen Consulting Group analysis, Australian Bureau of Statistics 2012 *Value of Building Work Done by Sector, States and Territories - Chain Volume Measures*, Cat No. 8752.0 and Australian Bureau of Statistics 2012 *Value of Residential Building Work Done, States and Territories - Chain Volume Measures*, Cat No. 8752.0 and Minerals UK Centre for sustainable mineral development, various years.

ACM already removed or buildings demolished

A certain proportion of ACM in Australia has already been removed from buildings and/or the buildings have been demolished. In calculating the total amount of ACM in non-residential buildings (the proxy used for workplaces) an adjustment therefore needs to be made for the removal of ACM to date.

Information and data is not available on the removal rate of asbestos from buildings and it is acknowledged that different buildings and different uses of ACM will have different useful lives. For example, ACM tended to be particularly popular for low cost buildings such as factories where building life expectancy is likely to be less than that of more substantial office buildings designed for longer lives.

Further, stakeholders suggested that in some situations, property owners have been removing asbestos cement and asbestos items that contains blue asbestos as a priority. This results in older items (also having potentially higher asbestos concentrations) being removed first. In addition, some former asbestos uses such as sprayed asbestos lagging to fire-proof steel beams in office towers, have been identified as a high risk materials since the late 1970s and have been largely removed.

This analysis has assumed that given commercial buildings generally have an average working life of 40 years, only ACM used after 1973 are still in use. This is such as it has been assumed that all ACM used prior to this time has already been removed from buildings or such buildings have been demolished.

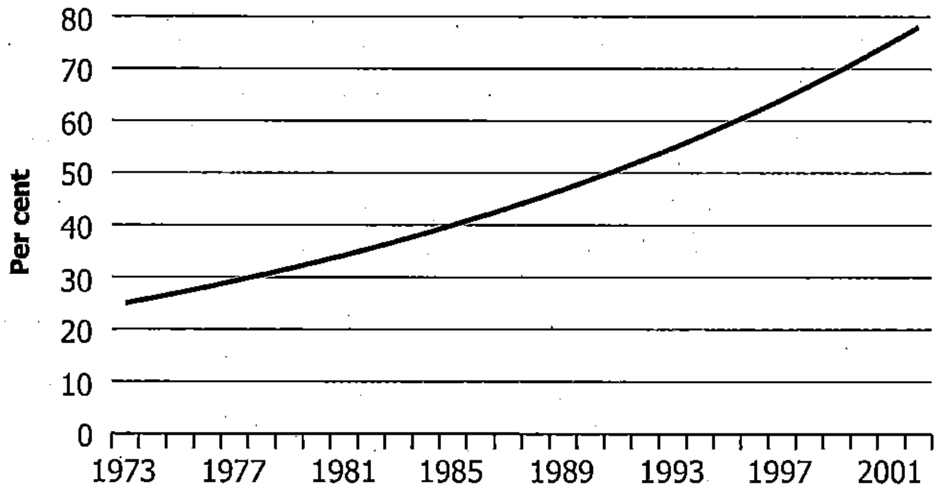
Further, the analysis has assumed that only 25 per cent of ACM used in 1973 in non-residential buildings is still in use. From 1973, it has been assumed that each year, four per cent more ACM remains in use. Thus it has been assumed that, of the ACM used in non-residential buildings in 1973, 25 per cent remains today. Of the ACM used in non-residential buildings in 1974, 26 per cent (0.25 x 1.04) remains today. This assumption continues to 2002, by which time the percentage of ACM remaining in non-residential buildings today is estimated to be 78 per cent. This is depicted in Figure 5.7.

While stakeholders validated this approach, it is noted that there are extensive areas of asbestos cement roof in Australian cities and industrial areas with much of this material being 1950s-1970s installation. Further, stakeholders noted that up to 40 per cent of all asbestos cement production was used for water pipe and much of this remains in use today.

If the assumption that all ACM installed pre-1973 in workplaces has now been removed underestimates the amount of remaining installed asbestos, then future removal costs will be greater than those estimated.

Figure 5.7

PROPORTION OF ACM PRESENT IN NON-RESIDENTIAL BUILDINGS IN 2013, BY YEAR OF CONSTRUCTION

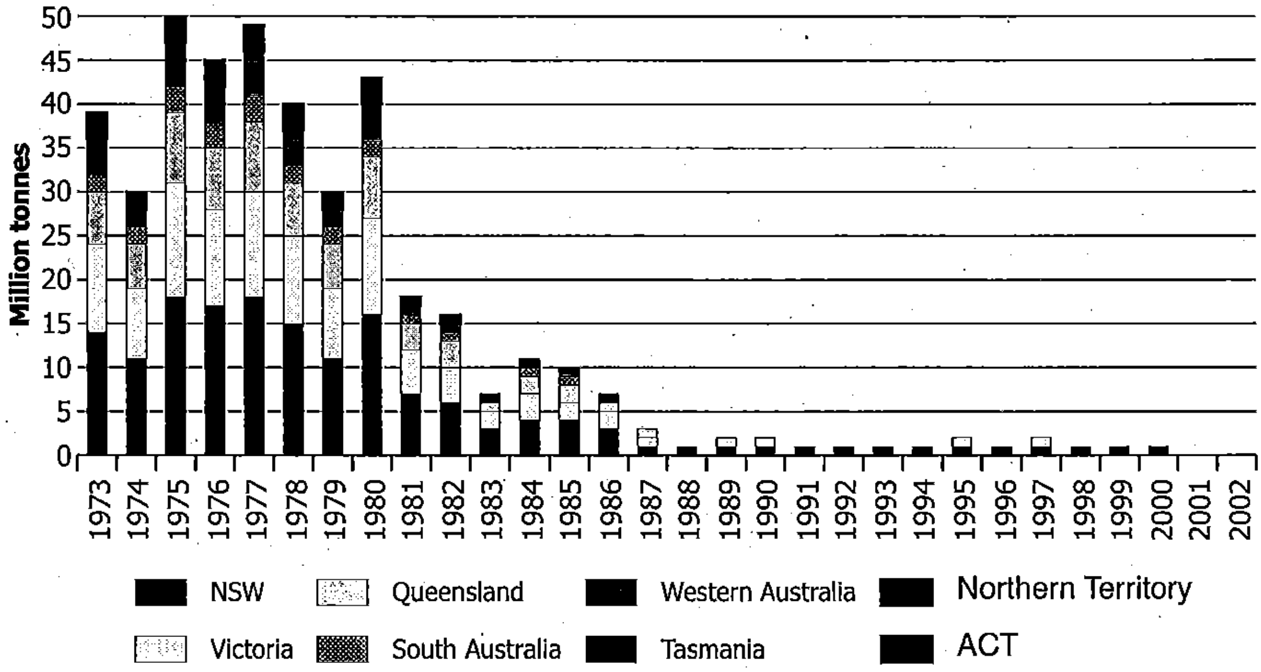


Source: Allen Consulting Group analysis

Figure 5.8 shows the adjusted quantities of ACM for each state and territory based on these assumptions. The total area of this chart represents the total amount of ACM estimated to be present in non-residential buildings.

Figure 5.8

ACM IN EACH STATE AND TERRITORY, ADJUSTED FOR DEMOLITION/REMOVAL, BY YEAR OF CONSTRUCTION



Source: Allen Consulting Group analysis, Australian Bureau of Statistics 2012 *Value of Building Work Done by Sector, States and Territories - Chain Volume Measures*, Cat No. 8752.0 and Australian Bureau of Statistics 2012 *Value of Residential Building Work Done, States and Territories - Chain Volume Measures*, Cat No. 8752.0 and Minerals UK Centre for sustainable mineral development, various years.

In total, it is therefore estimated that just over 425 million tonnes of ACM remains in non-residential buildings in Australia. As demonstrated in Table 5.4, it has been estimated that NSW contains the largest stock of ACM, followed by Victoria and Queensland.

Table 5.4

TOTAL ACM REMAINING IN NON-RESIDENTIAL BUILDINGS, MILLION TONNES

State	NSW	Vic	QLD	SA	WA	Tas	NT	ACT	Total
Amount	159.52	109.07	68.32	24.07	31.78	6.48	8.06	18.02	425.32

Source: Allen Consulting Group analysis, Australian Bureau of Statistics 2012 *Value of Building Work Done by Sector, States and Territories - Chain Volume Measures*, Cat No. 8752.0 and Australian Bureau of Statistics 2012 *Value of Residential Building Work Done, States and Territories - Chain Volume Measures*, Cat No. 8752.0 and Minerals UK Centre for sustainable mineral development, various years.

The cost of removal and disposal

The cost of removing ACM from buildings depends on the nature of the ACM and its accessibility. Table 5.5 shows typical costs for removing asbestos from non-residential buildings and other structures. As can be seen, there is a wide range in these costs.

Table 5.5
TYPICAL ASBESTOS REMOVAL COSTS

ACM	Removal cost
Corrugated ACM roofing	$40-60 per square metre
ACM from exposed steel beams in a large structure	$1000 per lineal metre
ACM pipe (buried)	$10 per lineal metre
Vermiculite from ceiling	$200 per square metre
Pipe lagging	$500 per lineal metre
Ceiling tiles (in a highway tunnel)	$30 per square metre
Asbestos sheeting on walls	$40 per square metre

Source: Consultations

Industrial buildings were often clad in ACM. In addition, corrugated ACM was widely used in roofing these buildings. On the other hand, commercial buildings made more limited use of ACM in wet areas and in areas potentially weather-exposed such as under eaves. ACM used in commercial buildings was generally 6mm in thickness (4mm material was generally used in residential applications).

Of all the ACM used in non-residential construction, stakeholders estimate that the majority was in the form of asbestos cement sheet. This is consistent with other studies, as mentioned above. Thus it is assumed that the cost of removing asbestos cement sheeting will dominate the cost estimate, and therefore this cost has been used as a proxy for the average cost of removal.

Thus, we have based our cost estimates on the cost of removing asbestos cement sheet. These calculations are outlined as follows:

- The average density of asbestos cement sheet is 1.75 tonnes/m^3 (Sokolov 1960 and Blokh and Litvinov 1964).
- A square metre of 6mm thick asbestos cement sheet therefore weighs 0.0105 tonnes.
- Therefore each tonne of 6mm asbestos cement sheet corresponds to 95 square metres.
- Assuming a cost of $40 per square metre, the cost per tonne of removing asbestos cement sheet is therefore $3,800.

However, it is noted that the cost varies depending on the type of ACM. For example, the cost of removing asbestos cement pipe is relatively low. While the cost of removing pipe lagging is higher, there are relatively small amounts of ACM lagging in most non –residential buildings (power stations may be an exception).

In addition stakeholder insights suggested that the capacity of landfills to deal with large quantities of ACM is limited and thus additional landfills may need to be created. This may increase the cost of disposal. Further, stakeholders noted that, in some locations, ACM needs to be transported large distances for appropriate disposal. For example, ACM removed in the NT is currently transported to South Australia for disposal. In these instances, the costs of removal may be significantly greater than the estimates included in this analysis.

Based on a cost per tonne of removing ACM of $3,800, it has been estimated that to remove 425 million tonnes of ACM would cost more than $1,616 billion[3]. The distribution of this cost by state and territory is outlined in Table 5.6.

Table 5.6

COST OF REMOVING ACM REMAINING IN NON-RESIDENTIAL BUILDINGS, $ BILLION

State	NSW	Vic	QLD	SA	WA	Tas	NT	ACT	Total
Amount	414	260	91	121	25	31	68	414	1,616

Source: Allen Consulting Group analysis

Account for changes in the timing of costs

The above figure considers the cost of removing all ACM in non-residential buildings in Australia. However, building owners will incur the costs of removal of ACM under the current RMA. While these costs will be incurred anyway, under the PRA such costs would be bought forward.

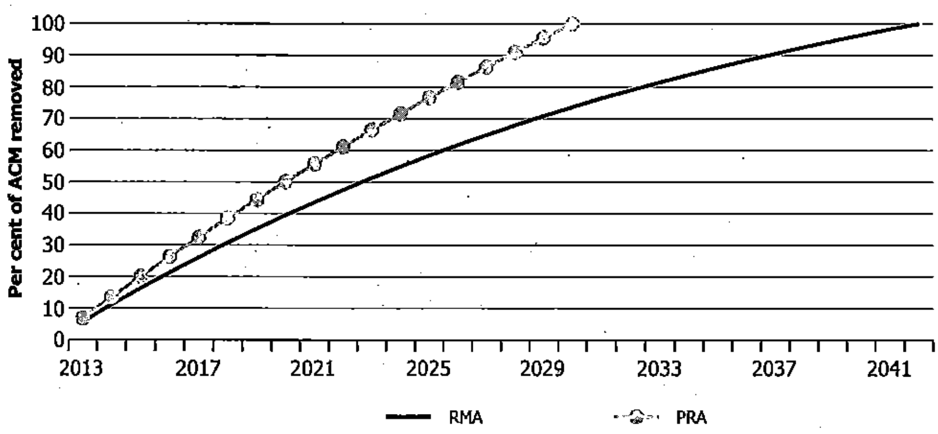
Hence the costs associated with removing ACM from non-residential buildings involve accounting for changes in the timing of removal costs. Based on a non-residential building having a useful life of approximately 40 years and given asbestos use stopped in 2002 it has been assumes that under the RMA all ACM would be removed from non-residential by 2042. Whereas, the PRA requires all ACM to be removed by 2030.

With the use of ACM declining over time, it would be expected that of the remaining ACM in non-residential buildings a greater proportion would be removed sooner. This reflects the assumption that ACM would be removed as buildings come to the end of their useful life and hence with a greater amount of ACM used in 1973 than 2002, more ACM is likely to be removed in 2014 than in 2042 under the PRA. With a lack of information and data in relation to the timing of the removal of ACM in workplaces this study has assumed a profile of removal as outlined in Figure 5.9.

[3] It is noted that the magnitude of these costs is broadly in line with other estimates. For example, the costs of removing asbestos from buildings owned by Housing Tasmania, the Tasmanian Education Department and the Tasmanian Health Department are in the order of $1.4 billion. See http://www.abc.net.au/news/2013-04-24/high-cost-of-asbestos-removal/4647914?section=tas.

Figure 5.9

ESTIMATED PROFILE OF REMOVAL OF ACM



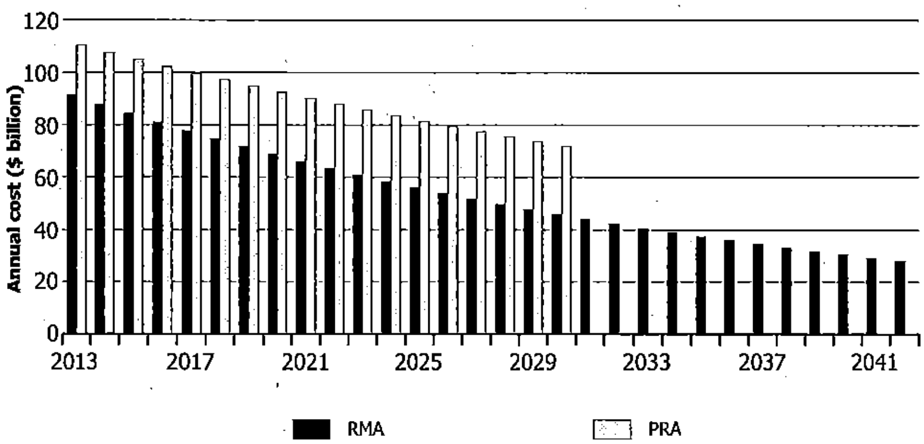
Source: Allen Consulting Group analysis

It is noted that under the PRA, the type of ACM removed may differ, in addition to the amount of ACM removed. This is such as the PRA, would involve prioritised removal, hence requiring certain types of ACM (based on risk) to be removed before other types of ACM. Without data on the volume of each type of ACM, the differences in cost associated with the removal of different types of ACM have not been included in this analysis.

Based on this removal profile, the estimated annual costs have been calculated under both the PRA and RMA, as demonstrated in Figure 5.10.

Figure 5.10

ESTIMATED ANNUAL COST OF REMOVAL OF ACM IN NON-RESIDENTIAL BUILDINGS



Source: Allen Consulting Group analysis

Applying a discount rate of seven per cent (OBPR 2011), the net present cost[4] of removing ACM under the RMA is estimated to be $829 billion, where us under the PRA the net present cost of removing ACM is estimated to be $943 billion. The difference between these costs therefore represents the additional cost of the PRA. This cost has been estimated to be $114 billion. The distribution of this cost by state and territory is outlined in Table 5.7.

Table 5.7

ADDITIONAL COST OF REMOVING ACM REMAINING IN NON-RESIDENTIAL BUILDINGS, $ BILLION

State	NSW	Vic	QLD	SA	WA	Tas	NT	ACT	Total
Cost	42.79	29.26	18.32	6.46	8.52	1.74	2.16	4.83	114.09

Source: Allen Consulting Group analysis

5.2 Cost of replacement material

The removal of ACM from buildings would necessitate the replacement of ACM with some other material for the remaining life of the building. Consultations indicated that the cost of replacing such material is similar to the removal cost. Therefore, based on an assumed cost of removal of $40 per square metre, the cost of replacing ACM with other materials is also estimated to be $40 a square metre.

However it is noted that the costs associated with the removal of ACM are likely to impact on the economic viability of buildings and hence PRA is likely to alter the lifespan of buildings. For some buildings, a move to the PRA might bring forward their demolition, while for others (which undergo significant renovation or refurbishment) a move towards PRA might delay their demolition. Due to a lack of data on the impact PRA is likely to have on the building stock the cost has not been assessed quantitatively.

5.3 Machinery of Government costs

Machinery of government costs relate to costs incurred by the government through organisational or functional changes affecting government, due to the introduction of new legislation or regulation (APSC 2011). Machinery of government costs may also include changes to administrative arrangements, governance arrangements, as well as other planning, management and communication strategies and arrangements.

Machinery of government costs considered in this analysis include:

- staff time required to implement the new legislation required for PRA; and
- cost of resources required to implement the new legislation required for PRA.

[4] Net present value compares the value of costs and benefits over time (calculated in today's dollars).

The machinery of government costs will depend on whether Commonwealth legislation alone is required, or whether each state and territory needs to enact its own legislation. Additionally, the government has to incur a certain amount of enforcement and inspection costs to ensure that all ACM is removed from buildings. Enforcement costs would depend on several factors such as the rate of compliance in duty holders (i.e. building owners), the frequency of inspections and the size of the fine for non-compliance.

According to a Regulation Impact Statement by the Australian Competition and Consumer Commission (2008), on limits on migration of lead and certain elements in children's toys, costs to government in administering the regulation covering millions of toys are estimated to be about $60,000 to cover market surveys, product testing, standards review, enforcement actions and other legal and educational expenses. The RIS noted that should the regulation be adopted by State administrations, they would incur costs associated with the administration of the State regulation.

Stakeholders suggested that it is likely that any changes to Commonwealth legislation, which would need to be reflected in state legislation would incur similar costs. It is therefore estimated that machinery of government costs in relation to a move to the PRA would cost $60,000 for each jurisdiction, with a total estimated cost of $540,000.

5.4 Disturbance to business operations

A move to the PRA would mandate the removal of certain types of ACM within certain timeframes. Higher risk materials such as those, which are friable, would be required to be removed from workplaces sooner than lower risk materials. This may cause a disruption to business operations, where they are affected by such activities. For example, if major removal work needed to be undertaken, an entire business may be shut-down to avoid exposure to employees.

However, it was noted by stakeholders that disturbance to business operations can be minimal if removal is undertaken in an appropriate manner, such as the use of negative air pressure, as the risk of exposure associated with such removal is low.

The costs associated with such disturbance will be highly variable according to the nature of the business, the type and location of ACM and the risk for employees. As such, costs would vary on a case-by-case basis and therefore have not been quantified in this analysis.

5.5 Training additional accredited removal staff

Under the PRA a greater amount of ACM will be removed in a shorter time period. As discussed above, under this approach ACM would be removed from workplaces by 2030, while under the current RMA it is estimated that the majority of ACM would be removed by 2042.

In order to remove this greater amount of ACM, additional trained and accredited removalists would be required. The costs related to this include the cost to removal businesses of training new staff and the cost of gaining appropriate licenses. The cost of gaining an appropriate license varies between state and territory as shown in Table 5.8.

Table 5.8

ASBESTOS REMOVAL LICENCES

State	Description of licences	Fee and validity
NSW	There are two types of licences: • Class A — a licence for friable asbestos removal work • Class B — a licence for bonded asbestos removal work	Valid for 5 years Class A — $5,000 (GST free) Class B — $500 (GST free)
Vic	There are licences to remove asbestos for the following categories: • Class A, friable and non-friable – remove any type of asbestos • Class A, specific friable asbestos • Class B, non-friable asbestos • Class B, specific non-friable asbestos	Valid for 5 years Class A — $507 Class B — $469. Replacement licence — $45
Qld	There are two types of licenses: • Class A — a licence for friable asbestos removal work • Class B — a licence for bonded asbestos removal work	The fee for a Class A and Class B asbestos removal licence is $152
SA	There are two types of licenses: • Class A — a licence for friable asbestos removal work (any form of asbestos material, including those permitted by Class B removal licences) • Class B — a licence for asbestos cement (fibro), and non-friable (floor tile) products	Valid for 5 years Class A — $20,930 Class B — $3,188
WA	There are two types of licences: • Unrestricted: allows people to remove all forms of asbestos (friable and non-friable) and replaces the current asbestos removal licence • Restricted: allows people to remove amounts exceeding 10 square metres of bonded (non-friable) asbestos	Unrestricted — valid for three years, $4,312
Tas	There are two types of licences: • Class A — approval to remove all types of asbestos and asbestos-containing materials (ACM). • Class B — approval to remove only non-friable, or bonded, types of asbestos-containing materials. (For example: asbestos cement products (sheet, pipe), floor and wall tiles, gaskets and pipe sealants.) Applicants also required to take a written examination and interview	Class A asbestos removal licence: $1130.40; Licence renewal: $773.28 Class B asbestos removal licence: $832.32; Licence renewal: $475.20 Asbestos assessor licence: $72.00; Licence renewal: $43.20
ACT	There are two classes of asbestos removalist: • asbestos removalist Class A: licensees can handle (include disturbing) asbestos in buildings, and remove and dispose of asbestos from buildings; and • asbestos removalist Class B: licensees can handle (include disturbing) only bonded asbestos in buildings, and remove and dispose of only bonded asbestos from buildings.	Asbestos removalist application: $207 Re-application: $31 Licence 1 year: $207 Licence 3 years: $466

NT	Class A asbestos removal licence allows the licence holder to remove friable asbestos and non-friable asbestos and asbestos contaminated dust or debris (ACD). Class B asbestos removal licence allows the licence holder to remove non-friable asbestos and ACD associated with the removal of non friable asbestos. An asbestos assessor licence is required for air monitoring, clearance inspections and clearance certificates for Class A removal work (friable asbestos removal work)	Not available

Source: Various sources.

Without a detailed examination of the capacity of the current industry to deal with an increase in the amount of ACM removed the study has been unable to quantify the costs associated with the training of additional accredited removal costs. However, it is anticipated that the costs associated with the training of additional staff would be low. It is noted, that it is likely that removal businesses would pass these costs directly onto their customers and hence the cost of removal may increase as a result.

5.6 Environmental costs

Although asbestos is extremely persistent in the environment, it poses a greater risk to human health than the environment *per se* (WA Health 2009). Environmental contamination therefore becomes a concern when it causes a hazard to human health. Queensland Health (2002) noted that typical environmental exposure to asbestos are below recommended occupational exposure standards, except for locations that are near asbestos mines or processing plants such as Wittenoom in WA and other factories using asbestos. In terms of environmental concern, asbestos fibres may end up in drinking water if rainwater was collected from an asbestos-cement roof. However, it was concluded that the carcinogenic effect of drinking water contaminated by asbestos is very small, if not zero (Queensland Health 2002).

Poor practices in construction, demolition or disposal activities can contaminate a site with ACM. For instance inadequately managed soil remediation can release asbestos fibres into soil and leave it contaminated with ACM. Asbestos cement sheets, fences and piping are common products that are other examples of articles that are found to contaminate a disposal or construction site (WA Health 2010). Asbestos fibres may also enter into the air or water through the wearing and degradation of manufactured products that contain asbestos such as brake pads and sheeting (DSEWPaC 2001).

The removal of ACM and asbestos in buildings will require demolition and disposal activities to be undertaken and these activities may contaminate a site with ACM. In addition, the illegal dumping of ACM waste can contaminate the soil beneath it, and the weathering of the ACM can release asbestos fibres into the air (DSEWPaC 2001). As a result, prioritised removal may have environmental costs if it results in increases in illegal dumping or increased site contamination. However, assuming a high level of compliance with existing regulation it is anticipated that the environmental costs associated with a move to the PRA would be low.

Chapter 6

Limitations and key issues

The analysis undertaken in the previous sections is based on a number of assumptions and estimations due to a variety of data and information gaps. This chapter discusses the limitations of this study by outlining key issues identified during the project, the key data gaps in relation to the benefits and costs of the PRA and alternative approaches that could be used to estimate the cost and benefits.

6.1 Key issues

There are a number of issues that need to be considered in moving from the RMA to the PRA of ACM. These issues have ramifications for both the approach to measuring the costs and benefits, as well as for policy actions and associated activities related to implementing the PRA. Issues identified include:

- In estimating the costs and benefits associated with the PRA, the study has found a lack of data in relation to a number of costs and benefits. As a result, some costs and benefits have been analysed qualitatively, while estimations and assumptions have been used to quantify others.
- The consumption of asbestos has a direct relationship with asbestos exposures and/or disease in the areas of mining and manufacture, initial use and initial 'take-home' exposures. However, exposure related to the cumulative amount of asbestos added to the building stock over time (corrected for demolition and removal) — exacerbated by deterioration, and mediated by better public knowledge of asbestos risk — will influence low level exposures in the future.
- Exposure to asbestos is behaviour-related. On face value, the sooner 'high-risk' materials are removed, the less chance there may be for incidental exposures. However in the field of asbestos management, there are many instances and examples where renovation and demolition combined with variously lack-of knowledge, time-pressures, criminality and cost pressures, result in people carrying out reckless and negligent work on asbestos. It needs to be considered whether, if there are any additional pressures driving the prioritised removal of asbestos such as deadlines or increased removal or disposal costs, there may be increased reckless or negligent work on asbestos.
- A move to the prioritised removal of ACM would need to include mechanisms to monitor and enforce the approach. Before commencing any prioritised removal, and putting deadlines in place it may be necessary to require an asbestos survey of all workplace asbestos items, their condition, amount, building types and ages to a specific standard, so that there is a baseline of data that may be accessed so as to assess and monitor whether a prioritised removal scheme is working or not, will meet its objectives or is being complied with. In addition, penalties and/or incentives may need to be developed. Further, some asbestos removal workers may be at high risk of asbestos-related disease if they fail to comply with appropriate safety procedures. As a result, more controls on asbestos removal may be warranted if the rate of removal is ramped-up by Government intervention.

- Consideration will need to be given to the factors that determine the priority of ACM removal. Factors to be considered include:
  - whether asbestos is friable or non-friable;
  - the likelihood of airborne fibres;
  - the volume of ACM;
  - the opportunity for removal;
  - specified items or settings;
  - assessments of air concentrations of asbestos (to determine risk categories for particular items); and/or
  - the probable inhalation exposure to asbestos, taking duration of exposure, amount of asbestos and number of people exposed, into account.

As a result it is likely that a guidance framework will need to be developed to set the out the nature of removal activities required.

- The ability to physically remove all ACM from workplaces in the timeframe (i.e. by 2030) has also been raised by some stakeholders and experts. In addition, such removal relies on the ability of ACM to be safely disposed of, and hence the capacity of appropriate waste facilities, as well the ability to physically be able to remove ACM in cases where it is hard to access, requires the demolition of buildings before the end of their useful life or is hard to isolate and/or identify.

6.2 Data gaps in relation to the benefits of the PRA

The analysis in this report has focused on the health benefits and the cost savings from the reduction in ongoing risk management of asbestos associated with the PRA.

There is a lack of quantitative information in relation to the cost savings as a result of moving to prioritised removal. It is anticipated that these would vary on a case-by-case basis according to the measures taken by each workplace in complying with the RMA. Further information on these costs is needed in order to assess them quantitatively.

A range of assumptions have been used in order to estimate the health benefits associated with the PRA. The gaps in data and information in measuring the health benefits are discussed below.

The future incidence of asbestos-related disease

The future incidence of asbestos-related disease is unknown and hence has to be estimated based on current levels of disease and predicted incidence. This study has relied heavily on the study by Clements *et al.* (2007a) to forecast the future incidence of asbestos-related disease. As a result, the estimated future incidence of asbestos-related disease is based on historical trends and information and may not fully account for changes in the nature of exposure as discussed in Chapter 3.

The incidence of asbestos-related disease attributable to workplaces

The incidence of asbestos-related disease attributable to workplaces in the future is also unknown. While historical data can be used to estimate the proportion of disease attributable to workplaces, again the changing nature of exposure may not be reflected in such estimations.

The effect of the PRA on incidence of asbestos-related disease

After the future incidence of asbestos-related disease attributed to workplaces is estimated, the effect of the PRA needs to be considered in order to calculate the benefits of moving from the RMA to the PRA. Without detailed information on the source of exposure within workplaces in the future, it is difficult to estimate the effect that a move to prioritised removal will have on incidences of disease.

6.3 Data gaps in relation to the cost of the PRA

There are a number of data gaps in relation to the cost of moving to the PRA. In addition to quantitative information on the costs associated with the cost of replacement materials, disturbance to business operations, training additional accredited removal staff and environmental costs, a number of assumptions and estimates had to be used to quantify the cost of removing asbestos from workplaces.

Given that it is anticipated the primary cost of the PRA is anticipated to be in relation to the removal of asbestos from workplaces, the subsequent sections focus on the data gaps in relation to the cost of removing asbestos from workplaces.

The amount and type of ACM in workplaces

Currently, there is no information or data on the amount or type of ACM in workplaces across Australia or within each state and territory. As a result, the amount of ACM in workplaces has been estimated based on volumes of asbestos consumed in Australia.

With a lack of information on precisely what the consumed asbestos was used for, it was necessary to estimate the amount of asbestos used in non-residential buildings and use this as a proxy for workplaces. Different categories of non-residential buildings are likely to have different ACM profiles. Class A office buildings are likely to contain very little ACM except for boiler lagging in colder climate areas such as Tasmania and the ACT. Such office buildings rarely have asbestos cement roofs. However, many factory buildings have asbestos cement roofs. Taking such difference into account without more data is difficult.

A lack of information on the product raw asbestos was made into necessitates the estimation of the amount of ACM in each state and territory. There are differences in the asbestos content of different types of ACM, however without further information on the type of ACM in workplaces, such differences cannot be accounted for.

Further, the amount of ACM that has already been removed from workplaces is unknown. Hence, this study has assumed that all ACM used prior to 1973 has been removed (based on the useful life of a building). However, it is noted that this is likely to lead to an underestimation of the amount of ACM still in use as there are likely to be at least some instances where ACM used prior to 1973 is still in use. In addition, the study has estimated the amount of ACM remaining in non-residential buildings used between 1973 and 2002. While stakeholders validated these estimations, there is no data available to provide an exact measure of the amount of ACM that has been removed.

The cost of removing ACM from workplaces

Without a catalogue of the amount or type of ACM in workplaces, high level estimations of the cost of removing ACM have to be made. It is recognised that the cost of removing ACM in each workplace is likely to be different due to differences in the degree of difficulty removing it, the varied cost of licensing and accreditation, different wage rates in different locations and differences in transport costs.

The profile of ACM removal in the future

In accounting for changes in the timing of costs related to the removal of ACM from workplaces this study has assumed a profile of removal (as outlined in Figure 5.9). This profile is important as it allows for a comparison of the estimated annual costs of removing ACM under the RMA and the PRA and hence the cost of bringing removal forward under the PRA. In a similar manner to the approach used to measure the amount of ACM remaining in workplaces, the profile of removal was based on a building having a useful life of forty years and hence has assumed that under the RMA all ACM would be removed by 2042. This is unlikely to occur in practice and the removal of ACM may occur over a longer time period. However, due to a lack of data on the likely profile of ACM removal this approach was considered robust.

6.4 Alternative methods to estimating costs and benefits

This study has focused on assessing the two primary costs and benefits of moving from the RMA to the PRA, being health benefits and the cost of removing asbestos from workplaces, quantitatively. The following sections discuss alternative approaches to measuring each of these.

Health benefits

The analysis undertaken in relation to the health benefits relies heavily on the study by Clements *et al.* to forecast the future incidence of asbestos-related disease. Additionally it uses the ratio of previous disease incidences in NSW males to the overall Australian population; hence it is based on historical trends and information.

The Clements *et al.* (2007a) model accounted for the risk of mesothelioma of different age groups (with greatest exposure risk being in the 40 to 50 year age group) and year of exposure (with greatest risk being in the 1960s to 1970s). Other models have been based on asbestos consumption and a lag rate (such as KPMG 2006), age and time since exposure (Stallard et al 2005) or age cohort (Peto et al 1995). These models are further described in Table 7.1.

This study utilised the Clements *et al.* model (2007a) as it accounted for the impacts of different age groups and year of exposure on mesothelioma risk. The other models did not do so. Additionally, Clements *et al.* (2007b) reviewed the other models used to predict mesothelioma incidences, and have adjusted and refined their model to provide improved estimations.

Table 6.9

DESCRIPTION AND INPUTS OF DIFFERENT MODELS

Model	Model description	Model inputs
Clements et al (2007a)	Age cohort and calendar year model	Mesothelioma incidence rates
KPMG (2006)	Exposure model with delay distribution	Asbestos consumption and a lag rate
Stallard et al (2005)	Mesothelioma risk is a function of age and time since exposure	Mesothelioma incidence or claims
Peto et al (2005)	Age cohort model	Mesothelioma mortality rates

Source: Clements et al 2007b.

Cost of removing asbestos from workplaces

The analysis undertaken for this report took a 'top-down' approach to measuring the costs of removing asbestos from workplaces. That is, it began by using information and data on the consumption of asbestos in Australia and sought to then attribute this to workplaces in each state and territory in order to measure costs.

The alternative would be to take a 'bottom up' approach. This would entail exploring the amount of asbestos in certain workplaces in each state and territory and using this information to aggregate up such amounts to estimate the total ACM in Australia. This would require detailed information on the amount of ACM in a number of 'typical' workplaces and the number of these 'typical' workplaces in each state and territory.

However, the requisite data and information to undertake a bottom-up analysis is not available. In order to undertake such analysis a comprehensive survey of the amount of ACM in a variety of workplaces would need to be undertaken. Alternatively, an understanding of the stock of buildings and the likely amount of ACM within each building would be required.

Data on the stock of buildings such as year of construction, square metre of floor space is very limited. Geoscience Australia through the development of the National Exposure Information System (NEXIS) project has some data (see http://www.ga.gov.au/meta/ANZCW0703015635.html), as does a recent study undertaken for the Department of Climate Change and Energy Efficiency (see http://www.climatechange.gov.au/government/initiatives/cbbs.aspx).

Once an understanding of the stock of buildings was obtained (which could be achieved through the above sources) the amount of ACM within each building type would need to be estimated. One potential source of such information is asbestos registers. However, asbestos registers are not centrally held in the states and territories. As a result, they cannot be collectively reviewed to provide information on the overall size of the problem. Even if they were centrally held, these records would need to be compiled in a database in order to make use of such information.

Chapter 7

Impact analysis

This chapter assesses the costs and benefits of moving from the RMA to the PRA. It then provides a sensitivity and break-even analysis to test the effect of changing the key assumptions used.

7.1 Costs and benefits of prioritised removal

The analysis has explored a variety of costs and benefits of moving from the RMA to the PRA. Due to a lack of data and information a number of these costs and benefits have been assessed qualitatively. This study has focused on assessing the two primary costs and benefits of moving from the RMA to the PRA, being health benefits and the cost of removing asbestos from workplaces, quantitatively. This has entailed the used of a number of assumptions. The key assumptions used are set out in Table 7.1.

Table 7.1

KEY BASE CASE ASSUMPTIONS

Health benefits	Cost of removing ACM from workplaces
Australia-wide incidence of mesothelioma is 3.7 times greater than the predicted incidences of mesothelioma cases in NSW males.	The proportion of non-residential building activity undertaken in each state and territory relative to total work done varied between 31-50 per cent.
Asbestos-related diseases are 3.14 times greater than the number of mesothelioma incidences in Australia.	On average, ACM is made up of 20 per cent asbestos content.
Occupational exposure accounts for 70 per cent of asbestos-related disease.	All ACM used prior to 1973 has already been removed from buildings. 25 per cent of ACM used in 1973 in non-residential buildings is still in use. From 1973, each year four per cent more ACM remains in use.
Prioritised removal will reduce the number of asbestos-related diseases by 80 per cent.	The average cost of removing ACM is $3,800 per tonne.

Source: Allen Consulting group analysis

The study also assessed machinery of government costs quantitatively, while all other costs and benefits have been assessed qualitatively.

Table 7.2 summarises the costs and benefits of moving to the PRA. Health benefits of approximately $2.7 billion are anticipated to arise from the PRA, while the cost of removing asbestos from workplaces under the PRA is estimated to be $114 billion greater than under the RMA. In addition, machinery of government costs are estimated to cost just over $0.5 million.

Table 7.2

BENEFITS AND COSTS OF THE PRA

Impact	Description	Assessment
Benefits		
Health benefits	The reduction in asbestos-related disease as a result of the PRA	In total, it is expected that PRA will result in $2.68 billion in health benefits.
Cost savings from the reduction in ongoing risk management of asbestos	A range of potential costs savings may result including savings in the costs of complying with ongoing management of asbestos requirements	Cost savings are likely to be small in magnitude. For example each annual inspection required to update asbestos registers costs between $250-$1000, while ACM identified as a concern is generally likely to be removed rather than enclosed, encapsulated or sealed. There may also be cost savings resulting from a reduced need to ensure employees are not exposed to asbestos.
Costs		
Cost of removing asbestos from workplaces	The additional cost of removing ACM from workplaces under the PRA	The additional cost of removal is estimated to be $114.09 billion.
Cost of replacement material	The cost of replacing ACM removed from buildings before the end of their useful life	Stakeholders suggested that the cost of replacing ACM with other material is similar to the cost of removal. That is, the cost of replacing ACM would be estimated to be $40 per square metre. However it is noted that the costs associated with the removal of ACM are likely to impact on the economic viability of buildings and hence PRA is likely to alter the lifespan of buildings.
Machinery of Government costs	Costs incurred by the government through organisational or functional changes affecting government, due to the introduction of new legislation or regulation	It is estimated that machinery of government costs in relation to a move to the PRA would cost $60,000 for each jurisdiction, with a total estimated cost of $540,000.
Disturbance to business operations	The cost of disruption to business activities as a result of the removal of ACM	Mandating the removal of certain types of ACM within certain timeframes may cause a disruption to business operations, where they are affected by such activities. However, it was noted by stakeholders that disturbance to business operations can be minimal if removal is undertaken in an appropriate manner, such as the used of negative air pressure, as the risk of exposure associated with such removal is low. The costs associated with such disturbance will be highly variable according to the nature of the business, the type and location of ACM and the risk for employees.
Training additional accredited removal staff	The cost associated with training additional removalists in order to remove a greater amount of ACM form workplaces in a shorter time period	In order to remove this greater amount of ACM, additional trained and accredited removalists would be required. The costs related to this include the cost to removal businesses of training new staff and the cost of gaining appropriate licenses. It is anticipated that the costs associated with the training of additional staff would be low
Environment costs	The costs associated with an increase in illegal dumping associated with the PRA	Assuming a high level of compliance with existing regulation it is anticipated that the environmental costs associated with a move to the PRA would be low.

Source: Allen Consulting Group analysis

Net impact

The overall finding of the cost benefit analysis is that the costs of moving to PRA significantly outweigh the benefits. As demonstrated in Table 7.3, a move to the PRA would generate $2.7 billion of benefits, while over $114 billion of costs have been identified.

A number of the impacts identified in this analysis have not been assessed quantitatively. This is primarily due to a lack of information and data. Nonetheless, the costs and benefits associated with these impacts are expected to be low and not material to the overall analysis. They have been assessed qualitatively as to their likely nature and scale.

Given the magnitude of the costs associated with removing ACM from workplaces, this analysis has attempted to provide a "best-case" scenario for the policy. Despite this, the analysis shows little economic support for the move to the PRA. The following sensitivity and break-even analysis further demonstrate this point.

Table 7.3

COSTS AND BENEFITS BY STATE AND TERRITORY, $ MILLION

Cost / benefit	NSW	Vic	Qld	WA	SA	Tas	ACT	NT	Total
Health benefit	933	572	454	376	270	42	20	8	2,675
Additional cost of removing asbestos	(42,790)	(29,257)	(18,325)	(6,457)	(8,524)	(1,738)	(2,161)	(4,835)	**(114,087)**
Machinery of Government costs	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	**(0.54)**
Net impact	**(41,857)**	**(28,685)**	**(17,871)**	**(6,081)**	**(8,254)**	**(1,696)**	**(2,141)**	**(4,827)**	**(111,413)**

Source: The Allen Consulting Group.

7.2 Sensitivity analysis

Due to a high degree of uncertainty surrounding the values used to estimate potential future benefits and costs, a sensitivity analysis has been undertaken to demonstrate the effect of changing the key assumptions used in the analysis. The sensitivity analysis helps assess the robustness of the parameters used to estimate potential impacts.

The health benefits are the key quantitative benefits assessed in this analysis, while the costs of removing ACM from workplaces are the key quantitative costs assessed. As such, the sensitivity analysis focuses on changing the key assumptions used to estimate the health benefits and the cost of removing ACM from workplaces. A range of different scenarios have been tested to explore the effect of changing each of these assumptions on the net impact.

Notably, since under the base case, the costs substantially exceed the benefits, all assumptions tested have examined the effect of either reducing costs or increasing benefits. The various scenarios tested and the assumption changed relative to the base case are outlined in Table 7.4.

Table 7.4

SCENARIOS TESTED

Scenario	Assumption	Tested value
Scenario 1	Australia-wide incidence of mesothelioma	Australia-wide incidence of mesothelioma is 6 times greater than the predicted incidences of mesothelioma cases in NSW males.
Scenario 2	Asbestos-related diseases	Asbestos-related diseases are double the baseline assumptions i.e. asbestosis is 28 per cent and lung cancer is 400 per cent greater than mesothelioma incidences
Scenario 3	Occupational exposure	Occupational exposure accounts for 90 per cent of asbestos-related disease.
Scenario 4	Reduction in asbestos-related disease as a result of prioritised removal	Prioritised removal will reduce the number of asbestos-related diseases by 90 per cent.
Scenario 5	Amount of asbestos used in non-residential buildings	The proportion of non-residential building activity undertaken in each state and territory relative to total work done is 20 per cent.
Scenario 6	Asbestos content in ACM	ACM is made up of 50 per cent asbestos content.
Scenario 7	Removal of ACM from workplaces	5 per cent of used in 1973 in non-residential building s is still in use. From 1973, each year four per cent more ACM remains in use.
Scenario 8	Cost of removing ACM	It costs $20 per square metre to remove asbestos.

Source: Allen Consulting group analysis

The effect of the changes identified line each scenario on the costs and benefits is demonstrated in Table 7.5.

Table 7.5

SENSITVITY ANALYSIS

Scenario	Cost, $ billion	Benefit, $ billion	Change relative to base case, $ billion
Base case	114.09	2.68	0
Scenario 1	114.09	4.34	1.66
Scenario 2	114.09	4.40	1.72
Scenario 3	114.09	3.44	0.76
Scenario 4	114.09	3.01	0.33
Scenario 5	58.43	2.68	55.66
Scenario 6	45.63	2.68	68.46
Scenario 7	22.82	2.68	91.27
Scenario 8	57.04	2.68	57.05

Source: Allen Consulting group analysis

7.3 Break-even analysis

A break-even analysis identifies the minimum quantum of benefits needed for a regulatory program (or proposal) to provide a net positive outcome. This is particularly applicable to the removal of ACM, as the benefits generated by regulation can be easily articulated qualitatively, but not quantified with certainty.

Table 7.6 outlines the findings of the break-even analysis. As can be seen, Australia-wide mesothelioma incidence has to increase by 15,800 per cent in order to break even with PRA costs, and asbestos-related disease has to increase by 8,800 per cent. Calculations show that even if occupational exposure to asbestos and reduction in asbestos-related diseases by PRA will both reach their maximum, i.e. 100 per cent, benefits will not increase sufficiently to offset costs of PRA.

In order for the costs to be reduced to be inline with the benefits the following would need to occur (holding all other base case assumptions constant):

- the proportion of non-residential building activity undertaken in each state and territory relative to total work done would have to be 0.9 per cent.
- 0.6 per cent of ACM used in 1973 would still be in use. From 1973, each year four per cent more ACM remains in use; or
- removing ACM from buildings would cost $90per tonne.

In addition, if pure asbestos was used in the calculations (i.e. asbestos content was 100 per cent) the cost of removing it would still outweigh the benefits (holding all other assumptions constant).

Table 7.6
BREAK EVEN ANALYSIS

Assumption	Base case value	Break-even value
Australia-wide incidence of mesothelioma	Australia-wide incidence of mesothelioma is 3.7 times greater than the predicted incidences of mesothelioma cases in NSW males.	In order to break-even the Australia-wide incidence of mesothelioma would need to be 158 times greater than the predicted incidences of mesothelioma cases in NSW males.
Asbestos-related diseases	Asbestos-related diseases are 1.34 times greater than the number of mesothelioma incidences in Australia.	In order to break-even asbestos-related diseases are 66 times greater than the number of mesothelioma incidences in Australia.
Occupational exposure	Occupational exposure accounts for 70 per cent of asbestos-related disease.	NA 100 per cent occupational exposure results in $3.82 billion of benefits.
Reduction in asbestos-related disease as a result of prioritised removal	Prioritised removal will reduce the number of asbestos-related diseases by 80 per cent.	NA 100 per cent reduction in asbestos-related disease results in $3.34 billion of benefits .
Amount of asbestos used in non-residential buildings	The average amount of raw asbestos used in non-residential work undertaken varied between 31-50 per cent.	In order to break-even the proportion of non-residential building activity undertaken in each state and territory relative to total work done would have to be 0.9 per cent.
Asbestos content in ACM	ACM is made up of 20 per cent asbestos content.	NA 100 per cent asbestos content results in costs of $22.82 billion.
Removal of ACM from workplaces	25 per cent of used in 1973 in non-residential buildings is still in use. From 1973, each year four per cent more ACM remains in use.	In order to break-even 0.6 per cent of ACM used in 1973 would need to be still in use. From 1973, each year four per cent more ACM remains in use.
Cost of removing ACM	It costs $3,800 per tonne to remove ACM.	In order to break-even the cost of removing ACM would need to be $90 per tonne.

Source: Allen Consulting group analysis

Appendix A

Stakeholder consultations

Table A.1

PRESONS CONSULTED IN THE COURSE OF THIS PROJECT

Stakeholder	Organisation
Audrey Formentin	WA Department of Finance
Brian Bradley	WA Department of Commerce
Confidential	Veolia Environmental Services
David Clement	Asbestoswise
David Joyce	ACT Chief Minister and Cabinet
Deborah Vallance	Australian Manufacturing Workers Union
Dr Mark Clements	Karolinska Institute
Graeme Lewis	Tasmanian Government Inspector
Halil Ahmet	WorkSafe Victoria
Jacqui Quarton	Master Builders Association of SA Inc
John Flavel	McMahon Services
John Pritchard	Australian Local Government Association
Justin Ward	SA Department of the Premier and Cabinet
Karyn Davidson	WorkCover NSW
Karin Renetzeder	Tasmanian Department of Justice
Michael Ness	SA Department of Planning, Transport and Infrastructure
Neil Burgess	NT WorkSafe
Neil Watson	NT WorkSafe
Pat and Brett Gibson	1stChoice Asbestos Removal
Peter McGarry	Queensland Department of Justice and Attorney-General
Sam Mangas	SA Department of Planning, Transport and Infrastructure
Sebastian Bielen	Queensland Department of Justice and Attorney-General
Tara Hewitt	Tasmanian Department of Justice
Wayne Bruton	Asbestoswise

Appendix B

Disposal of asbestos

This appendix provides an overview of the disposal of asbestos in different states and territories.

New South Wales

Local councils govern asbestos waste management, however not all local councils have waste facilities that handle asbestos. The landfill must be contacted beforehand to find out if they accept asbestos waste, or have requirements for the delivery of asbestos waste. If the local council does have a waste facility that accepts asbestos, it must be managed in accordance with the Protection of the Environment Operations (Waste) Regulation 2005 including section 42, which specifies that:

- asbestos waste in any form must be disposed of only at a landfill site that may lawfully receive the waste
- when asbestos waste is delivered to a landfill site, the occupier of the landfill site must be informed by the person delivering the waste that the waste contains asbestos
- when unloading and disposing of asbestos waste at a landfill site, the waste must be unloaded and disposed of in such a manner as to prevent the generation of dust or the stirring up of dust, and
- asbestos waste disposed of at a landfill site must be covered with virgin excavated natural material or other material as approved in the facility's environment protection licence as detailed in the Protection of the Environment Operations (Waste) Regulation 2005.

Victoria

Disposal must only be at a site licensed by EPA to accept waste asbestos. Persons intending to dispose of waste asbestos (both industrial and domestically sourced) should contact the disposal site operator to check whether the site is appropriately licensed to accept the waste.

Licence conditions require waste asbestos to be handled and covered in such a manner that no dust is generated. To achieve this and the long-term security of the disposal operation the following measures or equivalent practices should be adopted:

- before compacting, cover with a layer of soil at least 300 mm thick or with a layer of waste at least 1 m thick;
- asbestos must not be deposited within 2 m of the final tipping surface of the landfill; and
- when not receiving waste, any containers used for temporary storage at a site must be covered.

It is preferable that a dedicated area of a landfill be used for asbestos disposal and that this area be clearly designated on site maps.

While landfilling of waste asbestos is generally appropriate, situations may arise where pre-treatment before landfilling should be considered. Acid treatment of white asbestos changes the nature of the asbestos fibres and appears to be the cheapest form of treatment available. Other treatment methods include thermal processes, chemical coagulation and immobilisation.

Northern Territory

All new landfills, regardless of serviceable population size, must be sited, designed and managed in accordance with the Guidelines for the Siting, Design and Management of Solid Waste Disposal Sites in the Northern Territory. All landfills must be within a secure compound with a perimeter fence of at least 1.8m high wire mesh, a lockable entrance with signage detailing the following:

- approval/Licence holder and number;
- hours of operation;
- type of waste accepted;
- 24 hour contact details; and
- access is prohibited to unauthorised users.

All landfills, regardless of serviceable population size, licensed to accept asbestos must have a designated area or trench (monocell) for the acceptance of only asbestos contaminated material.

Disposal Requirements

- Each load of asbestos waste must be covered with a suitable inert material immediately after it has been deposited.
- The licensee must keep records of the volume and GPS coordinates of all asbestos disposed of by burial. These records are to be made available to an Authorised Officer upon request.
- Asbestos waste shall be deposited in a position which is:
  - In the case of asbestos fibre and dust wastes, at least three metres
  - In the case of stabilised asbestos wastes in a bonded matrix, at least one metre beneath the planned final land surface in such a manner that they do not come into direct contact with compaction or earthmoving equipment.
- Asbestos waste being deposited must be covered finally by:
  - in the case of asbestos fibre and dust wastes, orange marker mesh identifying that asbestos is buried below and not less than three metres of compacted material.
  - in the case of stabilised asbestos wastes in a bonded matrix, orange marker mesh identifying that asbestos is buried below and not less than one metre of compacted material.

- All asbestos landfills are required to place the following information of the land title:
  - cadastral boundaries of asbestos landfill;
  - quantities of asbestos buried at the site; and
  - caution against the disturbance of the area.

All landfills require a closure and post closure plan detailing the revegetation program and ongoing management and maintenance requirements for the site. All species used in revegetation programs should be sourced from local provenance.

Queensland

Asbestos waste needs to be double wrapped or packaged in thick plastic, sealed with tape, labelled and disposed of at site approved by the local Council as soon as possible. Each council sets its own rules on if and how it receives asbestos waste.

A licensed waste removal company can collect and remove asbestos waste and provide different bins and containers, including drums and skips, for asbestos waste.

Asbestos waste must be double wrapped/bagged and placed in a trailer or in the back of a utility or truck.

If transporting 250kg or more of asbestos waste, a licence from the Department of Environment and Resource Management is required.

Australian Capital Territory

Disposal requirements for asbestos waste are as follows:

- asbestos waste in any form must be disposed of only at a landfill site that may lawfully receive the waste.
- disposal of asbestos waste in any form must be by way of burial.
- before disposal of the asbestos waste, arrangements must be made with the occupier of the landfill site for the purposes of ensuring that the asbestos waste will be covered:
  - initially to a depth of at least 0.5 metre, and
  - finally to a depth of at least 1 metre (in the case of stabilised asbestos waste in bonded matrix) or 3 metres (in the case of asbestos fibre and dust waste) beneath the planned final land surface of the landfill site.
- The asbestos waste must:
  - be disposed of in accordance with the arrangements in the paragraph above; and
  - be buried to the initial depth on the same day it is received at the landfill site.
- In disposing of asbestos waste in any form at a landfill site, the waste must:
  - be unloaded in such a manner as to avoid the creation of dust;

- not be compacted before it is covered; and
- not come into contact with any earthmoving equipment at any time.

South Australia

Contractors removing more than 0.5 m^2 of friable asbestos require:

- an environmental authorisation (licence) as a 'Producer of Listed Waste' issued by the Environment Protection Authority (EPA) under section 36 of the Environment Protection Act 1993 (EP Act) and
- a licence issued by SafeWork SA under the Occupational Health, Safety And Welfare (Asbestos) Regulations 1995.

Contractors removing 10 m^2 or more of non-friable asbestos require a relevant licence issued by SafeWork SA under the Occupational Health, Safety and Welfare (Asbestos) Regulations 1995.

When a licence is not required, the removal must be carried out in accordance with the Occupational Health, Safety and Welfare Regulations 1995, the Code of Practice for the Safe Removal of Asbestos and section 25 (General Environmental Duty) of the EP Act.

Persons who transport asbestos waste for fee or reward require an environmental authorisation (licence) as a 'Transporter of Listed Waste', issued by the EPA under Section 36 of the EP Act.

References

ACT Government (2011), *Information sheet 5 — Requirements for the transport and disposal of asbestos contaminated wastes,* accessed at <http://www.environment.act.gov.au/__data/assets/pdf_file/0018/193410/Contaminated_Sites_-_Sheet_5_.pdf>

ACT Government (2012), Asbestos removalists' licensing, accessed at <http://www.actpla.act.gov.au/topics/hiring_licensing/licence_registration/asbestos_removalists>

ACT Government (2012), Fees and Charges 2012-13, accessed at <http://www.actpla.act.gov.au/__data/assets/pdf_file/0004/18148/2012-13_Fee_and_Charges_book.pdf>

Agency for Toxic Substances and Disease Registry (2010), *Case Studies in Environmental Medicine (CSEM): Asbestos Toxicity,* USA.

Agency for Toxic Substances and Disease Registry (ATSDR) (2008), What is Asbestos?, accessed at <http://www.atsdr.cdc.gov/asbestos/more_about_asbestos/what_is_asbestos/index.html#detecting>

American Family Physician (2007), *Asbestos-Related Lung Disease*, accessed at <http://www.aafp.org/afp/2007/0301/p683.html>

ATSDR US (2001), *Toxicological profile for asbestos*, Georgia.

Australian Bureau of Statistics (2012), Causes of death, Australia, 2010, cat. no. 3303, Canberra.

Australian Bureau of Statistics (2012a) Value of Building Work Done by Sector, States and Territories - Chain Volume Measures, Cat No. 8752.0

Australian Bureau of Statistics (2012b) Value of Residential Building Work Done, States and Territories - Chain Volume Measures, Cat No. 8752.0

Australian Bureau of Statistics (2013) Consumer Price Index data, cat. no. 6401, Canberra.

Australian Competition & Consumer Commission (2008), *Regulation Impact Statement: Limits on migration of lead and certain elements in children's toys.*

Australian Customs Service (2007), *Importing asbestos into Australia,* accessed at <http://www.customs.gov.au/webdata/resources/files/FS_ImportingAsbestos.pdf>

Australian Health Protection Principal Committee (2012), *Asbestos: A guide for householders and the general public*, Canberra.

Australian Institute of Health and Welfare (AIHW) (1999), *Years of life lost due to disability' (YLD) workbooks*, accessed at <http://www.aihw.gov.au/bod-yld-by-disease/#F>

Australian Institute of Health and Welfare (AIHW) (2010), *Asthma, chronic obstructive pulmonary disease and other respiratory diseases in Australia*, cat. no. ACM 20, Canberra.

Australian Institute of Health and Welfare (AIHW) (2012a), *Australian Hospital statistics, 2010-11*, Canberra.

Australian Institute of Health and Welfare (AIHW) (2012b), *Cancer incidence projections, Australia, 2011 to 2020*, Cancer series, Number 66, Canberra.

Australian Institute of Health and Welfare (AIHW) (2012c), *Mesothelioma for Australia*, ICD10 C45, Australian Cancer Incidence and Mortality Workbooks, Canberra.

Australian Institute of Health and Welfare report (2012d), *Cancer in Australia: an overview 2012*, Canberra.

Australian Mesothelioma Registry (2011), *1st Annual Report: Mesothelioma in Australia 2011*, Alexandria.

Australian Safety and Compensation Council (2008a), Preparing an estimate of the national pattern of exposure to asbestos in cases of malignant mesothelioma, Barton.

Australian Safety and Compensation Council (2008b), *Asbestos Management and Control: A review of national and international literature*, Barton.

Blokh, G.S., and A.N. Litvinov. *Asbestotsementnye materialy i konstruktsii i ikh ekspluatatsionnye kachestva, Moscow, 1964.*

Cancer Australia (2013), *Lung cancer statistics*, accessed at <http://canceraustralia.gov.au/affected-cancer/cancer-types/lung-cancer/lung-cancer-statistics>

Cancer Council Victoria 2010, *Asbestos and lung disease*, accessed at <http://www.cancervic.org.au/about-cancer/cancer-types/mesothelioma>

Clements, M Berry, G and Shi, J (2007b), *Actuarial projections for mesothelioma: an epidemiological perspective*, Presentation to the Institute of Actuaries of Australia April 2007.

Clements, M, Berry, G, Shi, J, Ware, S, Yates, D, and Johnson, A (2007a), *Projected mesothelioma incidence in men in New South Wales*, Occupational and Environmental Medicine, vol. 64, pp. 747-752.Commonwealth Treasury (2011), *Strong Growth, low Pollution: Modelling a Carbon Price,* Commonwealth of Australia, Canberra.

Customs (Prohibited Imports) Regulation 1956, Statutory Rules 1956 No. 90 as amended, Prepared by of the Office of Parliamentary Counsel, Canberra.

Department of Education, Employment and Workplace Relations (DEEWR) 2012, *Asbestos Management Review Report*, Canberra.

Department of Health Western Australia (WA Health) (2009), *Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia*, Perth.

Department of Human Services (2013), *Carer Payment Rates*, accessed at <http://www.humanservices.gov.au/customer/enablers/centrelink/carer-payment/payment-rates>

Department of Human Services (2013), *Payment rates for Carer Allowance*, accessed at <http://www.humanservices.gov.au/customer/enablers/centrelink/carer-allowance/payment-rates>

Department of Justice, Workplace Standards (2012), *How to Safely Remove Asbestos: Code of Practice*, accessed at <http://www.worksafe.tas.gov.au/__data/assets/pdf_file/0019/192061/safely_remove_asbestos_code.pdf>

Department of Natural resources, Environment, the Arts and Sport (2012), Asbestos Disposal in the Northern Territory, accessed at <http://www.nretas.nt.gov.au/__data/assets/pdf_file/0008/14030/asbestos_disposal_in_the_northern_territory.pdf>

Department of Sustainability, Environment, Water, Population and Communities (2001), *Air toxics and indoor air quality in Australia*, updated 2011, accessed at <http://www.environment.gov.au/atmosphere/airquality/publications/sok/asbestos.html>

Finity Consulting (2010), Actuarial Costing of the Proposed Statutory Compensation Scheme for Asbestos Related Diseases, report prepared for Work Cover Tasmania.

Health and Safety Executive, undated, accessed at http://www.fia-online.co.uk/pdf/Presentation/asbestos.pdf

King & Wood Mallesons (2012), *OHS Harmonisation: current state of play*, accessed at <http://www.mallesons.com/publications/marketAlerts/2012/Pages/OHS-Harmonisation-current-state-of-play.aspx>

Kivi, R (2010), Ecological Impacts of Asbestos, Bright Hub, accessed at <http://www.brighthub.com/environment/science-environmental/articles/86213.aspx#>

KPMG (2006), Valuation of asbestos-related disease liabilities of former James HArdie entities ('The Liable Entities') to be met by the Special Purpose Fund, Sydney.

KPMG (2011), Valuation of Asbestos-related Disease, prepared for Asbestos Injuries Compensation Fund Limited, Sydney.

Leigh, J, Davidson, P, Hendrie, L and Berry, D (2002), *Malignant Mesothelioma in Australia, 1945-2000*, American Journal of Industrial Medicine, vol 41, pp. 188-201.

McCormack, V and Schuz, J (2012), *Mesothelioma Trends as Predictors of the Asbestos-Related Lung Cancer Burden*, International Agency for Research on Cancer, World Health Organization, Montreal.

Model Work Health and Safety Bill (2011)

Model Work Health and Safety Regulations (2011)

Musk AW, Olsen NJ, Shilkin, K, Threlfell, T, Reid, A, Lee, E, Franklin, P and de Klerk, N (2012), *Changing Pattern Of Occupational Asbestos Exposure In People With Malignant Mesothelioma In Western Australia*, American Journal of Respiratory and Critical Care Medicine, vol 185. pp. A1574.

Musk, A.W (undated), *Asbestos and lung disease*, Department of Respiratory Medicine, Sir Charles Gairdner Hospital, Perth.

National Health and Medical Research Council (NHMRC) (2012), *Asbestos related diseases*, accessed at <http://www.nhmrc.gov.au/your-health/asbestos-related-diseases>

National Safety Council of Australia (NSCA undated), *What is happening? WHS legislation*, accessed at <http://www.nsca.org.au/Resource_Centre/Harmonisation_Updates/What_is_happening.aspx>

New South Wales Environment Protection Authority (NSW EPA) (2012), *Safely disposing of asbestos waste*, accessed at <http://www.environment.nsw.gov.au/waste/asbestos/>

NOHSC (2001), NOHSC Regulatory Impact Statement on the Proposed Phase Out of Chrysotile Asbestos, Canberra.

NSW (2012), *Asbestos licensing*, accessed at <http://www.workcover.nsw.gov.au/licensing/Licencesandcertificates/Asbestoslicensing/Pages/default.aspx>

NSW Premier and Cabinet (Division of Local Government, Department of Premier and Cabinet) (2012), accessed at <http://www.workcover.nsw.gov.au/formspublications/publications/Documents/model-asbestos-policy-nsw-councils-LGSA-3899.pdf>

NT Work Safe (2013), For licensed asbestos removalists, accessed at <http://www.worksafe.nt.gov.au/ServiceProviders/AsbestosRemovalists/Pages/For-Licensed-Asbestos-Removalists.aspx>

O'Hara K (2011), *Asbestos in soil*, Australian Publishing Resource Service, accessed at <http://www.aprs.com.au/australian-safety-news/asbestos-in-soil>

Office of Best Practice Regulation (OBPR) (2008), *Best Practice Regulation Guidance Note Value of statistical life*, Canberra.

Office of Best Practice Regulation (OBPR) (2011), *Best Practice Regulation Handbook*, Appendix E. Cost-benefit analysis, Canberra.

Olsen, J, Franklin, J, Alison, R, deKlerk, H, Threfall, J, Keith, S and Musk, B (2011), *Increasing incidence of malignant mesothelioma after exposure to asbestos during home maintenance and renovation*, Medical Journal of Australia, vol.195, pp. 271-4.

Parkes WR Occupational Lung Disorders 3rd ed Butterworth Heineman Oxford 1993 Safe Work Australia (2010), *Asbestos-related Disease Indicators*, Canberra.

Peto J, Hodgson JT, Mathews FE, Jones JR (1995), Continuing increase in mesothelioma mortality in Britain, Lancet, vol. 345, pp. 535-9.

Queensland Government (2012), Transport and disposal: asbestos, accessed at <http://www.deir.qld.gov.au/asbestos/law/transport-disposal.htm>

Queensland Government (undated), *Form guide - Application for asbestos removal licence for Class A or Class B*, accessed at <http://www.deir.qld.gov.au/workplace/resources/pdfs/form80-appfor-asbestos-removal-licence-a-b.pdf>

Queensland Health (2011), Disposing of asbestos waste, accessed at <http://www.health.qld.gov.au/asbestos/home_renovators/disposing_waste.asp>

Safe Work Australia (2010), *Asbestos-related Disease Indicators*, accessed at <http://www.safeworkaustralia.gov.au/sites/SWA/about/Publications/Documents/538/Asbestos-related_Disease_Indicators.pdf>

Safe Work Australia (2011), *How to manage and control asbestos in the workplace: Code of practice*, accessed at <http://www.safeworkaustralia.gov.au/sites/SWA/about/Publications/Documents/625/How_to_Manage_and_Control_Asbestos_in_the_Workplace.pdf>

Safe Work Australia (2011b), *How to Safely Remove asbestos: code of practice*, accessed at <http://www.safeworkaustralia.gov.au/sites/SWA/about/Publications/Documents/641/How_to_Safely_Remove_Asbestos.pdf>

Safe Work Australia (2012a), *Guide to the Model Work Health and Safety Act*, accessed at <http://www.safeworkaustralia.gov.au/sites/SWA/about/Publications/Documents/717/Guide-to-the-WHS-Act.pdf>

Safe Work Australia (2012b), Asbestos-related disease indicators, Canberra.

Safe Work Australia (2012c), Mesothelioma in Australia: Incidence 1982 to 2008, Mortality 1997 to 2007, Canberra.

SafeWork SA (2013), *Work Health and Safety Laws*, accessed at <http://www.safework.sa.gov.au/show_page.jsp?id=112104>

Sokolov, P.N. *Tekhnoloogiia asbestotsementnykh izdelii*, 3rd ed. Moscow, 1960.

South Australia EPA (2009), *EPA Guidelines: Wastes containing asbestos — removal, transport and disposal*, accessed at <http://www.epa.sa.gov.au/xstd_files/Waste/Guideline/guide_asbestos.pdf>

Stallard E, Manton KG, Cohen JE (2005), Forecasting Product liability claims: epidemiology and modelling in the Manville asbestos case, Springer Science & Business Media, Inc. New York.

The Asbestos Diseases Society of Australia (2012), *Asbestos products*, accessed at <http://www.asbestosdiseases.org.au/asbestos-products.html>

The Workers Compensation Dust Diseases Board, Annual Report 2002-03.

United States Department of the Interior (2006), *U.S. Geological Survey, Worldwide Asbestos Supply and Consumption Trends from 1990 through 2003*, Virginia.

United States Environmental Protection Agency (US EPA) (2000), Asbestos: Hazard Summary, updated 2007, accessed at <http://www.epa.gov/ttnatw01/hlthef/asbestos.html>

United States Environmental Protection Agency (US EPA) 2013, *IRIS Toxicological Review of Libby Amphibole Asbestos (External Review Draft)*, accessed at < http://cfpub.epa.gov/ncea/iris_drafts/recordisplay.cfm?deid=235092>

URS 2005, *ACT Asbestos Surveys - Health Risk Assessment*, Final report, prepared for the ACT Asbestos Taskforce

Victoria Environment Protection Authority (Vic EPA) (2009), Industrial waste resource guidelines: Asbestos transport and disposal, accessed at <http://www.epa.vic.gov.au/~/media/Publications/IWRG611%201.pdf>

Wang, X, Lin, S, Yu, I, Qui, H, Lan, Y and Yano, E (2013), *Cause-specific mortality in a Chinese chrysotile textile worker cohort*, Cancer Science, Japanese Cancer Association, vol. 104, no. 2, pp. 245-249.

Western Australia Department of Health (2010), *Public Health and contamination of soil by asbestos cement material*, accessed at <http://www.public.health.wa.gov.au/cproot/2983/2/PH_Contamination_of_Soil.pdf>

WorkCover NSW (2012), Naturally-occurring asbestos: Fact Sheet, accessed at <http://www.workcover.nsw.gov.au/formspublications/publications/Documents/naturally_occurring_asbestos_fact_sheet_3728.pdf>

Workplace health and Safety Queensland (2013), *Transitional arrangements*, accessed at <http://www.deir.qld.gov.au/workplace/subjects/asbestos/transition/index.htm>

Workplace Standards Department of Justice (Tasmania), Asbestos Removal and Assessor Licensing Information, accessed at <http://workplacestandards.tas.gov.au/licensing/asbestos_removalists_and_assessors/Asbestos_Removal_and_Assessor_Guidelines.pdf>

WorkSafe Tasmania (2012), *Work Health and safety laws*, accessed at <http://www.worksafe.tas.gov.au/whs_laws>

WorkSafe Victoria (2007), Application for a licence to operate as an asbestos removalist, accessed at <http://www.worksafe.vic.gov.au/forms-and-publications/forms-and-publications/application-for-a-licence-to-operate-as-an-asbestos-removalist>

World Mineral Statistics Dataset, British Geological Survey, www.mineralsuk.com
R Virta, USGS Website Annual Yearbook.